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CONTENT

EVALUATION OF PRECISION AND ACCURACY OF A SPECTROPHOTOMETRIC METHOD FOR MEASURING CONCENTRATION OF ACTIVE COMPOUND IN PHARMACEUTICAL FORMS

EVALUAREA PRECIZIEI ŞI ACURATEŢII UNEI METODE SPECTROFOTOMETRICE DE MĂSURARE A CONCENTRAŢIEI COMPUSULUI ACTIV ÎN FORME FARMACEUTICE

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Abstract. *A spectrophotometric method in visible range measuring the active compound content of pharmaceutical tablets was developed and proposed to be validated and applied. The analysis method was highly precise (presenting the relative standard deviation values within the accepted range of values, RSD ≤ 5%), and highly accurate (presenting the average recovery and average relative error value located within the accepted range of values, $Xd_m \leq 5$).*
Key-words: spectrophotometric method, validation, precision, accuracy

Rezumat. *O metodă spectrofotometrică de analiză în domeniul vizibil a conținutului de compus activ din comprimatele farmaceutice a fost propusă pentru validare şi aplicare. Metoda propusă a prezentat o precizie mare (valorile relative ale deviației standard fiind încadrate în limita de variație recomandată, RSD ≤ 5%) şi o acuratețe ridicată (valorile erorii relative fiind încadrate în limita de variație recomandată, Xdm ≤ 5).*
Cuvinte cheie: metoda spectrofotometrică, validare, precizie, acuratețe

INTRODUCTION

To find out the active compound content of pharmaceutical tablets, a spectrophotometric method in visible range was developed and proposed to be validated and applied (Dorneanu *et al.,* 2003; Dorneanu *et al.,* 2007). Method validation is the process used to confirm that the analytical procedure employed for a specific test is suitable for its intended use. Results from method validation can be used to judge the quality, reliability and consistency of analytical results, being an integral part of any good analytical practice (ISO/IEC 17025).

One of the method's validation stage involved precision and accuracy evaluation. Precision of the method being a description of random errors, a measure of statistical variability, it was investigated under two aspects:

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repeatability and reproducibility (Roman et al., 1998; Boiculesii *et al.,* 2007; Tulasamma *et al.,* 2016; Aboud *et al.,* 2017, Singh *et al.,* 2015). Repeatability is expressing the consistency of the measurements under identical experimental conditions at short time intervals (in the same day), while reproducibility is expressing the fidelity of the measurement at large intervals of time (in different days). Accuracy is a description of systematic errors, a measure of statistical bias, that cause a difference between the obtained result and the true value. Accuracy of a method may be determined, by calculating a relative error, which is expressing a close correlation between a true, reference value and the analytical result of the laboratory measurements**.**

MATERIAL AND METHOD

Investigation of reproducibility consisted in carrying out the analysis on many samples from the same set of standard solutions in different days under the same given conditions (intermediate precision). Repeatability measurements consisted in conducting the analysis made on many samples coming from the same set of standard solutions in the same day under the same conditions (Bhalani *et al.,* 2015; Banjare *et al.,* 2013). Standard deviation (SD) and relative standard deviation (RSD %) were calculated for the tests carried out in the same day (intra-day test) and in different days (inter-day test).

To investigate the precision of the method, three solutions with different concentrations of analyte (2 µg/mL, 10 µg/mL and 25 µg/mL), were processed with the same reagents under the same conditions. Absorbances were measured at the wavelength λ = 690 nm. Four separate determinations have been made for each solution, three times in the same day (intra-day precision) and four determinations have been made in three different days (inter-day precision) by recording the mean absorbance's values.

Concentration C_C (µg/mL) was determined from the regression equation line: A = 0.0234 C_C (µg/mL) - 0.0031, thus:

$$C_C\,(\mu g/mL) = (A + 0.0031) / 0.0234 \quad (1)$$

Recovery (%) was determined with the formula (Roman *et al.,* 1998; Boiculesii *et al.,* 2007]:

$$\text{Recovery (\%)} = (C_C\,(\mu g/mL) \times 100) / C_T\,(\mu g/mL) \quad (2)$$

For accurate measurements, recovery R (%) should be in the following range: 85% ≤ R % ≤ 105%.

Standard deviation (SD) was calculated with STDEV function in Microsoft Office Excel 2016 while relative standard deviation (RSD %) was determined with equation (3):

$$RSD\ \% = (SD \times 100) / R_{\,average} \quad (3)$$

whereas $R_{\,average}$ was average recovery (%) value.

Thus, method precision was expressed as relative standard deviation (RSD %) of the calculated recovery R (%) values. For appropriate measurements, RSD≤ 5% (Banjare *et al.,* 2013; Mubeen *et al.,* 2009).

To determine method accuracy, three solutions of various concentrations (2 µg/mL, 10 µg/mL and 25 µg/mL) were selected to interact under the same experimental conditions. Four investigations for each solution were achieved in different moments of the same day and resulted absorbances were measured for λ = 690 nm. Then, the average absorbances, the recovery (%), the minimum and

maximum values were calculated (Dorneanu *et al.,* 2003; Dorneanu *et al.,* 2007, Roman *et al.,* 1998; Boiculesii *et al.,* 2007; Tulasamma *et al.,* 2016; Aboud *et al.,* 2017, Singh et *al.,* 2015). Recovery (%) values were established by using equation (2). Standard deviation (SD) and relative standard deviation (RSD %) were calculated by using equation (3).

Accuracy was determined, by calculating a relative error Xd, which is expressing a close correlation between a true, reference value (Xa) and the analytical result of the laboratory measurements (Xr). Relative error X_D was calculated for the same three sample concentrations (2 µg/mL, 10 µg/mL and 25 µg/mL), according to formula:

$$\mathbf{Xd} = \frac{|\mathbf{Xr} - \mathbf{Xa}|}{\mathbf{Xa}} \cdot \mathbf{100} \leq \mathbf{5\%} \quad (4)$$

Whereas Xr is the measured value (calculated concentration), Xa is the real/true value (theoretical concentration) and Xd is the relative error.

RESULTS AND DISCUSSIONS

Measured absorbances of all three standard solutions, their theoretical concentrations (C_T), their calculated concentrations (C_C) expressed in µg/mL and their recovery (%) values are presented in table 1 and table 2.

Table 1

Intra-day precision test of the spectrophotometric method

Theoretical concentration C_T (µg/mL)	Mean absorbance (A_m)	Calculated concentration (C_C) (µg/mL)	Recovery (%)	Standard Deviation (SD)	RSD (%)
2.0	0.0429	1.966	98.30	1.660	1.629
	0.0429	1.966	98.30		
	0.0431	1.974	98.70		
	0.0428	1.962	98.10		
10.0	0.2360	10.218	102.18		
	0.2357	10.205	102.05		
	0.2358	10.209	102.09		
	0.2357	10.205	102.05		
25.0	0.5800	24.918	99.67		
	0.5795	24.897	99.58		
	0.5795	24.897	99.58		
	0.5798	24.910	99.64		

For the intra-day precision test, the average recovery (%) value was $R_{average}$ = 100.020%, while the standard deviation was SD = 1.660 (table 1). According to equation (3), the relative standard deviation (RSD = 1.629 %) was situated within normal limits range, being ≤ 5%.

For the inter-day precision testing of the spectrophotometric method, the average recovery (%) was $R_{average}$ = 100.414 %, while the standard deviation was

SD = 1.395. The relative standard deviation (RSD = 1.389%) was within normal limits, being ≤ 5%.

Table 2

Inter-day precision test of the spectrophotometric method

Theoretical concentration C_T (µg/mL)	Mean absorbance (A_m)	Calculated concentration C_C (µg/mL)	Recovery (%)	Standard Deviation (SD)	RSD (%)
2.0	0.0432	1.979	98.95	1.395	1.389
	0.0433	1.983	99.15		
	0.0433	1.983	99.15		
	0.0435	1.991	99.55		
10.0	0.2361	10.222	102.22		
	0.2361	10.222	102.22		
	0.2363	10.231	102.31		
	0.2363	10.231	102.31		
25.0	0.5804	24.936	99.74		
	0.5804	24.936	99.74		
	0.5807	24.949	99.80		
	0.5809	24.957	99.83		

The evaluation results of the system precision, done for 4 µg/mL standard solution, are presented in table 3. The absorbances corresponding to standard solution presented close, one to another, values.

The relative standard deviation (RSD = 0.235%) was within the normal range of values.

Table 3

System precision

Det. No.	Mean aborbance (A_m) values
1.	0.0920
2.	0.0924
3.	0.0925
4.	0.0925
5.	0.0922
Mean	0.092320
SD	0.000217
RSD (%)	0.235

In order to evaluate the accuracy of the method, absorbance values, calculated concentrations (C_C) and recovery (%) values were determined (table 4).

Table 4

Accuracy of the method

Theoretical concentration C_T (µg/mL)	Average absorbance (A)	Calculated concentration C_C (µg/mL)	Recovery (%)
2.0	0.0428	1.962	98.10
	0.0428	1.962	98.10
	0.0430	1.970	98.50
	0.0429	1.966	98.30
10.0	0.2357	10.205	102.05
	0.2358	10.209	102.09
	0.2356	10.201	102.01
	0.2355	10.197	101.97
25.0	0.5795	24.897	99.58
	0.5795	24.897	99.58
	0.5798	24.910	99.64
	0.5797	24.906	99.62

Average recovery was $R_{average}$ = 99.962 %, while the standard deviation was SD = 1.6365. According to equation (3), the relative standard deviation value (RSD = 1.6376 %) was located within normal range of values. Minimum recovery (%) calculated value was 98.10 % while the maximum recovery value was 102.09 % (table 4).

The relative error (Xd%) was calculated for each of the three solution concentrations (table 5).

Table 5

Calculated relative error values (Xd %)

C_T (µg/mL)	Xd (%)
2.0	1.900
	1.900
	1.500
	1,700
10.0	2.050
	2.090
	2.010
	1.970
25.0	0.412
	0.412
	0.360
	0.376

Individual values of the relative error (table 5) were below 5%. Also, the average relative error (Xd_m = 1.390 %) was within the normal range of values, being ≤ 5 %.

CONCLUSIONS

The spectrophotometric analysis method was highly precise presenting the relative standard deviation values (RSD = 1.629 % for intra-day precision test and RSD = 1.389 % for inter-day precision test) located within the accepted range of values (RSD ≤ 5%).

The spectrophotometric analysis method was highly accurate presenting the average recovery ($R_{average}$ = 99.962 %) and average relative error value (Xd_m = 1.390 %) located within the accepted range of values ($Xd_m \leq 5$).

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THE EFFECT OF COMBINED APPLICATION OF *B. JAPONICUM* AND *P. PUTIDA* WITH MINERAL AND ORGANIC FERTILIZATION ON PROLINE CONTENTS IN SOYBEAN UNDER PHOSPHORUS INSUFFICIENCY AND MODERATE DROUGHT

INFLUENŢA APLICĂRII COMBINATE A RIZOBACTERIILOR *B. JAPONICUM* ŞI *P. PUTIDA* PE FONDAL DE FERTILIZARE MINERALĂ ŞI ORGANICĂ ASUPRA CONŢINUTULUI DE PROLINĂ LA SOIA ÎN CONDIŢII INSUFICIENTE DE FOSFOR ŞI SECETĂ MODERATĂ

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Abstract. *The use of plant growth promoting rhizobacteria (PGPR) is considered a strategy to improve plant tolerance in hostile environments. However, its underlying mechanisms are not completly understood under phosphorus (P) insufficiency and water deficit conditions. In the present study, a vegetation vessels experiment was conducted to assess the combined effects of Bradyrhizobium japonicum inoculation with Pseudomonas putida in conjunction with P and organic fertilization on proline contents of soybean (Glycine max L.) plants grown in P-deficient soil and subjected to moderate drought. The experimental results demonstrated that the application of both strains significantly changed proline contents in leaves and roots, especially under moderate drought and P insufficiency compared to the inoculation with the symbiotic B. japonicum strain alone. The rhizobacteria strains application without fertilization or with cattle manure increased proline accumulation in leaves under drought but did not affect significantly this parameter in well-watered plants. By contrast, integrated use of isolates decreased proline concentration in roots of soybean with mineral P and organic fertilization regardless of soil moisture level. In conclusion, the combined use of B. japonicum and P. putida is efficient approach to improve soybean growth and drought tolerance through altering proline contents, especially in soil with P insufficiency as well as under application of organic fertilizer.*

Key words: drought, manure, phosphorus, proline, rhizobacteria, soybean.

Rezumat. *Aplicarea bacteriilor promotoare a creşterii este considerată strategie de ameliorare a toleranţei plantelor la factorii nefavorabili de mediu, însă mecanismele ce determină rezistenţa cauzată de bacteriile benefice sunt insuficient elucidate în condiţii deficitului de P şi umiditate. În prezentul studiu, s-a organizat o experienţă în vase de vegetaţie care a avut ca scop evaluarea efectului combinat al bacteriilor Bradyrhizobium japonicum şi Pseudomonas putida, aplicate pe fondalul fertilizării cu P sau îngrăşăminte organice asupra conţinutului de prolină la plantele de soia (Glycine max L.) supuse secetei moderate. Rezultatele experimentale au arătat că aplicarea împreună a*

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ambelor tulpini bacteriene au modificat semnificativ conținutul de prolină în frunze şi rădăcini, în mod special la plantele supuse concomitent secetei moderate şi insuficienței de P în raport cu plantele inoculate numai cu tulpina B. japonicum. Influența tulpinilor rizobacteriene asupra plantelor fără fertilizare sau fertilizate cu bălegar de vite cornute a majorat acumularea prolinei în frunze în condiții de secetă, dar n-a influentat semnificativ acest indice la plantele bine irigate. Utilizarea combinată a acestor tulpini dimpotrivă a diminuat semnificativ concentrația prolinei în rădăcinile soii fertilizate cu P mineral sau fertilizate organic indiferent de nivelul de umiditate a solului. În concluzie, aplicarea combinată a bacteriilor B. japonicum şi P. putida este opțiune eficientă de îmbunătățire a creşterii soii şi de majorare a toleranței la secetă determinată, în particular la plantele cultivate pe solul cu insuficiență de fosfați mobili cât şi la plantele fertilizate cu îngrăşăminte organice.

Cuvinte cheie: fosfor, prolină, rizobacterii, secet*ă*, soia.

INTRODUCTION

Abiotic stresses such as drought and phosphorus deficiency are main constraints of agricultural production and therefore remain a big problem of food insecurity and sustainability of agriculture (Dimkpa *et al*., 2009; Egamberdiyeva *et al*., 2016). Legumes are more vulnerable to unfavorable conditions than cereal crops. Soybean (*Glycine max* L.) is an agronomically and nutritionally important legume crop because it is a major source of protein and vegetable oils in many countries, however, its production is restricted by drought (Devi and Sinclair, 2013) and P deficiency (Vance *et al*., 2003). Maintaining high plant productivity under environmental stresses is important challenge facing sustainable agriculture (Gill and Tuteja, 2010). Therefore, it is necessary to find out approaches to improve the productivity and tolerance of crops to abiotic stress factors. The use of plant growth-promoting bacteria (PGPR) and symbiotic microorganisms may prove useful in developing strategies to promote plant growth and enhance tolerance of crops in hostile environments (Khan *et al*., 2006). One of the efficient mechanisms of crop tolerance is osmotic adjustment through the accumulation of active/compatible solutes in plant tissues that enable plants to improve water status (Ashraf and Foolad, 2007; Ashraf, 2010). Amongst osmoprotectants proline has essential functions in plant metabolism including acquiring plant resistance to drought conditions. Glick *et al*. (1998) showed that under different stresses using PGPR such as *Pseudomonas fluorescence* can alleviate the adverse effects of stress on plant growth. Likewise, Egamberdieva *et al*. (2016) established improved drought tolerance of lupine due to application of rhizobium inoculants. It is proposed the use of more than single PGPR in biofertilizer preparation could be better option over a single bacterium to bring synergistic effect of nutrient mobilization, enhanced efficacy, stability and increase crops productivity (Abdah_ALah *et al*., 2017). It is necessary to be mentioned, the use of rhizobacteria along with chemical and organic fertilizers may serve as an effective option for enhancing crop tolerance and productivity, as well as nutrients efficiency.

Although there are reports regarding beneficial effects of species *Pseudomonas* sp. and *B. japonicum* sp. on plant growth under unfavorable environmental conditions, it is still not completely clear to what extent does these rhizobacteria species impact accumulations of key osmoprotectants, in particular proline, in soybean plants cultivated under P-deficit soils and drought conditions.

The aim of this study was to assess the effect of combined application of *Bradyrhizobium japonicum* and *Pseudomonas putida* in conjunction with mineral or organic fertilization on proline contents and growth of soybean under P insufficiency and moderate drought conditions.

MATERIAL AND METHOD

In a controlled pot culture experiment, soybean (*Glycine max* L. cv. Horboveanca) plants were inoculated with *B. japonicum* (denoted as Rh*)* alone as reference treatment and other set of plants was inoculated with *B. japonicum* in combination with soil applied *P. putida* (denoted as PP). The soil used in this study was a carbonated chernoziom mixed with sand in order to create P insufficiency condition. These rhizobacteria treatments were tested in conjunction with plant fertilization: without P fertilization (P0), fertilized with 100 mg P/kg soil (P100) and application of cattle manure (M) at rate 20 g/kg of soil. Soybean seeds before inoculation were surface-sterilized in 70% ethanol and then rinsed five times with sterile distilled water. Four replicate pots were used per treatment (n=4). Two levels of soil moisture were installed as normal 70% WHC (water holding capacity) and drought (35% WHC) imposed at flowering stage for 12 days. Water-stressed plants and their corresponding non-stressed controls were harvested on 12^{th} day of exposure to drought. Relative water content (RWC) was measured at the end of drought. After harvest, roots, nodules and leaves were weighed separately to determine fresh weight, and then placed in an oven to dry at 60°C until a constant dry weight was obtained. Also, the numbers of nodules were recorded. The proline content in plant tissues was estimated by spectrophotometrically analysis at 520 nm of the ninhydrin reaction, according to Bates *et al*. (1973). Data were subjected to varying means of analysis and categorized using the “least significant difference” test in the Statistic program 7 at 0.05 probability level. Statistics values were presented as means ± SE of three replicates.

RESULTS AND DISCUSSIONS

A compatible osmolyte such as proline, glycine or betaine plays an important role in plant tolerance to stress factors through osmotic adjustment (Ashraf, 2010). In this study, we examined the effect of combined application of two rhizobacteria species *Bradyrhizobium japonicum* and *Pseudomonas putida* on proline contents in leaves and roots of soybean in relation to types of fertilization and soil moisture conditions.

Experimental data of the effect of rhizobacteria on proline concentration in leaves under P insufficiency and moderate drought are presented in figure 1 (A,B). Proline accumulation was higher in leaves of plants subjected to water deficit as compared with well-irrigated plants. However, combined effects of *B.*

japonicum and *P. putida* on proline accumulation in leaves were significant only under low soil water regimes (fig. 1A). Similarly, Lobato *et al*. (2008) revealed an accumulation of proline in leaves of *Glycine max* grown under water deficit conditions. In the present investigation, there was no significant difference between rhizobacteria treatments in well-watered plants. Hence, in conditions of P insufficiency and moderate drought, the combined application of both rhizobacteria increased the content of proline in leaves approximately by 2 fold compared to single application of *B. japonicum* (fig. 1A). Our results of enhanced proline accumulation in drought stressed plants corroborate with results of Egamberdieva *et al*. (2017a) for lupine. Data regarding the osmolyte accumulation in roots of plants grown under normal irrigation and drought are shown in fig. 1B.

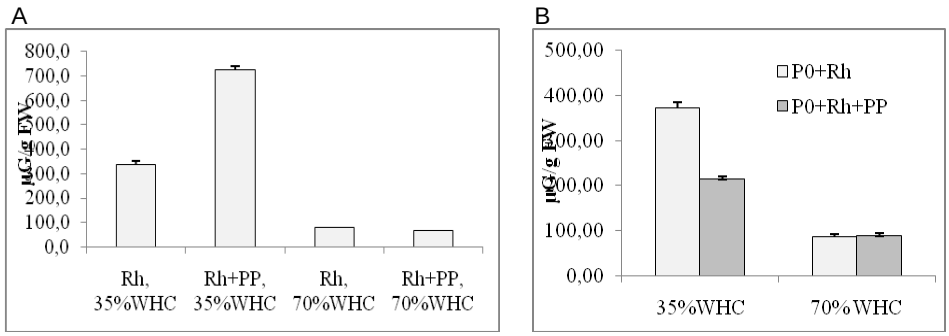

Fig. 1 The effect of *Bradyrhizobium japonicum* (Rh) applied alone or in combination with *Pseudomonas putida* (PP) on proline content in leaves (A) and roots (B) under no fertilization (P0) and moderate drought. WHC – water holding capacity. Columns are means ± SE.

In the treatment with both strains application the decrease in proline concentration in roots was observed (by 73.5%) due to combined use of strains compared with treatment of *B. japonicum* alone at the low moisture level (35% WHC), but there was no difference between bacteria treatments in well-watered plants (fig. 1B). Therefore, the highest concentration was registered in leaves of plants grown under P deficiency and subjected to moderate drought. A high level of proline enables the plants to maintain an osmotic balance when growing under low water potentials (Ashraf, 2010). In this regard we agree with literature findings that the combined use of tested rhizobacteria could compensate the drought effects and improve plant development through enhanced production of proline, amino acids, and soluble sugars and provided for better absorption of water and nutrients from soil (Vardharajula *et al.*, 2011). Hence, the accumulation of proline in leaves under combined application of *B. japonicum* and *P. putida* plays positive influence in osmotic adjustments of plant tissues under unfavorable moisture of soil and low P supply.

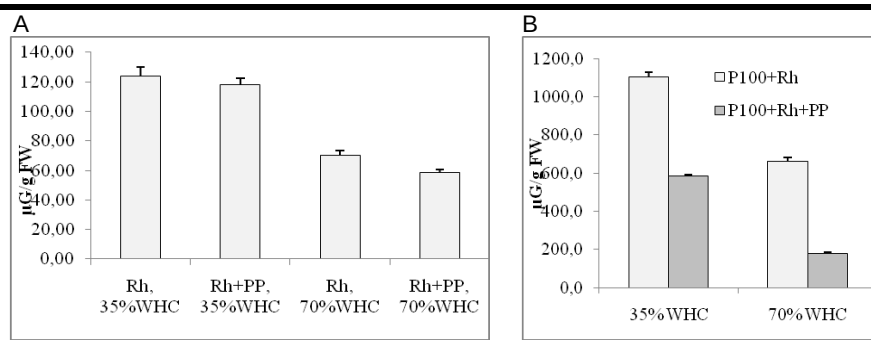

Fig. 2 The effect of *Bradyrhizobium japonicum* (Rh) applied alone or in combination with *Pseudomonas putida* (PP) on proline content in leaves (A) and roots (B) under phosphorus fertilization (P100) and moderate drought. WHC – water holding capacity. Columns are means ± SE.

According to literature data the effect of PGPR has been examined, as a rule, under low soil fertility. Unfortunately, there is scarce information regarding integrated use of these bacteria strains with chemical P fertilizer application, especially under water deficit conditions. In the present study it was tested a treatment of rhizobacteria application with P fertilization. The current experimental results revealed that adequate phosphorus nutrition (100 mg P/kg soil) decreased concentration of proline in leaves (fig. 2A) compared to plants cultivated under P deficiency (fig. 1A) regardless of rhizobacteria application. However, the combined use of *B. japonicum* and *P. putida* had less impact on proline content in leaves of soybean fertilized with mineral phosphorus. Thus, under adequate P nutrition and normal moisture (fig. 2A) dual inoculations decreased proline level in leaves by 20.2% as compared to single inoculated plants with *B. japonicum*. This could indicate that moderate drought affected to a lesser extent the accumulation pattern of this osmolyte when P nutrition is sufficient. The most significant effect of inoculates applied on tissues parameter was found in root tissue in both soil moisture regimes (fig. 2B). Combined application of tested strains decreased this parameter in roots in both water soil regimes. Experimental results revealed a remarkably decrease (3,6 fold) of proline in normal moisture conditions and by 1,9 fold in roots of plants grown under water deficit (fig. 2B). Also, Liu *et al*. (2015) suggested that P fertilization significantly decreased proline concentration in water-stressed *Fargesia rufa*. Again, plants subjected to insufficiency of water registered higher proline concentrations in leaves and roots than in well irrigated plants (fig. 2A,B).

There are investigations reporting a considerable impact of integrated application of PGPR and organic fertilization on growth and productivity of crops cultivated under no stress conditions as was demonstrated by Krey and coworkers (2011). In our trail, it was included treatment of integrated use of rhizobacteria and manure fertilization in order to finding out their interaction effect on soybean

under moderate drought. The patterns of proline accumulation in leaves and roots affected by rhizobacteria and soil moisture conditions under organic fertilization are shown in figure 3A and B. Under moderate drought, plants with both bacteria strains showed a slight increase of proline accumulation in leaves as compared to reference plants (*B. japonicum* alone). It was revealed that proline accumulation in leaves increased by 35.7% in plants treated with *B. japonicum* and *P. putida* under temporary drought. Likewise, Agami *et al*. (2016) demonstrated a significant improvement in proline accumulation in *Ocimum basilicum* L. after administration of PGPR (*Azotobacter chroococcum* A101), resulting in enhanced water uptake, water use efficiency and photosynthetic efficiency. However, in treatments with organic fertilization, there was no difference between strains regarding concentration of this osmolyte in leaves of plants grown under normal irrigation regime (fig. 3A).

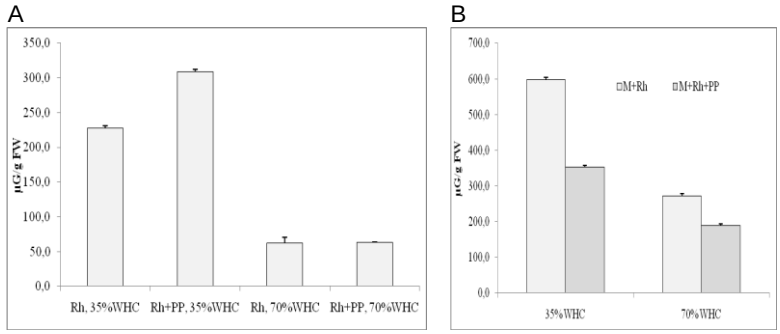

Fig. 3 The proline content in leaves (A) and roots (B) of soybean plants inoculated with *Bradyrhizobium japonicum* alone (Rh) and together with *Pseudomonas putida* (PP) in conjunction with manure fertilization under drought. WHC – water holding capacity. Columns are means ± SE.

Comparing with leaves the changes of this metabolite were more evidently in roots. Particularly, the proline accumulation decreased in roots after rhizobacteria application (*B. japonicum* combined with *P. putida*) of plants fertilized with manure and subjected to temporary drought (fig. 3B). Accordingly, these rhizobacteria diminished the concentration of proline in roots by 74.8%. The reason for this result is that combined application of two rhizobacteria increased significantly root growth, nodulation rate as well as leaf vigour that provided more favourable physiological conditions for a higher utilization of proline in different physiological processes. Similar influence was registered in well-irrigated plants. Therefore, we suggested that physiological state of plants was less affected by abiotic factors. Likewise, some researches obtain similar tolerance enhancement under stress environments with other bacterial species (Estévez *et al*., 2010; Egamberdieva *et al*., 2004; 2017a; 2017b). Ashraf (2010) concluded that drought stress is an essential limiting abiotic factor for plant growth and crop productivity. The application of PGPR has been found an

effective biotechnology option to increase productivity of crops under drought conditions (Vardharajula *et al.*, 2011).

The summary parameter to estimate the influence of rhizobacteria, fertilization and abiotic factors is considered plant growth. Plant growth was estimated using dry matter accumulation. The experimental results regarding the effect of studied biotic and abiotic factors on soybean growth are presented in table 1. The dry matter weights of plants were significantly inhibited by moderate drought. Under combined abiotic factors P insufficiency and water deficit soybean registered the lowest value (4.87 g/plant) of primary productivity. However, the combined application of tested rhizobacteria under such unfavorable conditions increased plant growth by 12.7% compared to inoculation with *B. japonicum* alone. Similar impact was observed under well-watered condition. Egamberdieva *et al*. (2017a) also revealed an enhancement in the dry weight of lupine (*Lupinus angustifolius* L.*)* plants treated with the bacterium *Bradyrhizobium* under drought stress. In our study, the moderate increase of plant productivity due to rhizobacteria inoculation was because plants were subjected to short drought. However, the better impact of bacteria application occurred when crops were grown in stressful conditions for prolonged periods (Egamberdiyeva and Hoflich, 2004).

In current investigation, the combined use of these strains in conjunction with mineral P fertilization inhibited beneficial impact of bacteria (Table 1). It was found out that growth response to rhizobacteria application was more pronounced under organic fertilization than under mineral P fertilization. Hence, the highest increase of soybean production was recorded in response to inoculation with both strains under manure fertilization in well irrigated plants (70% WHC). Also, the combined use of rhizobacteria promoted better plant growth under low soil moisture level (35% WHC) where that parameter increased by 14.3% in comparison to single *B. japonicum* inoculation.

Table 1

Effect of rhizobacteria (*B. japonicum* and *P. putida*) in conjunction with fertilization on dry matter weight of soybean in relation to soil moisture level

Treatments	Soil moisture (%)	P insufficiency		P fertilization		Manure fertilization	
		g/plant	SE	g/plant	SE	g/plant	SE
B. japonicum	70% WHC	7.71	0.24	14.89	0.16	10.39	0.27
B. japonicum+ *P. putida*		8.66	0.19	15.63	0.16	11.22	0.16
B. japonicum	35% WHC	4.87	0.09	8.66	0.35	7.05	0.14
B. japonicum+ *P. putida*		5.49	0.12	9.23	0.35	8.06	0.13

WHC - water holding capacity, SE - standard error. Data presented are the means ± SE (n = 4).

Probably, organic matter of cattle manure facilitated proliferation of microorganisms in soil and promotes higher activities of tested bacteria which in turn enhanced plant vigour and performance especially under limited water conditions. It is necessary to note that under manure fertilization leaves of inoculated plants with both bacteria strains grown in water limited conditions had higher RWC compared to those of inoculated plants only with *B. japonicum*. Likewise, plants inoculated with both rhizobacteria strains had more nodules and vigorous roots development than treatment with *B. japonicum* alone (data not shown). In general, plants with combined use of *B. japonicum* and *P. putida* had higher biomass production than plants treated with single inoculation with *B. japonicum.* We supposed that that effect was probably indirect due to rhizobacteria enhancement of nutrients uptake and assimilation in particular of P because plants also had higher P concentrations in leaves and roots than single inoculated plants (Rotaru, 2018). In addition, beneficial effects of rhizobacteria could be due to the presence of other activities. For instance, PGPR facilitate synthesis of some plant-growth promoting elicitors such as IAA, cytokines, axuins under normal as well as under drought conditions, improve synthesis of photosynthetic pigments, some antioxidant enzymes and antioxidants under stress conditions which contributed to stimulation of plant growth induced by rhizobacteria (Egamberdieva *et al.*, 2016). Therefore, this study clearly demonstrated the beneficial impact of combined use of these bacterial strains in soybean productivity under well-watered as well as under moderate drought condition. Thus, the combined application of *Bradyrhizobium japonicum* and *Pseudomonas putida* strains is more efficient for improving the growth of soybean cultivated on P-deficient soil or with organic fertilization under normal moisture as well as under moderate drought when compared with inoculation of *B. japonicum* alone. Experimental results find out that the combined use of *B. japonicum* with *P. putida* evidently had impact on proline contents in leaves and roots of soybean. Regarding leaves, bacterium biofertilizers significantly affected the proline contents under drought and there were not remarkable changes in well-watered plants. However, when the plants were inoculated with *B. japonicum* along with *P. putida* application the extent of growth suppression was decreased and plants had greater dry weights than treated plants with *B. japonicum* alone.

CONCLUSIONS

1. The combined use of bacterial strains (*B. japonicum* and *P. putida*) affected proline contents in soybean irrespective of type of fertilization and soil moisture conditions. The positive effects of the microbial use on tolerance of drought-stressed soybean, cultivated under P insufficiency and water deficit conditions could be through increasing contents of osmotic compounds.

2. Combined application of both bacteria strains showed synergic effects on soybean growth under P insufficiency and moderate drought conditions as well as under manure fertilization. There is a need to perform similar experiments under

field conditions with different types of inoculants in order to improve crop productivity under hostile environments.

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STOMATIC CONDUCTANCE AND CHLOROPHYLL CONTENT INDEX AND LEAF AREA OF SOME BEANS LOCAL CULTIVARS FROM NORTH-EAST OF ROMANIA, UNDER SALT STRESS

DETERMINAREA CONDUCTIVITĂŢII STOMATICE ŞI A CONŢINUTULUI DE CLOROFILĂ A UNOR CULTIVARE LOCALE DE FASOLE, DIN REGIUNEA DE NORD-EST A ROMÂNIEI, SUB INFLUENŢA STRESULUI SALIN

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Abstract. *Beans is a salt-sensitive species. For this reason, the purpose of the face work was to determine the effect of excess NaCl on the some physiological processes such as photosynthesis and transpiration. Research has focused on dynamics of the chlorophylle content index and foliar stomatic conductivity, in the case of 7 bean genotypes, as an indicator of salt stress tolerance. The biological material was represented by seven bean genotypes, collected from saline soils in the Moldavian region, in 2018 and exposed to salt stress over a 30-day period. They were constantly wetted with saline at a concentration of 100 mM and 200 mM NaCl. Stomatale conductance decrease is a mechanism of resistance to salinity as it prevents water loss from plants. As a response to osmotic component of salt stress to reduce transpiration stomata are partially closed, so we can conclude that genotypes Blăgeşti 2 shows better tolerance to osmotic stress, compared with other genotypes. After 30 days at 200 mM NaCl, the genotypes Blăgeşti 2, Blăgeşti 3, Blăgeşti 4 and Truşeşti 2 are superior to the control plants, indicating a good adaptation to intense photosynthetic rhythm. Saline stress influences stomatic conductivite foliar and chlorophylle content, causing significant differences between genotypes.*
Key words: salinity, beans, chlorophylle, stomata, conductance

Rezumat. *Fasolea este o specie sensibilă la sare. Din acest motiv, scopul lucrării de faţă a fost acela de a determina efectul excesului de NaCl asupra unor procese fiziologice, cum ar fi fotosinteza şi transpiraţia. Cercetările s-au axat pe dinamica indicele conţinutului de clorofilă şi a conductivităţii stomatice foliare, în cazul a 7 genotipuri de fasole, ca indicator al toleranţei la stresul salin. Materialul biologic a fost reprezentat de şapte genotipuri de fasole, colectate din soluri saline în regiunea Moldovei, în anul 2018 şi expuse la stresul salin pe o perioadă de 30 de zile. Acestea au fost udate constant cu soluţie salină la o concentraţie de 100 mM şi 200 mM NaCI. Reducerea conductivităţii stomatale este un mecanism de rezistenţă la salinitate, deoarece previne pierderea apei din plante. Ca răspuns la componenţa osmotică a stresului salin pentru reducerea transpiraţiei, stomatele sunt parţial închise, astfel încât putem concluziona că genotipul Blăgeşti 2 prezintă o toleranţă mai bună la stresul osmotic, comparativ cu alte genotipuri. După 30 de zile la tratamentul cu 200*

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mM NaCI, genotipurile Blăgeşti 2, Blăgeşti 3, Blăgeşti 4 şi Truşeşti 2 sunt superioare plantelor control, indicând o bună adaptare la ritmul fotosintetic intens. Astfe, se poate concluziona că stresul salin influenţează conţinutul conductivităţii stomatice, dar şi conţinutul de clorofilă a frunzelor, provocând diferenţe semnificative între genotipuri.
Cuvinte cheie: salinitate, fasole, clorofilă, stomată, conductivitate

INTRODUCTION

Soil salinity it is among the major agricultural problems limiting plant growth and development throughout the world (Adcock *et. al.*, 2007; Cantrell and Linderman, 2001). Currently, 20% of the irrigated areas in the world are affected by salinity due to climate change and excessive irrigation. Saline stress is the most devastating abiotic stress, because it affects crop productivity. It diminishes growth, seed germination, photosynthesis and yield (Galani, 2014). Such stress affects agricultural crops by causing an increase in concentration, which leads to a reduction of salts around the root system of the osmotic potential of the water, as it is difficult to absorb water by plants; also induce symptoms of toxicity (ionic effect) (Munns, 2002). Glycophytes, which includes most crop plants, cannot grow in the presence of high salt levels; their growth is inhibited or even completely prevented by NaCl concentrations of 100-200 mM, resulting in plant death (Munns and Termaat, 1986). Salinity can affect plant growth in three ways (James *et. al.*, 1982): it can increase the osmotic potential, reducing water availability, respectively the osmotic effect. Munns (1992) concluded that the salts absorbed by plants do not control growth directly, but that they do influence, photosynthesis and/or the activity of specific enzymes.

MATERIAL AND METHOD

The biological material was represented by seven bean genotypes, collected from saline soils in the Moldavian region, in 2018 and exposed to salt stress over a 30-day period. They were constantly wetted with saline at a concentration of 100 mM and 200 mM NaCl. The bifactorial experience was performed in a randomized three-repeat block experiment. The chlorophylle content of the leaves was determined using the CCM 200 PLUS apparatus. Stomatal conduction was determined using the SC-1-Terra-Preta foliar porometer (Jitareanu *et. al.,* 2014). The results were statistically interpreted using the Student test model determined with Microsoft Excel Data Analysis (Oancea, 2007).

RESULTS AND DISCUSSIONS

Effect of saline stress on stomatice conductivity. In most unfavorable conditions, dehydration is the first signal that induces the plant response, consistent with maintaining the status of water in tissues. The condition of keeping the stomata relatively open to plants is the efficient delivery of water to the leaves. In fact, the decrease in the hydraulic conductivity of the leaves is usually caused by the decrease in the degree of hydration associated with the reduction of the stomatice conductivity and, consequently, the reduction of carbon assimilation (Melenciuc, 2010, Sperry *et. al.*, 2002, Johnson *et. al.*, 2009). The stomatic conductivite foliar to the bean plants in experience

was determined using porometre, and the readings were made at 15 and 30 days after the application of saline treatments.

The stomatic conductivite foliar to 15 days after the application of saline treatments with 100 mM NaCl compared to the witness, was decreasing to three of the populations taken in the study. The genotype with the highest stomatal conductance was Moşna (94.81 mmol/m^2), and the Săveni showed the lowest stomatic conductance (40.30 mmol/m^2s), presenting a reaction to the osmotic component of saline stress, to reduce trash; in this case the stomata were partially closed, as also reported by Galan (2014) (tab.1); that present results confirm for the four populations that the data from the literature, according to which the stomata are partially closed, as a reaction to the osmotic component. Similar results were recorded by Munns and Tester (2008), Covaşă (2016), Galani (2014).

Table 1

The 15 days effect of the saline stress on the foliar stomatal conductance on bean (mmol/m^2s)

Genotype	Control	100 mM NaCl	200 mM NaCl
Blăgeşti 1	81.39	59.06	27.40
Blăgeşti 2	34.29	49.88	42.44
Blăgeşti 3	74.51	42.96	37.76
Blăgeşti 4	38.01	68.18	40.40
Truşeşti 2	50.42	60.22	80.12
Săveni	52.64	40.30	42.14
Moşna	91.82	94.81	82.37

After 30 days of saline treatment, with regard to stomatic conductivite foliar to the variant treated with 100 mM NaCl, compared to the witness, the genotype Blăgeşti 2 recorded the highest value (65.34 mmol/m^2s), instead the Moşna population showed the lowest stomatic conductivite foliar (30.46 mmol/m^2s) (tab. 2). At the end of the saline treatment, no specific symptoms of ionic stress, chlorosis and necrosis were observed, indicating that the local populations taken in the study are maintained in the first phase of saline stress, making them tolerant to the salin concentrations used.

Table 2

The 30 days effect of the saline stress on the foliar stomatal conductance on bean (mmol/m^2s)

Genotype	Control	100mM NaCl	200 mM NaCl
Blăgeşti 1	46.54	35.73	24.82
Blăgeşti 2	62.31	65.34	71.23
Blăgeşti 3	41.06	41.64	43.45
Blăgeşti 4	82.02	74.46	63.56
Truşeşti 2	74.99	46.56	42.33
Săveni	28.64	58.30	61.02
Moşna	36.66	30.46	25.91

Following the statistical analysis (tab. 3) for local bean population subject to saline stress, there are statistically significant differences between genotypes within the same variants, indicating a different behavior to saline stress, depending on the genetic capacity of each genotype. Insignificant differences are highlighted between the populations of different variants, which suggests to us that stomatic conductivite foliar recorded values close to the control group. Thus we can conclude that the local populations taken in the study have a good ability to adapt to saline stress.

Table 3

The variance analysis of the bean genotypes under stress salinity of stomatal conductance (after 30 days)

Source of variation	SP	GL	MS	F	P-value	F crit	Influence
Genotype	3630.136	5	726.0272	4.766066	0.01734	3.32583	*
Concentratic	27.54591	2	13.77296	0.090414	0.91429	4.102821	NS
Error	1523.326	10	152.3326				
Total	5181.008	17					

Anova Two-Factor: NS statistical insignificant differences ($p \geq 0.05$); * Significant statistical differences ($p \leq 0.05$); ** Significant distinct statistical differences ($p \leq 0,01$); *** very significant statistical differences ($p \leq 0,001$)

Effect of saline stress on the chlorophyll content index (CCI). After 15 days when applying 200 mM treatment, the chlorophylle content was superior to only one population, taken in the study, and lower for the other five populations; the highest increase of the chlorophylle content was found in Blăgeşti 3 (27.78 CCI), and Truşeşti 2 recorded the smallest increase (16.26 CCI) (tab.4). The results obtained show an increase of this index in plants exposed to saline stress, indicating that populations with a high index are found in the first phase of saline stress (Munns, 2008).

Table 4

The 15 days effect of the saline stress on the chlorophyll content index (unit. SPAD)

Genotype	Control	100 mM NaCl	200 mm NaCl
Blăgeşti 1	32.15	32.04	26.09
Blăgeşti 2	14.2	22.73	21.68
Blăgeşti 3	31.44	33.37	27.78
Blăgeşti 4	23.91	26.57	21.91
Truşeşti 2	16.84	15.31	16.26
Săveni	33.52	25.41	26.01
Moşna	24.77	20.69	19.21

From the data presented in tab.5 it can be observed that after 30 days, the chlorophylle content in the leaves presents values which to most bean populations, when exposed to 100 mM NaCl, is inferior to all studied populations ranging from 11.33 to 22.21 CCI, which indicates the passage of genotypes to the second phase of saline stress, the ionic stress. On the other hand, local populations Blăgeşti 1, Săveni and Moşna show lower values compared to the control variant, which indicates that the second phase of saline stress manifests (Munns and Tester, 2008). At the end of the saline treatment, no specific symptoms of ionic stress, chlorosis and necrosis, were observed, suggesting that the local populations under study remain in the first phase of saline stress, making them tolerant to the saline concentrations used.

Table 5

The 30 days effect of the saline stress on the chlorophyll content index (unit. SPAD)

Genotype	Control	100 mM NaCl	200 Mm NaCl
Blăgeşti 1	15.74	13.87	12.81
Blăgeşti 2	10.15	11.33	13.75
Blăgeşti 3	20.98	20.21	22.39
Blăgeşti 4	18.65	13.54	23.71
Truşeşti 2	14.02	12.35	15.8
Săveni	26.09	13.63	20.74
Moşna	22.94	14.76	21.28

The statistical analysis of the influence of saline stress on the content of chlorophyll pigments (tab.6) in the local bean populations studied, presents both statistically significant differences between genotypes within the same variants, as well as between genotypes within different variants, indicating that this parameter is significantly influenced by saline stress, and the plants under study show an intense reaction to adapt to this abiotic stress.

Table 6

The variance analysis of the bean genotypes under stress salinity of the chlorophyll content index (after 30 days)

Source of variation	*SP*	*GL*	*MS*	*F*	*P-value*	*F crit*	*Influence*
Genotype	214.7833	5	42.95665	5.102013	0.013924	3.325835	*
Concentratio	98.18823	2	49.09412	5.830967	0.020966	4.102821	*
Error	84.1955	10	8.41955				
Total	397.167	17					

Anova Two-Factor: NS statistical insignificant differences ($p \geq 0.05$); * Significant statistical differences ($p \leq 0.05$); ** Significant distinct statistical differences ($p \leq 0,01$); *** Verry significant statistical differences ($p \leq 0,001$).

CONCLUSIONS

1. Stomatal conductance decrease is a mechanism of resistance to salinity as it prevents water loss from plants. As a response to osmotic component of salt stress to reduce transpiration stomata are partially closed, so we can conclude that genotypes Blăgeşti 2 shows better tolerance to osmotic stress, compared with other genotypes.

2. After 30 days at 200 mM NaCl, the genotypes Blăgeşti 2, Blăgeşti 3, Blăgeşti 4 and Truşeşti 2 are superior to the control plants, indicating a good adaptation to intense photosynthetic rhythm.

3. Saline stress influences stomatic conductivite foliar and chlorophylle content, causing significant differences between genotypes.

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SOME CONSIDERATIONS ON THE FROST BEHAVIOUR AND THE FLOWER ORGANOGENESIS OF FOUR LOCAL POPULATIONS OF PLUM CULTIVARS FROM BUZĂU COUNTY

CÂTEVA OBSERVAȚII ASUPRA REZISTENȚEI LA ÎNGHEȚ ŞI A PROCESULUI DE ORGANOGENEZĂ FLORALĂ A PATRU POPULAȚII LOCALE DE PRUN DIN JUDEȚUL BUZĂU

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Abstract: *Four local populations of Prunus domestica from Buzau - Pătârlagele city were analysed to evaluate the resistance to frost as well as the organogenesis process. To evaluate the frost resistance of the flower buds two moments were chosen - late February and first decade of April. In the first determination, more than 50% of the analysed buds showed different kinds of damage on flower components, while at the second determination most of the buds remaining on the branch were viable. The evaluation of the flower organogenesis process carried out at the end of February revealed differences in the stage of carpel development, while the rest of the floral organs were formed in all four populations.*
Key words: *Prunus domestica*, local cultivar populations, frost damage, flower organogenesis

Rezumat: *Patru populații locale de Prunus domestica din județul Buzău – oraş Pătârlagele au fost analizate din punct de vedere al rezistenței la îngheț şi al proceselor de organogeneză florală. Cele două momente alese pentru determinarea rezistenței la îngheț au fost sfârşitul lunii februarie şi sfârşitul lunii martie. În cazul primei determinări peste 50% din mugurii analizați au prezentat leziuni datorate înghețului, în timp ce la a doua determinare majoritatea mugurilor rămaşi pe ramură erau viabili.Evaluarea procesului de organogeneză florală, efectuat la sfârşitul lunii februarie, a evidențiat diferențe în stadiul de dezvoltare al gineceului, în timp ce restul organelor florale erau formate la toate cele patru populații.*
Cuvinte cheie: *Prunus domestica*, populații locale, rezistență la îngheț, organogenezăflorală

INTRODUCTION

The plum resistance to the frost as well as the viability of flower buds are negatively affected by the changes in thermic regime and the fluctuating temperatures especially, occurred during the dormancy in winter (Neumüller, 2011; Duchovskis *et al.,* 2007).

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Genotype, in addition to climatic conditions affects the plum's behaviour towards chill (Cosmulescu *et al.,* 2010; Neumüller, 2011).

As specie, depending on varieties, Prunus domestica can withstand a minimum temperature up to -31^{o}C, - 32^{o}C, if there is a gradually decrease, or up to -22^{o}C if there is an abrupt temperature decrease (Voiculescu, 1999).

Flower biology, starting with the bud stage carrying on with flowering stages, reflected both the influence of temperature during winter and soil moisture during the growing season (Butac, 2003).

The inadequacy at low temperatures of varieties chosen for a particular area can influence the differentiation of flower buds, leading to low harvests (Oukabli *et. al*., 2003).

Understanding the behaviour of the of local varieties, old cultivars and landraces to the temperature can become an important source for improving the response of new plum varieties to frost damages (Paunovic, 1988).

In this paper is discussed the response of flower buds to the changes of the temperature during the dormancy and their organogenesis for four local cultivar populations from Pătârlagele – Buzău County.

MATERIAL AND METHOD

The study was conducted in Pătârlagele, a town located in the north western part of Buzău County, at 45 ° 19 'north latitude and 26 ° 21' east longitude. The city is located in the Pătâragele Basin of the Subcarpathian area, on the Buzău River, at an altitude of approximately 400 meters, with hills - the dominant landscape of the area. The average of the annual temperature is 10,9^{0}C, with + 25^{0}; + 26^{0} C in summer and - 2^{0},-4^{0} C in winter.

From the local plum orchards four populations were chosen, named T1, T2, T3 and T4; T1, T3 and T4 populations are in independent plantations, while the T2 population is planted together with other local varieties. T2, T3, T4 populations are on sites with northern exposure, while the T1 population is on a land with southern exposure.

To determine the resistance to coldness of the flower buds, they were collected in two-stage during dormancy. The buds were examined using the stereomicroscope Leica S8APO.The damage scale was established based on the proportion of the affected flower parts, with brown colour.

The progress of the floral organogenesis process was observedon paraffin wax embedded plant material (floral buds). The vegetal material was processed according to a method described in Şerbănescu-Jitariu *et.al.*, 1983 and analysed with a Leica DM 1000LED microscope.

RESULTS AND DISCUSSIONS

The response of flower buds to coldness

The first assessment of flower buds' responses to coldness was carried out during their dormancy, on February 10, 2018.

Air temperature during the day, from the first 10 days of January until the determination date, had recorded generally positive values, higher than the

average of the period (4 ° C), as follows: up to in mid-January, daily temperatures were higher than the average with 1-8 ° C; 4 days had temperatures equal to or below 0 ° C in the middle of the month; after this period the air temperature was positive, sometimes higher than the month average up to 11-12 ° C.

At this assessment over 50% of the collected buds showed some or all flower components of brown colours to all four populations. The most of these buds have fallen.

Second assessment was conducted at the end of the dormancy period, on 2 April 2018. The flower buds were sampled from branches near those used for the first evaluation.

Air temperature decreased at the end of February and early March, but no lower of -10 ° C values were recorded during the day, as follows: at the end of February and in the first days of March, the values were negative, between - 8 ° C and -1 ° C; during March, positive values were recorded, excepting 5 days at the end of the month when these were negative but not lower than -10 ° C; at the end of March and in the early days of April air temperature values were positive.

The number of affected buds at the level of each population was much lower than to the previous determination (tab. 1):

Table 1

Results of the flower buds' assessment on 2.04.2018

Population	Total number of buds	Damaged buds	Viable buds	% viable buds
T1	50	3	47	94
T2	50	3	47	94
T3	50	4	46	92
T4	50	2	48	96

T1 population: 47 out of the 50 analysed buds were viable. The affected buds showed lesions at the perianth and carpel level or they were entirely damaged (fig. 1a).

T2 population: like at the T1 population, 47 out of the 50 analysed buds were viable. The affected buds showed different damages at all flower components (fig.1b).

T3 population: 46 buds from the total of 50 analysed were viable. Different lesions were observed to all flower components (fig.1c).

T4 population: only two buds were affected out of a total of 50 observed, the highest percentage of viability at this population (96%) was recorded; lesions were observed both at the flower components and cataphylls (fig.1d).

First assessment revealed that during dormancy a removal of the flower buds could take place if there were a surplus.

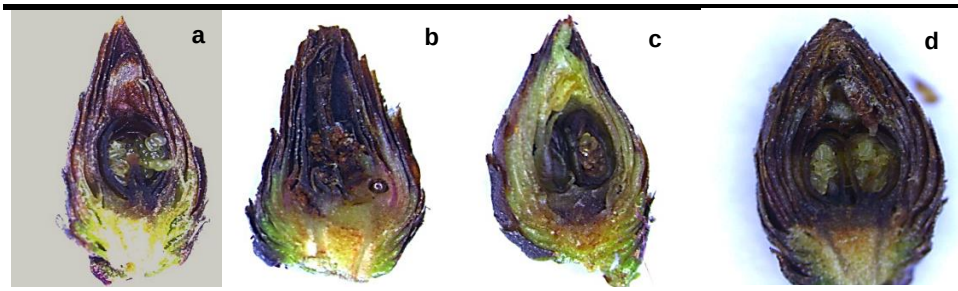

Fig. 1 Different types of frost damages on floral buds: a. T1 – cataphylls, perianth and carpel injured; b. T2 – damage of the whole flower; c. T3 – damage of the whole flower; d. T4 – cataphylls, perianth, carpel injured

Oscillating air temperature recorded in January, February and March did not affect the viability of flower buds, in any of the four populations, as long as temperatures did not reach the minimum value of plum resistance, as we have seen at the second assessment.

The small differences observed between the four cultivars related to frost resistance indicate a good adaptation to the local conditions, their selection being in accordance with the particularities of the climate in the area of Pătârlagele.

Floral development (Organogenesis)

In February, towards the end of dormancy (the moment of buds' collection) the main flower parts - the perianth, stamens, and carpel were differentiating.

A single flower is differentiate in the buds of the T1 cultivar population; the perianth elements and the anthers are well featured (fig. 2a); at the level of the anthers the pollen grain formation is finished, the anthers becoming unilocular (fig.2a); in the wall of the anther only the epidermis and endothecium are evident and pollen grains can be observed in the anther locules (Fig. 2b); in the ovule the process of forming the embryo sac is initiated (fig.2c).

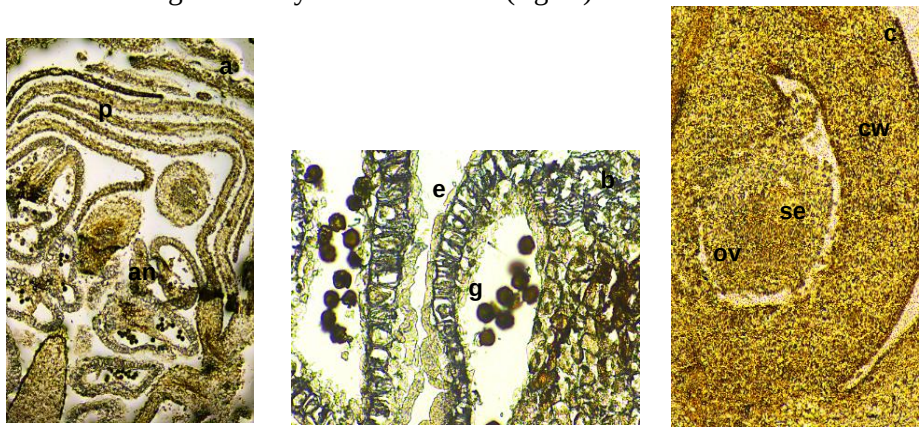

Fig. 2 Organogenesis in the floral buds of T1 population: a. the perianth elements (p) and unilocular anthers (an); b. the anther (e= endothecium; g = pollen grains; c. the carpel (c.w. = carpel wall; ov = ovule; se = embrio sac)

A single flower is discerned in sections through the buds of the T2 population; the elements of the perianth and the unilocular anthers with the pollen grains are also distinguished; the absence of the carpel in some buds can be notice (fig.3a).

One or two flowers can be observed in the buds of the T3 population; the anthers are at the same stage as the populations described above (fig.3b); the carpel with a long style is noticed also (fig.3c).

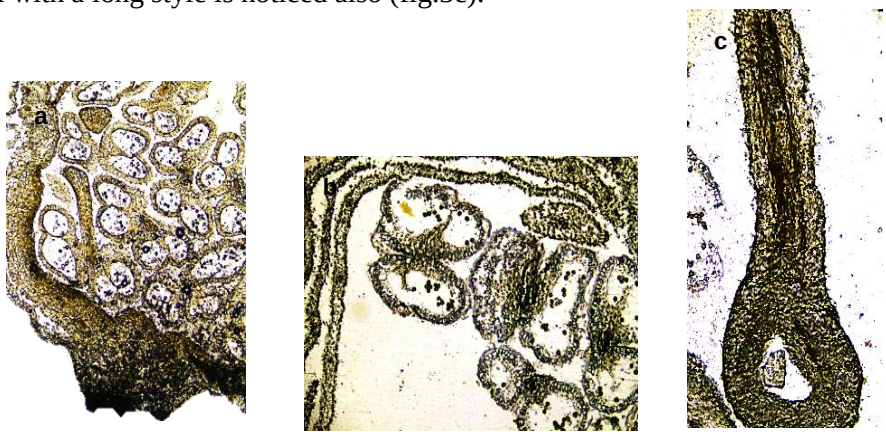

Fig. 3 Organogenesis in the floral buds of T2 and T3 population: a. T2 – the anthers with pollen grains; carpel is avorted; b. T3 – the perianth and the anthers with pollen grains; c. T3 – the carpel with a long style

Two flowers are observed usually in flower buds of the T4 population (fig. 11); the pollen grains are formed in anthers (12); the short style carpel (fig. 13) has an ovule in a primordial stage of development (fig. 11).

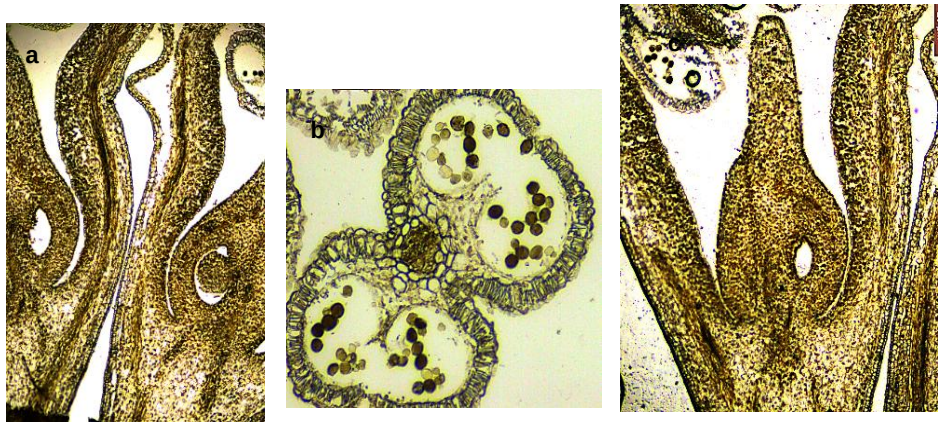

Fig. 4 Organogenesis in the floral buds of T4 population: a. – two flowers into a bud; b. the anther and the pollen grains; c. the carpel with a short style

The examination of the flower buds' sections emphasized the stage of floral organogenesis process to each population.

Toward the end of dormancy in all four cases the elements of the perianth and the pollen grains are already formed; differences are found in the stage of the carpel formation for each population.

Although in the literature it is specified that the ovule remains in the primordial stage during the dormancy to Prunus species (Mănescu et al., 1975), to the T1 population was found that the differentiation of the embryonic sac is initiate during this period. This population belongs to early varieties group, the fruits being mature in the second decade of August.

CONCLUSIONS

1. During dormancy a removal of flower buds could take place if they were produced in excess.

2. There is a well adaptation to the local conditions from Pătârlagele (Buzău County) for all four observed population.

3. Carpels are in different stages of development depending on the cultivars and the moment of fruit formation

4. The perianth elements and pollen grains are already formed at the end of dormancy to all four populations.

5. The carpels are in different stages of development depending on the cultivars and the moment of fruit formation.

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GENE EFFECTS IMPLIED IN MANIFESTATION OF THE SOME QUANTITATIVE TRAITS AT THE TOMATO

EFECTE GENICE IMPLICATE ÎN MANIFESTAREA UNOR CARACTERE CANTITATIVE LA TOMATE

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Abstract. *In the article are presented the results of the research on the genetic effects involved in the manifestation of some quantitative characters to tomatoes. It has been established that the various actions (aditive - a, dominant - d) and epistatic interactions (aa, ad, dd) of the genes vary in their degree and orientation (+/-), and depend on the combination, traits and participate to the inheritance of morphobiological and agronomic traits of tomatoes. Duplicate epistasis play an important role in forming the phenotype of these characters in most combinations. As a result of the clustering analysis of the degree of association of the characters mean in the F_2 population with the investigated gene effects, it was found that in all cases, the F_2 media displayed a high associative association with epistasis ad. The broad spectrum of gene effects involved in the formation of the phenotype of morphobiological and agronomic features highlights their genetic basis which considerably contributes to the targere of tomato breeding.*
Key words: tomato, quantitative traits, gene effects

Rezumat. *În acest articol sunt prezentate lucrările de cercetare asupra efectelor genetice implicate în manifestarea unor caractere cantitative la tomate. A fost stabilit că acțiuni diferite (aditive-a, dominante-D) şi interacțiunile epistatice (aa, ad, dd) a genelor variază ca grad şi orientare (+/-) şi depind de combinațiile şi caracteristicile pe care le exprimă şi participă la ereditatea caracterelor morfobiologice şi agronomice ale tomatelor. Epistazia duplicată joacă un rol important în exprimarea fenotipului acestor caracteristici în cele mai multe combinații. Ca rezultat al analizei cluster a gradelor de asociere a mediei caracterelor în populația F_2 cu efecte genetice demonstrate a fost găsit faptul că în toate cazurile media din F_2 a exprimat un grad de asociere ridicat cu epistazie ad. Spectrul larg al efectelor genelor implicate în formarea fenotipului pentru caracteristicile morfobiologice şi agronomice subliniază baza lor genetică care contribuie în mod considerabil la atingerea obiectivelor de ameliorare a tomatelor.*
Cuvinte cheie: tomate, caractere cantitative, efecte genetice

INTRODUCTION

Numerous factors contribute to the formation of genetic and phenotypic variants within a hybrid population. Phenotypic variation within a species or population is extremely complex, often – polygenic and quantitative, being influenced by genetic and environmental factors. In addition, along with allelic variations (dominance), both

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additive actions and non-aditive interactions of the genes play an important role in formation of the quantitative characters in plants (Eckardt, 2008) and their heredity transmission (Holland, 2001; Liberman *et al.*, 2007; Lupaşcu, 2010; Phillips, 2008), for which reason the elucidation of tomato cross combinations with gene effects favorable to obtaining a certain level of character is a safe way of optimizing and accelerating the creation of the new tomato genotypes with the desired traits (Munteanu, 2003; Ciobanu *et al.*, 2009, a).

In control of the quantitative character of tomato fruit, various *Quantitative Trait Loci* (QTL) located on the same chromosome, or on different chromosomes, are involved. For example, for fruit weight (fw), 6 QTLs were detected: on cr.1 (*fw*1.1 and *fw*1.2), cr.2 (*fw*2.1 and *fw*2.2), cr.3 (*fw*3.1), and Cr. 11 (*fw*11.3). The most important QTL – *fw*1.1, *fw*2.2. and *fw*11.3, demonstrated the phenotypic variance values of 17.22 and 37% respectively (Lippman and Tanksley, 2001).

Improving of the size of tomato fruit has been achieved relatively easily, due to the high heritability of the character, but the inheritance patern is quite complex, being determined by the number of loci. A trait correlated with the weight of the fruit – the size of the fruit depends on the number of cells in the ovary to pollination, the number of successful pollination and cell divisions after fertilization, and the extent of the cell size (Ghosh *et al*, 2010).

In tomatoes, the number of fruits *per* plant, the number of fruits *per* sprout, the fruit weight and the fruit yield *per* plant showed high values of the genetic variation coefficient and genetic performance, which revealed the contribution of additive factors and the selectivity efficiency on a the genetic basis for improving these characters (Mohanty, 2003; Saeed *et al*, 2007; Dar and Sharm, 2011; Al-Aysh *et al.,* 2012).

The significant positive association between fruit weight and fruit yield *per* plant indicates a genotypic relationship between these attributes, and the fruit harvest can be increased by simply selecting the plants based on those characters. It should be noted that the significant negative correlation between the number of fruits *per* plant and the fruit weight denotes, in fact, the impossibility of simultaneously improving these attributes within one and the same genotype. For this reason, the improvement must to be oriented towards the formation of large fruit genotypes, with the optimal fruit weight (Mohanty, 2002; Singh *et al,* 2004).

Thus, in order to obtain the high fruit yield tomatoes *per* plant, selecting plants based on the number of fruits per plant and the fruit weight, more precisely selecting based on the positive correlation between these characters, can be performed up to a certain level which does not involve the reciprocal exclusion of factors (Munteanu and Făticeanu, 2008; Ciobanu *et al.*, 2009 b; Ciobanu *et al.*, 2016).

Creating of the high-performance genotypes involves the use of an initial high-capacity hereditary transmission of valuable attributes and the enhanced adaptation to local environmental conditions, able to accumulate a large number of valuable positive gene interactions.

Genetic actions and interactions largely control the phenotype and inheritance of quantitative characters in plants (Liberman *et al*, 2007; Lupascu, 2010).

If the epistatic interactions are subject to the selection factor and the influence of the environmental conditions, their degree of manifestation can also be predicted (Blows and Hoffmann, 1996; Carlborg and Haley, 2004).

The purpose of the research was to elucidate the gene effects involved in the manifestation of quantitative traits in tomatoes and to identify combinations with favorable gene effects that would allow optimization and acceleration of the creation of new genotypes with the desired characteristics.

MATERIAL AND METHOD

Four parental forms – Maestro, Dwarf Moneymaker (D.M.M.), Mihaelia, Irisca, hybrid combinations F_1 and F_2, first-generation backcross (BC) combinations were used as research material.

A number of characters of biological and agronomic importance were analyzed: *fruit length and diameter, thickness of the pericarp, number of seminal locule, fruit weight, number of fruit branches, number of fruits per plant, fruit yield per plant.* The number of fruits analyzed was: 30-40 – for parental forms and hybrid F_1, 120 – F_2 and 60 – backcross populations.

To determine the level and orientation (+/-) of additive (*a*) and nonadditive (*dominant - d, additive x additive - aa, additive x dominant - ad, dominant x dominant - dd*) gene effects, involved in the heredity of biological and productivity traits in tomatoes, was applied the Gamble model (Gamble, 1962).

Construction of the distribution dendrogram was performed based on the iteration algorithm by Ward method in the STATISTICA 7 software package.

RESULTS AND DISCUSSIONS

The obtained results indicate that the gene effects involved in the inheritance of valuable morpho-anatomic and agronomic characters in tomatoes were quite differentiated by level, orientation (+/-) and variance depended largely on the hybrid combination (table 1, table 2).

Fruit length and diametert. Gene effects with the statistical support were found in 100% cases for length and 90% – fruit diameter. With exception of the *ad* epistasis that have always been positive, but with low variance, for all types of effects, significant (+/-) guidelines have been identified to increase or decrease the character.

The thickness of the pericarp. Gene effects with statistical support were confirmed in 17 out of 20 variants (cross combination x gene action / interaction), ie in 85% of cases. Significant additive actions were recorded at the crosses Maestro x D.M.M., Mihaela x Irisca, Mihaela x D.M.M. The effects of dominance, unlike the additive ones, were more influential, both in terms of value and variance, the latter varying within the limits of 23.6 ... 27.7% of the general genetic variation GGV. Positive strong dominance was certified at Maestro x Dwarf Moneymaker (3.17 *), Maestro x Irişca (2.12 *) and Mihaela x Irişca (2.05 *).

Of the epistasis, the interactions *aa* had statistical support in 3 of the 4 combinations, their share in the GGV being quite high: 22.78 ... 24.02. Epistasis

ad have always been positive, but their low variance of 1.90 ... 2.40 demonstrates the minor role in character formation.

The most important epistasis of the investigated cross combinations were interactions *dd*, the high variance of which demonstrates their major involvement in genetic control of character. However, their practical application has quite different possibilities. Thus, from the four combinations analyzed, only Maestro x D.M.M., by virtue of the manifestation of complementary epistasis (unidirectional orientation of the positive *d* and *dd* forces), presents the chances of obtaining more accelerated genophytes with thick pericarp, while in the other combinations, by epistasis dublicate (the opposite orientation of *d* and *dd* effects), genotypes with the desired character can only be obtained by long-term selection. However, the Mihaela x Irişca cross combinations, due to their positive actions and interactions, and their high variance (50.32%), which contribute to the enhancement of character, present opportunities and chances of obtaining genotypes with thick fruit pericarp.

Locules per fruit. Gene effects, with statistical support, were found in 90.0% of cases. In most combinations, *d* and *aa* effects were recorded, oriented to the decreasing of character, thus increasing the quality of the fruit and reducing the number of seeds. Of the interactions strongly involved in increasing the number of seminal loci, epistasis *dd* can be mentioned.

Fruit weight. Gene effects were found, varying by level, orientation and magnitude of variance, which reveals complexity of the character control. Significant additive actions were found in all hybrid combinations indicating their contribution to increasing the fruit weight. Dominance actions were significant, by level: -29.47 ... 6.67, and a variance that represented 23.52 ... 27.05% of GGV. The strongest dominance effects, aimed at enhancing character, were manifested in Maestro x D.M.M. (6.67 *) and Mihaela x Irisca (4.32 *), and to the diminution of character – at Mihaela x D.M.M. (-29 47 *).

It was found that *ad* interactions had only positive values, indicating that this type of epistase contributes to nonspecific increase of the values of all the surveyed production indices – the fruit yield *per* plant, the number of fruits *per* plant, the weight of the fruit. Strong epistasis in the direction of diminution of character were found at Mihaela x D.M.M. (-25.34 *).

The *dd* epistasis at all combinations acted in the direction of increasing the values of character. It should be noted that interactions *dd* recorded the highest variance, constituting 42.71 ... 49.18% of the GGV. With the exception of the combination, Mihaela x Irisca, in the control of the size of the fruit, there were duplicate epistasis, ie opposite directions (+/-) of *d* and *dd* effects, which puts the process of selecting forms with certain dimensions of the fruit in difficulty.

According to the data obtained, for the creation of large fruit forms there are certain chances for the crosses Maestro x Dwarf Moneymaker, Mihaela x Irişca, which have been certified *a* and *aa* positive effects with the variation sum of 45,91 and 47,32, respectively, in GGV.

Table 1

Gene effects that control the morphobiological and productivity traits of tomatoes

Backcross combination	Gene effects					
	m	***a***	***d***	***aa***	***ad***	***dd***
Length of the tomato fruit						
Maestro x Irişca	43.30*	14.65*	23.12*	27.50*	71.12*	-11.05*
Maestro xD.M.M	77.70*	5.30*	-63.55*	-64.40*	73.45*	92.30*
Mihaela x Irişca	40.60*	3.55*	17.12*	13.30*	42.67*	-24.85*
Mihaela xD.M.M	49.7*	-5.85*	10.30*	13.10*	44.95*	-27.40*
Diameter of the tomato fruit						
Maestro x Irişca	40.15*	-3.45*	-21.07*	-18.70*	33.63*	20.35*
Maestro xD.M.M	33.85*	0.20	3.60*	2.80*	38.10*	12.20*
Mihaela x Irişca	42.05*	6.40*	13.47*	11.00*	42.27*	-21.75*
Mihaela xD.M.M	49.35*	7.6*	-15.15*	-18.2	49.30*	11.90*
Thickness of the pericarp						
Maestro x Irişca	4.85*	-0.15	2.12*	2.30*	5.62*	-1.25*
Maestro xD.M.M	4.75*	-2.70*	3.17*	3.00*	4.92*	5.85*
Mihaela x Irişca	5.45*	0.65*	2.05*	1.90*	5.4*	-6.3*
Mihaela xD.M.M	7.45*	-1.10*	0.45	-0.60	5.50*	-0.10
Locule number						
Maestro x Irişca	2.65*	0.41*	-1.40*	-1.6*	2.90*	3.00*
Maestro xD.M.M	3.15*	0.75*	-1.15*	-1.30*	3.20*	0.10
Mihaela x Irişca	2.45*	0.15*	-1.00*	-0.70*	2.60*	0.80*
Mihaela xD.M.M	2.60*	-0.10	-2.05*	-2.00*	2.30*	3.10*
Fruit weight						
Maestro x Irişca	43.12*	12.90*	0.71	0.33	60.35*	17.40*
Maestro xD.M.M	52.36*	14.29*	6.67*	3.09*	68.07*	6.67*
Mihaela x Irişca	44.47*	30.09*	4.32*	11.43*	84.28*	1.82
Mihaela xD.M.M	62.15*	20.37*	-29.47*	-25.34*	80.90*	35.95*
Branches per plant						
Maestro x Irişca	4.88*	0.15	-1.39*	-1.02*	4.97*	1.07*
Maestro xD.M.M	4.89*	-0.55*	-0.47*	-0.25	4.27*	-0.20
Mihaela x Irişca	4.65*	0.05	-0.82*	-1.32*	4.65*	3.42*
Mihaela xD.M.M	4.64*	-0.05	0.35*	0.15	4.55*	-0.05
Fruits per plant						
Maestro x Irişca	45.9*	-4.10	-9.72*	-13.12*	35.3*	7.06*
Maestro xD.M.M	38.28*	-8.57*	-9.91*	-9.2*	30.7*	20.9*
Mihaela x Irişca	41.27*	-9.53*	-19.27*	-26.02*	25.88*	42.12*
Mihaela xD.M.M	32.61*	-15.53*	5.18*	6.91*	19.75*	-6.54*
Fruit yield per plant						
Maestro x Irişca	1985.90*	360.00*	-242.00*	-634.83*	1978.10*	584.23*
Maestro xD.M.M	1961.17*	-67.04	96.26	-150.22*	1866.48*	682.78*
Mihaela x Irişca	1810.30*	502.17*	-264.52*	-784.62*	1979.97*	1279.42*
Mihaela xD.M.M	1834.01*	-230.53*	-97.95	-139.77*	156.65*	199.87*

$p \leq 0,05$.

Table 2

Variants of the gene effects that control the morphobiological and productivity traits of tomatoes

Backcross combination	Gene effects					
	m	***a***	***d***	***aa***	***ad***	***dd***
Length of the fruit						
Maestro x Irişca	21.80	43.13	534.89	521.34	52.07	1093.16
Maestro xD.M.M	119.48	169.30	2662.49	2588.95	180.52	4914.70
Mihaela x Irişca	11.41	18.99	266.76	258.51	23.50	519.33
Mihaela xD.M.M	18.43	22.14	403.02	383.48	28.94	727.37
Diameter of the fruit						
Maestro x Irişca	14.24	23.31	339.10	321.08	27.63	672.89
Maestro xD.M.M	14.55	26.08	350.70	337.20	30.62	704.16
Mihaela x Irişca	10.47	17.83	253.16	238.86	22.62	510.02
Mihaela xD.M.M	11.50	21.30	284.69	269.26	26.32	586.63
Thickness of the pericarp						
Maestro x Irişca	1.92	2.92	43.70	42.47	3.36	82.45
Maestro xD.M.M	2.62	4.69	61.99	60.65	5.23	122.29
Mihaela x Irişca	1.63	3.19	40.15	38.81	3.90	82.41
Mihaela xD.M.M	1.10	1.80	26.34	24.86	2.62	52.43
Locule number						
Maestro x Irişca	0.34	0.31	7.05	6.76	0.38	11.66
Maestro xD.M.M	0.66	1.06	15.11	14.81	1.11	28.74
Mihaela x Irişca	0.26	0.41	6.00	5.80	0.47	11.49
Mihaela xD.M.M	0.25	0.18	5.06	4.78	0.23	8.11
Branches per plant						
Maestro x Irişca	1.11	2.06	27.23	25.95	2.76	55.80
Maestro xD.M.M	0.83	1.51	20.61	19.42	2.14	42.35
Mihaela x Irişca	0.66	1.41	17.47	16.23	2.02	38.07
Mihaela xD.M.M	0.89	1.72	22.09	21.17	2.26	45.51
Fruit weight						
Maestro x Irişca	93.08	137.81	2167.25	2040.56	175.35	4201.05
Maestro xD.M.M	110.40	218.95	2775.80	2642.22	250.63	5804.04
Mihaela x Irişca	101.18	175.61	2401.42	2321.42	231.99	4748.81
Mihaela xD.M.M	394.31	330.64	7817.51	7631.51	381.16	12343.22
Fruits per plant						
Maestro x Irişca	389.6	566.8	8550.9	8404.5	611.1	1579.9
Maestro xD.M.M	257.0	610.1	6887.0	6552.2	693.9	15212.9
Mihaela x Irişca	179.0	331.1	4397.1	4188.7	376.0	8996.5
Mihaela xD.M.M	327.2	446.3	7200.0	7020.4	530.5	13094.0
Fruit yield per plant						
Maestro x Irişca	400.6	766.9	10570.0	9409.6	821.1	2082.9
Maestro xD.M.M	357.9	812.2	8837.0	7772.3	980.9	19223.9
Mihaela x Irişca	285.0	542.3	7399.7	6190.9	888.0	9970.5
Mihaela xD.M.M	528.2	756.3	9238.0	10400.8	938.5	15098.2

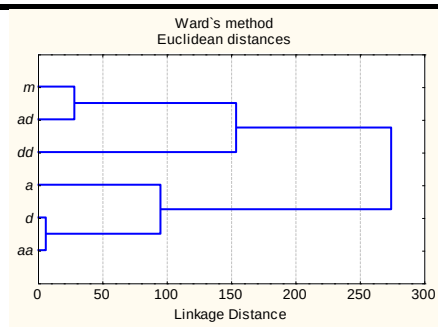
Branches per plant. The actions (*a, d*) and the gene interactions (*aa, ad, dd*) had a different role in character formation, casting it to increase or decrease it. The data reflects allelic actions of type *a* and *d* insignificant in the all hybrid cross combinations. Analysis of epistatic allelic interactions showed positive homozygous positive interactions of the type *aa* only at the Mihaela x Dwarf Moneymaker combination, heterozygous of the *ad* type at all combinations and *dd* – at the cross combinations Maestro x Irişca and Mihaela x Irişca.

Fruits per plant. Gene effects with statistical support involved in character formation were found in 95% of cases. Additive forces aimed at enhancing the character have not been attested, but they are interested in the Mihaela x Dwarf Moneymake combination, which due to the manifestation of high-positive (*d, aa* and *ad*) positive gene actions / interactions provide a safe chance of obtaining high- of character, but in the longer term, through the repeated selections.

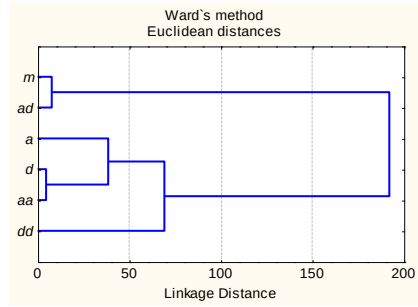
Fruit yieldt per plant. Significant positive additive actions were found in the cross combination Maestro x Irisca, Mihaela x Irisca. Strong epistatic interactions in the direction of dimishing of character were recorded to all combination. Note that the dominance factor that has great importance in amelioration recorded negative values with statistical support at 2 combinations - Maestro x Irisca and Mihaela x Irisca. All combinations exhibited positive and negative episases *ad* and *dd*.

In the combinations of Maestro x Irisca, Maestro x D.M.M., Mihaela x Irişca, Mihaela x D.M.M., most of the characters in the study were controlled by duplicated epistasis (different orientation of *d* and *dd* effects), which are a serious impediment to the improvement process toward a certain level of character – increased or diminished. This determines individual, long-term selections of plants that have the character of interest. Unlike duplication epistasis, complementary ones offer chances of success in narrower terms. Such epistasis were recorded in the case of fruit yield *per* plant to the Maestro x Irişca, Maestro x D.M.M., Mihaela x Irişca combinations, the fruit yield per plant, the diameter of the fruit and the thickness of the pericarp – the cross combination of Maestro x D.M.M., the positive value of the dominant shares and the interactions *dd* offering opportunities to streamline and accelerate the increase in the values of those characters.

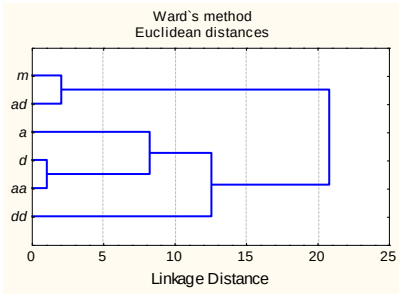
From a practical point of view, it is important to elucidate how the particular gene or association effects contribute to increasing or diminishing a character of interest. In connection with this, for the crosses under study, the clustering analysis of the degree of association of the mean of character in the F_2 population with the gene effects under study was carried out. According to the distribution dendrogram, in all cases the mean of characters in F_2 populations showed a high associative link with *ad* epistasis (fig. 1).



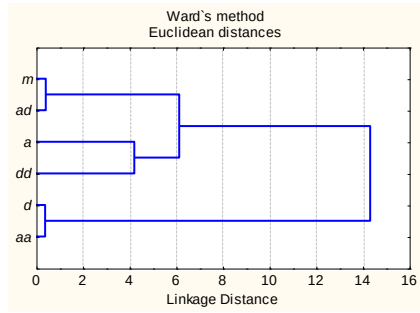
Length of the tomato fruit



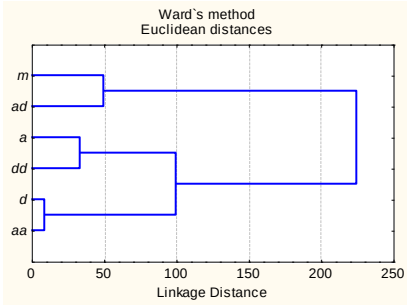
Diameter of the tomato fruit



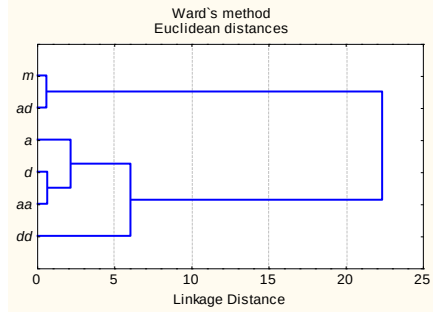
Thickness of the pericarp



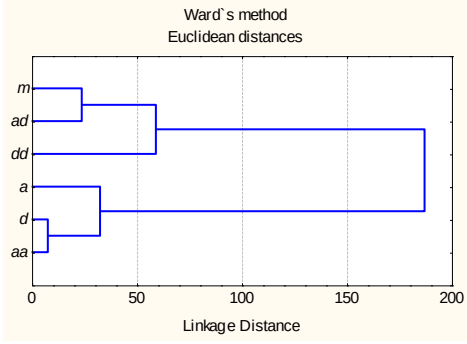
Locule number



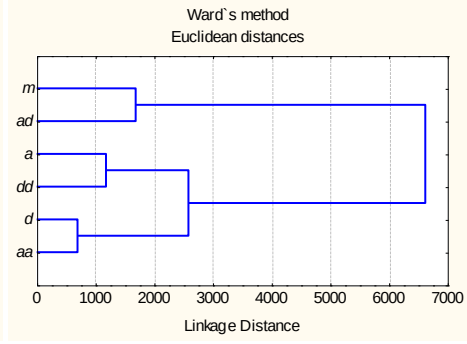
Fruit weight



Branches per plant



Fruits per plant



Fruit yield per plant

Fig. 1 The repartition dendrogram of the mean F_2 ant genetic effects involved in the control of some quantitative characters in tomatoes (*m* – the mean of character in the F_2 population, *a* – additive, *d* – dominant, *aa* – additive x additive, *ad* – additive x dominant, *dd* – dominant x dominant gene effects)

Taking into account the level of aggregation of the mean of character in F_2 populations and *ad* epistatic interactions, it can be easily observed that in increasing order the ties are as follows: number of locules, fruit branches *per* plant, thickness of the pericarp, fruit diameter, fruit length, number of fruits *per* plant, fruit weight, fruit yield *per* plant. It is worth mentioning that along with epistasis *ad*, the average of characters in F_2 populations also depends on other gene effects: the length of the fruit - the interaction aa, the number of seminal locules – the action *a* and the interaction *aa*, the number of fruits *per* plant – *aa*. So for these characters, gene systems as a control factor are more complex.

CONCLUSIONS

Phenotype and heritability of the morphoanatomic characters (fruit length and diameter, thickness of the pericarp, number of seminal locules, etc.) and agronomic (fruit weight, number of fruit per plant, fruit yield *per* plant,) in tomatoes are determined by different components of genetic variation – *additive, dominant*) and interactions (*additive x additive, dominant x, dominant x dominant additive*), involved in increasing or decreasing character values, and which record a differentiated magnitude in the general genotypic variance of trait. The average of the majority of characters in F_2 populations is most associated with epistasis *ad*, but for some (fruit length, number of fruits) – and *dd* interactions.

In the most tomato cross combinations, the prevalence of duplicate epistasis (the opposite orientation of dominating factors and *dd* epistasis) was recorded in the control of the quantitative character, which makes it difficult to create the genotypes with the desired characteristics in small terms, but the combinations of Maestro x Irişca, Maestro x Dwarf Moneymaker and Mihaela x Irisca present opportunities to accelerate the creation of large-scale genotypes, because they show additive actions and complementary epistasis that favor the enhancement of characters.

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MORPHOBIOLOGICAL AND AGRICULTURAL TRAITS OF THE TOMATO PROSPECTIVE LINES

ÎNSUŞIRILE MORFOBIOLOGICE ŞI AGROCHIMICE LA LINIILE DE PERSPECTIVĂ DE TOMATE

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Abstract. *The article presents the results of the evaluation of some tomato perspective lines developed at the Institute of Genetics, Plant Physiology and Plant Protection, Republic of Moldova. Testing on the basis of productivity, resistance to alternariosis and morphobiological characteristics of the fruit, and subsequent clusterian analysis, showed that the lines separated into three clusters differ on the basis of the fruit weight, fruit length, fruit diameter, mesocarp thickness, pericarp thickness, seminal lojes. Lines with increased productivity – L 304, L 306, L 309 and L 310 have been identified that can be included in the breeding programs. Lines L 304, L 306, L 308, L 310 exhibited a reduced degree and frequency of attack of alternarias and may be recommended as a source of resistance to disease.*
Key words: tomatoes, fruit characters, productivity, resistance

Rezumat. *Lucrarea prezintă rezultatele de cercetare asupra unor linii de perspectivă a tomatelor create la Institutul de Genetică, Fiziologie şi Protecţia Plantelor din Republica Moldova. Testarea pe baza agroproductivităţii, a rezistenţei la alternarioză, a caracteristicilor morfobiologice ale fructului şi analiza multiplă care a urmat au arătat că liniile separate din cele trei grupe diferă în funcţie de greutatea fructului, lungimea fructului, diametrul fructului, grosimea mezocarpului, grosimea pericarpului, lojelor seminale. Au fost identificate liniile cu productivitate crescută - L 304, L 306, L 309 şi L 310, acestea putând fi incluse în programele de multiplicare. Liniile L 304, L 306, L 308, L 310 au prezentat un grad şi o frecvenţă de atac reduse a alternariozei şi, ca atare, pot fi recomandate ca sursă de rezistenţă la agenţii patogeni.*
Cuvinte cheie: tomate, caracteristici ale fructelor, productivitate, rezistenţă

INTRODUCTION

Tomatoes (*Solanum lycopersicum* L.) are some of the most cultivated vegetables in the world, their fruits being a basic food source and a main component of dietary products in many countries (Munteanu, 2003; Borghesi *et al.*, 2011; Inculet *et al.*, 2017).

Classical plant improvement implies firstly the involvement of high biological value starting material in breeding programs, the determination of genetic variation, and the selection in the segregated or natural populations of

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forms of interest with the subsequent conservation of valuable genetic sources (Barrero and Tanksley, 2004; Gepts, 2002; Gepts P., 2006).

The limited genetic diversity of many agricultural crops necessitates the need to detect new sources of necessary characters / variations (Heywood V. *et al.*, 2007; Munteanu and Fălticeanu, 2008), in Solanaceae species the genetic diversity of genophores also being of great importance for the success of breeding programs (Ciobanu *et al.*, 2009, a; Albrecht *et al.*, 2010).

The ever-increasing requirements for newly created varieties require importers to use the contemporary methods of obtaining the original material and its use in hybridization and selection (Ciobanu *et al.*, 2016). A great interest is represented by the high-yielding native varieties and the forms coming from areas with similar conditions to those in the country in which they are to be implemented, thus offering high opportunities for their direct introduction into culture (Bai and Lindhout, 2007; Ciobanu *et al.*, 2009, b; Dar and Sharma, 2011).

Independent of the direction of breeding research, an important role is given to the characters of the fruit, as they often determine the ultimate goal of the improvement. The main characteristics of the tomato fruit are: the mass, the number of loaves, the thickness of the pericarp, the shape of the fruit, and the knowledge of the degree of their variability allows for more efficient use of the initial material in the ameliorative research.

This paper presents the results of the assessment of some tomato perspective lines created in the Institute of Genetics, Plant Physiology and Plant Protection on the basis of attributes of fruit, productivity and resistance to alternariose.

MATERIAL AND METHOD

Seven tomato lines selected from different intraspecific hybrids were used as study material, and Elvira native variety served as a control.

The establishment of the culture was carried out by seed without irrigation. The applied technology is approved for tomato culture in the Central Area of the Republic of Moldova (Eshova, 1978).

Genotypes were analyzed based on a set of quantitative characters valued at 10 plants taken at random for each genotype, according to the standards in force, according to the methods described in the work (Пухальский, 2005) and Test Guidelines for Tomato - UPOV (2011). In comparative competition cultures, the prospective forms were placed in randomized blocks (Dospehov, 1985).

The assessment of the frequency and degree of attack of alternariose was performed in field conditions, based on signs of disease (brown spots, ulcerations, necroses) in the 6-step scale, elaborated by the authors: 0 - healthy, immune (no signs of disease) 1 - High Resistance - RR (10-20%); 2 - resistant - R (21-30%); 3 - medium resistant - RM (31-40%); 4 - sensitive - S (41-50%); 5 - highly sensitive - SS (≥50% area with signs of disease).

Cluster analysis were performed by constructing dendrograms based on the agglomeration-iterational algorithm (the Ward method) and the *k*-mean method [355]. In the k-media method, 3 clusters were programmed after the possible values of the characters: small, medium and high. The main purpose of these procedures is to find

similarities and differences between objects (genotypes) according to the parameters used (fruit mass, fruit length, fruit diameter, mesocarp thickness, pericarp, number of seminal troughs) and their distribution in groups objects in the same group are similar, and those in different groups - special.

Statistical data was performed in the STATISTICA 7 software package.

RESULTS AND DISCUSSIONS

The climatic conditions of 2017 were unfavorable for the early ontogenesis of tomatoes in their growing by seed in connection with the snow that fell in the third decade of April. The crust that has formed at the surface of the soil has led to the uneven outflow of the plants, and in some forms low soil temperatures have influenced vegetative and reproductive growth of plants. Even under these conditions, some lines had a good development and recorded high productivity values (fig. 1).

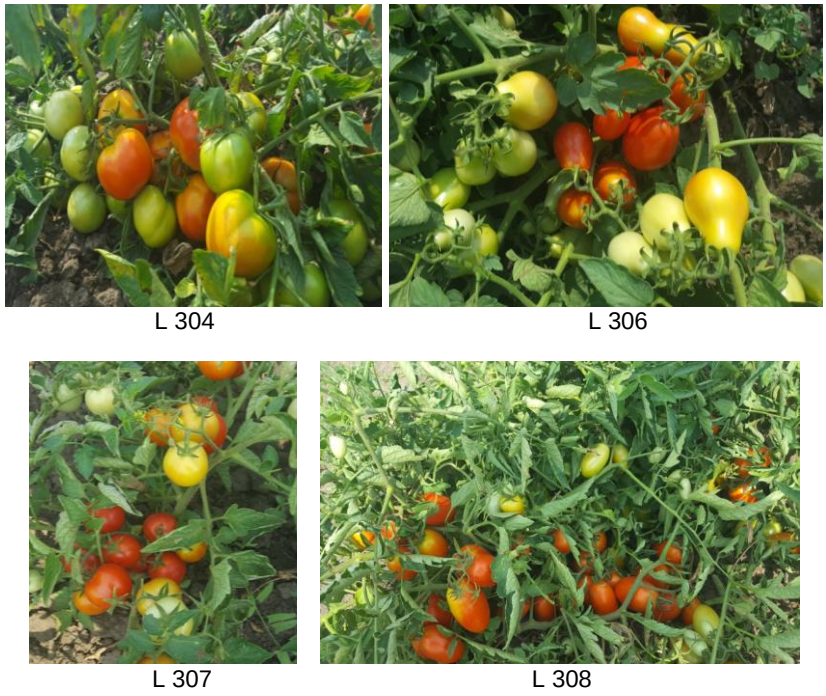


Fig. 1 Appearance of tomato perspective lines

As a result of the analysis of the number of fruits per plant (fig. 2), it was found to have a high variability in the perspective lines ranging from 6 ... 36 to the standard Elvira, L 304 – 16-45, L 305 – 17-32, L 306 – 32-98, L 307 – 47-87, L 308 – 52-99, L 309 – 49-92, L 310 – 34-68. The highest values were

recorded on lines L 306, L 307, L 308 and L 309, which indicates their suitability for breeding programs.

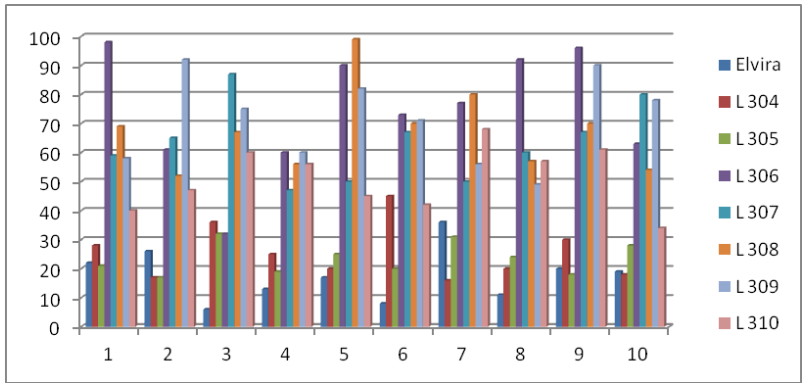


Fig. 2 Variability of fruits number per plant at the tomato perspective lines

The data showed essential differences of genotypes according to the fruit weight *per* plant (tab. 1). Two forms – L 309, L 310, were identified, where the fruit weight *per* plant was within the range of 2.01-3.94 kg. The highest values of the character were recorded at genotype L 306: 2.24 ... 5.39 kg.

Table 1

Variability of fruit mass per plant (kg) in tomatoes

Genotype	Plant number										$x \pm m_x$	V,%
	1	2	3	4	5	6	7	8	9	10		
Elvira, martor	1.98	2.24	0.96	1.36	1.60	1.23	3.10	1.54	1.90	1.71	1.71±0.20	36.8
L 304	2.67	1.73	2.38	2.12	1.96	2.75	1.60	1.90	2.10	1.89	2.12±0.12	18.0
L 305	2.08	1.90	2.11	1.62	2.45	1.22	3.10	2.28	1.26	2.88	2.09±0.20	29.7
L 306	4.41	3.23	2.24	3.48	4.59	4.96	5.39	4.88	4.42	3.91	4.15±0.30	22.9
L 307	1.18	1.17	1.31	1.03	1.15	1.14	1.05	1.14	1.34	1.28	1.18±0.03	8.50
L 308	2.35	1.82	2.21	1.90	2.77	2.31	2.32	2.05	2.45	2.00	2.22±0.09	12.6
L 309	2.32	3.13	3.37	2.10	2.87	3.27	2.41	2.21	2.61	3.28	2.76±0.15	17.7
L 310	2.16	2.40	2.58	2.80	2.29	2.10	3.94	2.74	2.87	2.01	2.59±0.18	21.6

By correlational analysis (tab. 2) we found a positive dependence with statistical support ($p \leq 0.05$) between the characters the number of fruits *per* plant - the fruit weight *per* plant and a negative correlation between the fruit weight *per* plant - the mass of the fruit, which is denoted that at the genotypes under study the fruit mass *per* plant depends on the number of fruits *per* plant rather than the mass of the fruit.

The negative correlation between the number of fruit per plant and the weight of the fruit recorded on most lines (L 304, L 306, L 307, L 308) indicates

that the increase in yields of tomato plants in the studied forms can only be carried out on the basis of one of those characters.

Table 2

Correlational analysis of tomato productivity characters

Genotype	Correlation coefficient	
	Number of fruits per plant - fruit weight per plant	***Number of fruits per plant - the mass of the fruit***
Elvira, control	0.98*	-0.82*
L 304	0.88*	-0.92*
L 305	0.75*	-0.32
L 306	0.79*	-0.69*
L 307	0.82*	-0.93*
L 308	0.94*	-0.89*
L 309	0.65*	-0.59*
L 310	0.89*	-0.37

*-p≤0,05.

Among the many attributes of the fruit, its mass is one of the most important, as it is not only a biological feature but also an economic importance of the genotype. The improvement direction for this character is quite different, driven by consumer preferences and usage specifics.

According to the fruit mass, the lines were classified in three categories: very small fruit: 20.7 g – line L 307; small: 32.9 and 43.0 g, respectively, lines L 308, L 309; medium fruit: 88.9; 101.1; 57.3 and 54.6 g, respectively, lines L 304, L 305, L 306, L 310. Thus most of the lines created had an average level of the fruit weight (tab. 3).

Table 3

Phenotypic variability of some fruit characters at the tomato perspective lines

Line	Fruit weight		Fruit length		Fruit diameter		Mesocarp thickness	
	$x \pm m_x$, g	V,%	$x \pm m_x$, mm	V,%	$x \pm m_x$, mm	V,%	$x \pm m_x$, mm	V,%
Elvira, martor	122.5±6.2	22.5	54.7±1.2	9.6	60.4±1.0	7.4	45.5±1.2	12.2
L 304	88.9±4.3	21.7	49.9±0.8	6.7	55.7±0.9	7.3	39.9±1.0	11.5
L 305	101.1±4.7	20.8	56.7±1.1	8.3	50.0±1.0	8.5	42.9±1.0	10.3
L 306	57.3±2.4	18.4	60.7±0.7	4.8	43.1±0.7	6.9	26.0±0.7	11.4
L 307	20.7±0.9	19.0	32.0±0.9	12.9	32.3±0.7	10.2	24.6±0.4	7.8
L 308	32.9±1.4	18.9	53.2±1.1	9.0	33.3±0.6	8.1	22.2±0.3	6.8
L 309	43.0±1.8	18.4	55.3±1.3	10.4	35.2±0.6	7.0	22.7±0.4	7.3
L 310	54.6±1.4	11.6	44.7±0.6	6.1	47.5±0.9	8.1	32.9±0.8	10.5
Mean for lines:	56.9±11.0		50.4±3.6		42.4±3.4		30.2±8.5	

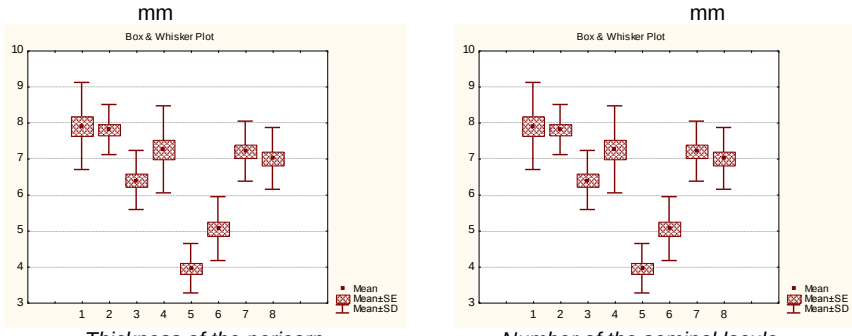
The shape of the fruit depends on its length and diameter. The data obtained (tab. 3) indicates the insignificant variability of this character, all the researched lines being denoted by its pronounced genetic determinism.

The thickness of the pericarp is of great importance for determining the appearance and quality of the fruit. Lately, the interest of breeders is aimed at obtaining tomato fruits with medium or thick pericarp, which ensures their transportability at great distances.

Forms evaluated on the basis of the pericarp thickness were very different, the index ranging from 3.9 to 7.9 mm (figure 3), and the coefficient of variation of character showed an average variability of 14.3%. The number of locules varied from one species to another – between 2-3 and 5-9. Thus, depending on the amount of tomato seed required, small or large varieties of seedlings may be created. The symmetry and the topography of the seminal locules in the fruit showed a regular settlement, the number of them ranging in the limits 2-5, and the variability of the character constituted 10.7-20.8%, the average being 16.0% (fig. 3).

Cluster analysis based on distribution dendrograms revealed similarities and differences of the tomato lines in the competition sector (fig. 4), and clustered *k*-mean analysis (centroid method) demonstrated that as members of cluster 1 were: Elvira, L 304, L 305, which recorded the highest values of the characters studied; cluster 2: L 306, L 309, L 310 – medium values of the characters; cluster 3: L 307 L 308 – smallest values.

The analysis of the alternariose attack frequency on the perspective lines compared to the standard Elvira variety highlighted a high variability that ranged from 18.2 to 88.5% (fig. 5). Note that only 4 lines – L 304, L 306, L 308 and L 310 recorded a lower frequency of 30%. L 309, L 305, L 306, L 308, L 310 lines showed a reduced degree and frequency of alternariose attack and may be recommended as sources of resistance to disease in the breeding programs.



Thickness of the pericarp *Number of the seminal locule*

Fig. 3 Morphobiological characters of the tomato fruit

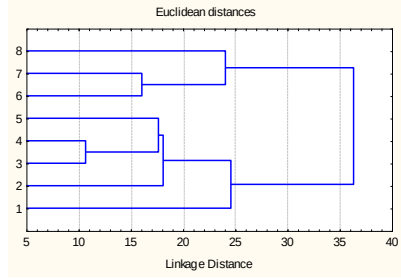
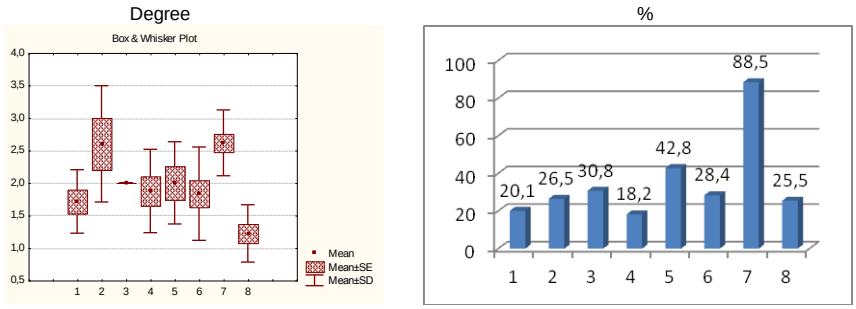


Fig. 4 The dendrogram of the tomato lines distribution based on some fruit characters



A B

Fig. 5 Degree (A) and frequency (B) of alternariose attack on tomato prospective lines (seed culture)
1 - Elvira, 2 - L 304, 3 - L 305, 4 - L 306, 5 - L 307, 6 - L 308, 7 - L 309, 8 - L 310

CONCLUSIONS

1. Cluster analysis has shown that the lines separated in three clusters differ on the basis of fruit mass, fruit length, fruit diameter, mesocarp thickness, pericarp thickness, and number of seminal locule numbers.

2. Testing of comparative competition crops based on productivity labels has made it possible to identify L 304, L 306, L 309 and L 310 lines with increased productivity, which can be recommended for homologation, implementation and inclusion in breeding programs.

3. The lines L 304, L 306, L 308, L 310 have shown a reduced degree and frequency of attack of the alternariose and can be recommended as a source of resistance to this disease in the improvement programs.

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THE MICROBIAL EVALUATION OF SOIL FROM IALOMIȚA COUNTY, ROMANIA

EVALUAREA MICROBIANĂ A SOLULUI DIN JUDEȚUL IALOMIȚA, ROMÂNIA

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Abstract. *This paper presents the population of micro-organisms found in six soil samples from Balaciu, Ialomița county, Romania, with a certain electrical conductivity and pH.The soil samples were dried, ground, revitalized with peptone water, and then incubated at 31 °C. The culture media used were: nutrient agar: yeast extract, peptone, agar; YPG agar: yeast extract, peptone, glucose, agar supplemented with chloramphenicol. The soil samples were inoculated in Petri dishes and incubated for 7 days at 35 °C for bacteria and 28 ºC for fungi. After incubation, the number of microorganisms was calculated by the CFU determination technique (colony forming units). Also, the electrical conductivity with values less than 4 dS/m and the pH, whose values exceeded 8, were determined.*
Key words: electrical conductivity, microbial population, pH

Rezumat. *Această lucrare prezintă populația de microorganisme găsite în şase probe de sol din zona Balaciu, Ialomița, România, cu o anumită conductivitate electrică şi pH. Probele de sol au fost uscate, măcinate, revitalizate cu apă peptonată, apoi incubate la 31 °C. Mediile de cultură utilizate au fost: agar nutritiv: extract de drojdie, peptonă, agar; Agar YPG: extract de drojdie, peptonă, glucoză, agar suplimentat cu cloramfenicol. Probele de sol s-au inoculat în plăci Petri şi s-au incubat timp de 7 zile la 35 °C pentru bacterii şi la 28 °C pentru fungi. După incubare, numărul de microorganisme a fost calculat prin tehnica de determinare UFC (unități formatoare de colonii). De asemenea, au fost determinate conductivitatea electrica cu valori mai mici de 4 dS/m si pH-ul, ale cărui valori au depăşit 8.*
Cuvinte cheie: conductivitate electrică, pH, populație microbiană

INTRODUCTION

Soil is a dynamic, living, natural system that is vital to the function of terrestrial ecosystems. Soil health is maintained by physical, chemical and biological factors (Micuti *et al.,* 2017). The soil as an ecosystem is one of the main

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factors in sustaining life, its composition being an indicator of environmental and food quality (Sharma *et al*., 2010). According to Doran and Zeiss (2000), soil can be defined as "the capacity of a soil to function, within land use and ecosystem boundaries, to sustain biological productivity, maintain environmental health, and promote plant, animal, and human health". There is a strong relationship between soil quality and its biodiversity (Steven Cork *et. al,* 2012).

One of the soil components is represented by microorganisms, being responsible for the decomposition of organic matter into nutrients easily assimilable by plants. Extracellular enzymes, most of them produced by soil microorganisms, are closely related to ecological functions of soil such as biomass production, contaminated soil recovery, and ecosystem conservation (Micuti *et al.*, 2017).

Since the demand for agricultural products is expected to increase by at least 70%, the exploitation of soil microbial communities for preserving the biosphere must be done (Barea, 2015).

Thus, the aim of this study was to evaluate the microbial population of soils from Balaciu, Ialomița county in order to know its status and to see if it is suitable for plant halophytes cultivation.

MATERIAL AND METHOD

The soil samples that were the basis of the experiments were collected from 6 sampling points at a depth of 0-30 cm. from which the average soil samples resulted.

After incubation, the samples of the soil were inoculated on culture media (nutrient agar - NA and YPG agar). Sowed Petri dishes were incubated for 7 days at 35 °C for bacteria and 28 °C for fungi.

After incubation, the number of bacteria and fungi in each soil sample was calculated by the CFU determination technique (colony forming units).

CFU = N x c x 10, where,

CFU = number of viable cells/1ml sample

N = average of the colonies counted from the same dilution

c = dilution reverse

10 = coefficient reference to 1ml.

The microscopic examination consisted in making smears using the Gram staining technique.

Using an adapted method (Rayment and Higginson, 1992) the EC was realized.

Samples soil pH was demined using an adapted method (Kalra, 1995).

RESULTS AND DISCUSSIONS

The EC values of soil samples were similar, the differences being insignificant (tab. 1). According to FAO, the EC values are in the range 0-2 dS/m, being non-saline.

At this stage, the following genres have been identified: Ascomycetes, Deuteromycetes (*Candida mycoderma* spp.), and the following pathogens: *Botryotinia fuckeliana ((Botrytis cinerea* Pers.*)* which produces extracellurar

polysaccharides (Fanizza *et al.*, 1995), *Penicillium* spp., *Rhizopus* spp., *Aspergillus* spp., *Mucor* spp., species of the genus *Agrobacterium, Bacillus, Clostridium, Pseudomonas, Sarcina, Staphylococcus*.

According to Garbeva *et al*., 2004, using traditional cultivation technique, the main organisms found in soil are gram positive bacteria (*Clostridium* spp., *Bacillus* spp., *Arthrobacter* spp., *Brevibacterium* spp., *Corynebacterium spp.)* or subgroups of the Proteobacteria like *Pseudomonas, Serratia, Enterobacter, Rhizobium*, etc.

The identified colony forming units are shown in table 1.

Table 1

Soil samples characterization

Sample	CFU/10g soil	pH	EC dS/m
P_1	287	8.54	0.3
P_2	269	8.55	0.2
P_3	253	8.33	0.2
P_4	274	8.18	0.2
P_5	284	8.69	0.3
P_6	267	8.48	0.2

There were no quantitative variations of the soil microbiota analyzed at the depth from which the samples were collected (30 cm).

Regarding the pH value, all samples recorded values above 8 indicating the presence of significant amounts of sodium exchangeable as a result of the presence of Na_2CO_3. This is corroborated with low EC values (Batjes, 1995).

CONCLUSIONS

1. With regard to microbiological soil evaluation the main classes of microorganisms were: actinomycetes, bacteria, and molds.
2. The assessment of soil microbiology highlighted: *Bacillus* sp., *Rhizopus* sp., *Aspergillus* sp., *Penicillium* sp.
3. Nonsporogenic bacteria are represented by a series of gram-negative species, mainly belonging to the genus *Pseudomonas*.
4. The soils analyzed are not saline.
5. According to pH values, soils have high sodium carbonate content.

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PRELIMINARY STUDIES ON THE SELECTION AND PREPARATION OF SUBSTRATES FOR CULTURE IN POTS AND CONTAINERS

STUDII PRELIMINARE PRIVIND ALEGEREA ŞI PREGĂTIREA SUBSTRATURILOR PENTRU CULTURA LA GHIVECE ŞI CONTAINERE

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Abstract. *The paper presents a study on the main pedological, agrochemical and biological indices of the different types of substrate used for growing vegetables in pots and containers in order to optimize the growth and development of plants. The researche were carried out in an experimental field set up at the Didactic Center of the University of Agricultural Sciences and Veterinary Medicine Iasi. Three types of substrate were used: S1 - substrate made from 35% garden soil, 35% compost, 20% peat, 10% sand and pearlite, S2 - substrate made of earth 35% garden, 20% compost, 35% peat, 10% sand and pearlite; S3 - commercially available substrate. Determinations have been made on: nutrients, pH, humidity and granulometry. Substrate quality assessment was performed on the basis of yield and harvest quality.*
Key words: substrates, quality, productivity

Rezumat: *Lucrarea prezintă prezintă un studiu asupra principalilor indici pedologici, agrochimici şi biologici a diferitelor tipuri de substrat folosite pentru cultivarea legumelor în ghivece şi containere, în vederea optimizării regimului de creştere şi dezvoltare a plantelor. Cercetările au fost efectuate într-un poligon experimental amenajat la Staţiunea Didactică a Universităţii de Ştiinţe Agricole şi Medicină Veterinară Iaşi. Au fost folosite trei tipuri de substrat: S1- substrat standard existent în comerţ, S2- substrat realizat pe bază de pământ de grădină 35%, compost 35%, turbă 20%, nisip şi perlit 10%, S3- substrat realizat din pământ de grădină 35%, compost 20%, turbă 35 %, nisip şi perlit 10%. Au fost efectuate determinări privind: elementele nutritive, pH, umiditate şi granulometrie. Evaluarea calităţii substraturilor a fost realizată pe baza productivităţii şi calităţii recoltei.*
Cuvinte cheie: substrat, calitate, productivitate

INTRODUCTION

The substrate is a mixture of different types of soil, minerals and garden soil, adapted to the culture of a plant type or group of plants. The nutrient substrate plays an extremely important role in achieving a successful crop in pots and containers. For this reason, the substrate has to meet certain characteristics: to

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have a suitable structure to ensure gas exchange with the atmosphere, porosity, be permeable to water and air, be rich in nutrients and not contain phytopathogenic microorganisms (Greenwood, 2008). Recent concerns about substrates have prompted many researchers to investigate available alternatives. The use of organic waste and compost in pots substrates provides efficient and environmentally friendly solutions. The substrates are organic materials, used in many types of crops, because they provide the necessary nutrients for the plants and support the roots that assure the taking of these nutrients. An important property of these soil types must be that which provides a good water and nutrient capacity that is gradually released, significantly improving plant growth conditions. In horticultural practice, the term crop substrate means the material support in which plants develop their roots and which constitute the main source of food (Gedda, 2007). Burnett *et. al*. (2016) also showed that the use of complex organic materials as a substrate for vegetable plants has been established as a common horticultural practice. Many growers choose to prepare their own substrates for crops in pots and containers (Gache *et al.,* 2017). Substrates can be made up of different components, such as peat, coconut, perlite or vermiculite. In addition, many other components can be used in the preparation of substrates such as compost, manure, wheat straw (Treadwell *et al.,* 2011).

MATERIAL AND METHOD

The researche were carried out in an experimental field set up at the Didactic Center of the University of Agricultural Sciences and Veterinary Medicine Iasi. Two experiences, such as pots and containers, were organized. The culture vessels were of different sizes and were categorized as containers, those of 60 liters and 25 liters and pots of 5 liters and 2.5 liters. For the pots experience, the following vegetables were used: *Capsicum annuum* L. (Medusa cultivar), salad, *Lactuca sativa* L. - (cultivar Lollo bionda), parsley, *Petroselium crispum* (Mill.) - (Mohafodrozatu cultivar) *Ocimum basilicum* L. (cultivar Aristotle), dill *Anethum graveolens* L. (Common cultivar) and *Satureja hortensis* L. (Thymian cultivar). For the container experience the following vegetable species were established: tomatoes (cherry type) - *Lycopersicon esculentum* Mill. (Aristan Purple cultivar), *Capsicum annuum* L. (Brilliant cultivar), *Phaseolus vulgaris* L. convar. communis (Aurie Bacau cultivar), *Phaseolus vulgaris* convar bean. Nanus - (cultivar Unidor) the lioness - *Levisticum officinale* Koch (cultivar Communis), oregano - *Origanum vulgare* (Italian cultivar). The placement of species in design has been done so that field have ornamental value and low risk of disease and pest attack (Galea *et al.,* 2017; Galea *et al.,* 2018; Hamburdă *et al*., 2014; Hamburdă *et al.,* 2016; Kluckert, 2005; Teliban *et al.,* 2016).

Three types of substrate were used: S_1- substrate made from 35% garden soil, 35% compost, 20% peat, 10% pearl and pearlite, S_2- substrate made from 35% garden soil, 20% peat 35%, sand and perlite 10%. S_3 -standard commercial substrate. Preparing the substrates is an absolutely necessary link for the vegetable species when setting up crops in pots and containers. In order to achieve a successful culture in pots and containers, we used the following components in the preparation of the substrate: garden soil, compost, peat, sand and perlite. Two types of substrate were made (S_1 and S_2) with the same materials but different quantities. The S_1 substrate

contains: 35% garden soil, 35% compost, 20% peat, 10% sans l and pearlite, S_2-substrate made from 35% garden soil, 20% compost, 35%, sand and pearlite 10 %. S_3 -standard commercial substrate (fig. 2).

Preparation of the substrates was done manually, on a flat, well-cleaned surface. Components must have been sifted before use with a netstick small mesh, after which they were measured in volume units (buckets) and placed in alternate layers in a conical heap. Mixing was done by shaking the materials, starting at the base, thus building two smaller heaps. In the end, a bunch of things was restored the initial one from which no component, a very homogenized mass, could be chosen (fig. 1). A series of nutrient, pH, humidity and granulometry analyzes were performed for the three substrate types (S_1, S_2 and S_3). The analyzes were analyzed in the perspective of the Office for Pedological and Agrochemical Studies in Iasi. Substrate samples were taken in the laboratory and conditioned for analysis by drying in well-ventilated rooms or with heating systems up to a temperature of 40 °C, then increased or ground to a particle size less than 2 mm.

To determine the humus and microelements content, extra processing was done by removing root crop residues by fine milling. The determinations were made according to the standardized or officialized methods in our country. In determining the substrate reaction, respectively, the pH, was potentiometrically determined in aqueous suspension (10 g soil / 25 ml bidistilled water, with a combined glass electrode - calomel). Humidity was determined by heating at 105 °C. The content of the alkaline earth carbonates was determined by the method of the gazevotumetric method - the Scheibler method. Humus was determined by wet titration (Walkley-Black) method. Mobile phosphorus was determined by the Egner-Rielhm Domingo method and colorimetric molybdenum blue, Murphy-Rieley method (ascorbic acid reduction). Potassium (mobile) extracts by the Egnur-Rielmn Domingo method and flame photometry dosing. Organic matter was determined by the method of losing to calcination (Lăcătuşu, 2006).

RESULTS AND DISCUSSIONS

1. Results on the content of nutrients, pH, humidity and granulometry of analyzed samples (S_1, S_2 and S_3).

Table 1

Evaluation of substrates (S1, S2 and S3) on pH, humidity and nutrient content

No.	Samples analyzed	S1	S2	S3
1	**pH**	8.00	7.78	5.82
2	**Humidity (U%)**	7.52	7.60	10.4
3	**Clay (%)**	37.3	30.9	20
4	**Organic matter %**	25.0	25.8	65.8
5	**Humus %**	12.7	11.8	7.9
6	**C org. %**	7.29	7.12	4.3
7	**$CaCo_3$ %**	4.48	4.32	2.4
8	**P_{Al} %**	275.5	268.5	37.5
9	**K_{AL} ppm**	1225	1300	235

Analytical values obtained in the laboratory are interpreted in accordance with the limits of nutrient soil / substrate levels, based on experience with vegetable plants. Thus, the results obtained for the determination of the substrate reaction were: S_1 - pH = 8.00; S_2-pH = 7.78; S_3-pH = 5.82. The results obtained with the water content (u) of the substrates presented are: S_1 - u = 7.52%; S_2 - u = 7.60% and S_3 - u = 10.4%. The results of clay content: S_1 - clay = 37.3%; S_2 -clay = 30.9%; S_3-clay = 20%. The organic matter in the substrate is appreciated according to their texture, so the results obtained from the determinations were: S_1 - M.O. = 25.0%; S_2 - M.O. = 25.8%; S_3- M.O. = 65.8%. By determining the humus content, the productive potential of these substrates is highlighted as it contains most of the organic nitrogen in the substrate. The results obtained are: S_1 - humus = 12.7%; S_2 - humus = 11.8%; S_3- humus = 7,9. Results obtained in Corg determination: S_1-org. = 7.29%; S_2 -C. org. = 7.12%; S_3- Corg. = 4.3. $CaCO_3$ content obtained for S_1-$CaCO_3$ = 4.48%; S_2 - $CaCO_3$ = 4.32%; S_3-$CaCO_3$ = 2.4.

It is important to know the supply status of phosphorus and potassium assimilation substrates as they are among the essential elements of the production. The following results were obtained for the P_{AL} - S_1 - P_{AL} = 275.5 ppm; S_2 - P_{AL} = 268.5 ppm; S_3-P_{AL} = 37.5 ppm, and in the determination of K_{AL} the following results were obtained S_1 - K_{AL} = 1225 ppm; S_2 - K_{AL} = 1300 ppm; S_3-K_{AL} = 235 ppm. Substrate quality assessment was determined by nutrient rich content. The experimental results are shown in table 1.

Fig. 1 Land mixes (original photo)

Fig. 2 Standard commercially available substrate (S_3) (original photo)

2. Results on substrate influence (S_1, S_2 and S_3) on productivity

The research results obtained from the above study showed that the substrates used for potting and container culture were significantly influenced from a quantitative and qualitative point of view. The influence of these crop substrates has been highlighted in terms of productivity and harvest quality.

The substrate factor for both container experience and pots experience has led to differences in production. The variance analysis shows that production differences are due to the composition of the substrates. The experimental results are shown in table 2.

Table2

Substrate results (S1, S2 and S3) on productivity

Experience 1 CONTAINERS			Experience 2 POTS		
No.	**Substrate**	**Prod. total/pl obtained (g)**	**No.**	**Substrate**	**Prod. total/pl obtained (g)**
1	S_1	787.8	4	S_1	173.7
2	S_2	761.3	5	S_2	149.3
3	S_3	711.4	6	S_3	108.1
Average experience		**786,8**	**Average experience**		**143,7**

The most important substrate that particularly influenced productivity was substrate S_1, which had in its composition 35% garden soil; 35% compost (80% vegetable compost + 20% broth); 20% peat; sand + perlite 10%. At the opposite end there is the standard S_3 commercial mix consisting of loamy celery, peat and sand, in which case the smallest production was obtained.

CONCLUSIONS

1. The dynamics of plant growth and growth in pots and containers has been strongly influenced by the composition of nutrient substrates.
2. Substrate quality assessment was determined by nutrient rich content.
3. Vegetable crops grown in pots and containers on substrate S1 recorded the best yields compared to those grown on substrates S2 and S3.
4. Experimental production values have highlighted the importance of the composition of the substrates, the most important composition being compost.

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STUDIES OF SEEDS GERMINATION AS A TECHNICAL STAGE IN THE PRODUCTION OF MICROGREENS

STUDIUL GERMINAȚIEI SEMINȚELOR CA ETAPĂ TEHNICĂ ÎN PRODUCEREA LEGUMELOR DE TIP MICROGREENS

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Abstract*. The paper addresses research on the possibility of optimizing the production of "microgreens", by assessing the seed germination regime in radish (Raphanus sativus L. convar. sativus) depending on different temperatures: 15°C, 20°C and 25°C. The results show that there are no significant differences for this species for the three types of temperature studied.*
Keywords: microgreens, seeds, germination

Rezumat*. Lucrarea abordează cerecetări privind posibilitatea de optimizare a producției de "microgreens", prin evaluarea regimului de germinație a semințelor la ridiche (Raphanus sativus L. convar. sativus) în funcție de diferite temperaturi: 15ºC, 20ºC şi 25ºC. Rezultatele arată că pentru această specie nu sunt înregistrate diferențe semnificative pentru cele trei tipuri de temperaturi luate în studiu.*
Cuvinte cheie: microgreens, semințe, germinație

INTRODUCTION

Microgreens are a new category food products, of different to sprouts and *"baby"* plants, with a height of 3 to 10 cm, a short vegetation period, a novel appearance and high nutritional value (Franks and Richardson, 2009; Xiao, 2013; Di Gioia and Santamaria, 2015; Kyriacou *et al.,* 2016).

The germination testing of the seeds of *"microgreens"* represents a decisive step for the optimization of their culture (Gupta, 2015; Marcos-Filho, 2015). In this type of crop, with a very short vegetation period, the temperature at which the seeds germinate makes it possible to obtain a crop that ensures an efficient harvest.

The purpose of the paper is the study of indices and seed germination of radish, towards creating a culture of *microgreens.*

MATERIAL AND METHOD

The researches were carried out in the Laboratory of Vegetable Science, within USAMV Iaşi, using the SANYO MLR-35 1H germinator. Experience has been achieved with biological material consisting of seeds at Rapanus Red *Ridicus sativus*

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cousin *radicula*, moon radish. The seeds used are produced by Agrosel, they are not chemically treated, calibrated, and of high physiological purity. With regard to the seed germination study, we used as many as 150 seeds for each study temperature (15°C, 20°C and 25°C). For the temperature of 25°C, humidity was 75%, and the light of an intensity of 1500 lux in the time slot 22:00 and 6:00, while for temperatures of 15°C and 20°C the humidity had a value of 80% between 06:00 and 22:00. Three rehearsals were used, using Petri dishes and filter paper, watering daily using a distilled water sprayer.

Throughout the experiment, daily waterings were made, observations were made regarding the germination of the seeds, and data was collected to evaluate the germination dynamics. Once the embryo breaks the skin of the seed, determinations and observations are made on the dynamics of daily germination, until three days in a row the values were the same, resulting in the total percentage of seed germinated each day for each variation (Gupta, 2015; Daxing *et al.,* 2018).

RESULTS AND DISCUSSIONS

1. Results on the dynamics of germination of radish seeds for temperature of 15°C

We see from table 1 that radish seeds on the third day of the observations on August 6 amounted to 96% of the germination dynamics, maintaining the same in the next two days of observations. In terms of germination rate, radish seeds had the highest value, namely 47% on 5 August and the lowest value (15%) we find it on the first day of the observations, namely on 4 August.

Table 1

Results on the dynamics of germination of radish seeds for temperature of 15°C

Temperature	Days	The germination dynamics		Rate of germination		Velocity of germination (%)	Coefficient of germination velocity (%)
		No.	%	No.	%		
15°C	4.08	29	19	-	-	15	10
	5.08	140	93	111	74	47	32
	6.08	144	96	4	3	36	25
	7.08	144	96	0	0	29	20
	8.08	144	96	0	0	24	17
	9.08	-	-	0	0	-	-

2. Results on the dynamics of germination of radish seeds for the temperature of 20°C

Table 2 shows that radish seeds have a germination dynamics value of 146 on day 4 of the observation - July 27, and the germination rate reaches a 30% on the second day of observations, going down to 14% on 29 July.

Table 2

Results on the dynamics of germination of radish seeds for temperature of 20°C

Temperature	Days	The germination dynamics		Rate of germination		Velocity of germination (%)	Coefficient of germination velocity (%)
		No.	%	No.	%		
20°C	24.07	66	44	-	-	33	23
	25.07	130	86	64	42	43	30
	26.07	145	96	15	10	36	25
	27.07	146	97	1	1	29	20
	28.07	146	97	0	0	24	17
	29.07	146	97	0	0	21	14
	30.07	-	-	-	-	-	-

3. Results on germination of seeds of radish growth temperature of 25°C

The results in table 3 show a radish seed germination with the highest value on September 14, ie 97% germinated seeds, the velocity of germination rate reaches a maximum of 44% on September 13, and the smallest value of germination being recorded on the first day of the observation, namely 4%.

Table 3

Results on the dynamics of germination of radish seeds for temperature of 25°C

Temperature	Days	The germination dynamics		Rate of germination		Velocity of germination (%)	Coefficient of germination velocity (%)
		No.	%	No.	%		
25°C	12.09	6	4	-	-	3	2
	13.09	132	88	126	84	44	30
	14.09	145	97	13	9	36	25
	15.09	145	97	0	0	29	20
	16.09	145	97	0	0	24	17
	17.09	-	-	-	-	-	-

As we can see from figure 1 and figure 2, the radish seeds germinate very well in all three types of temperatures studied, indicating that it is a species suitable for microgreens culture for several growth environments.

Fig. 1 Germination of radish seeds (original photos)

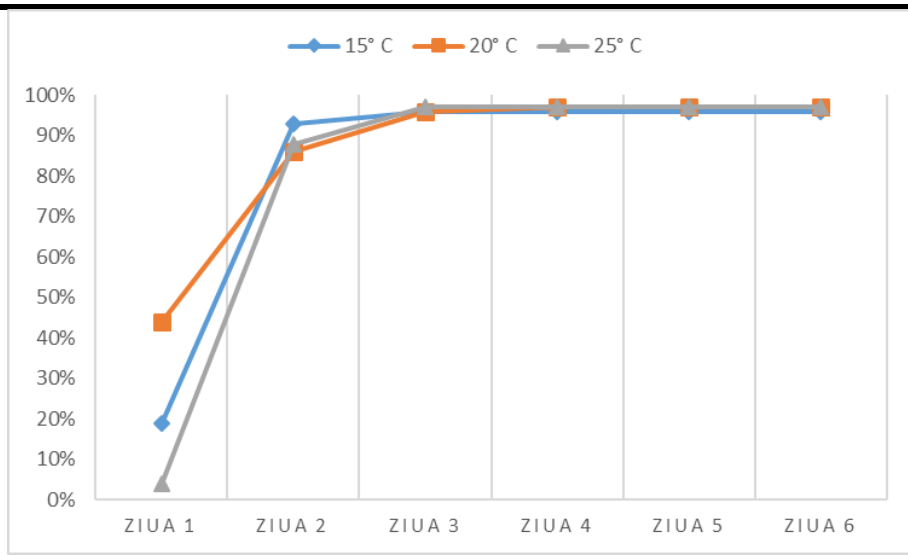

Fig. 2 Dynamics of germination in radish seeds

CONCLUSIONS

1. Temperature is a very important link in the process of gemination of radish seeds grown in microcreens.

2. Red radish seeds germinate well at 15°C, 20°C and 25°C, providing multiple possibilities for use in *microgreens* production.

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STAGE OF KNOWLEDGE ON CULTIVATION OF MICROGREENS PLANTS

STADIUL CUNOAŞTERII ASUPRA CULTIVĂRII PLANTELOR LEGUMICOLE MICROGREENS

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Abstract. *Microgreens are a form of young plants produced from vegetables, aromatic plants and other species harvested between 7 and 25 days. They range in size, from 3 to 10 cm, are more developed than germs and smaller than the "petit" and "baby" plants. Vegetable plants of the microgreens type can be considered a visual plus but also nutritional for any dish. The main advantage of this type of culture is the vegetation period, which is very short. This paper presents several important aspects of microgreens plant production technology and its success.*
Keywords: microgreens, culture, species.

Rezumat. *Microgreens reprezintă, o formă de plante tinere, produse din legume, plante aromatice şi alte specii, recoltate între 7 şi 25 de zile. Acestea variază în mărime, de la 3 la 10 cm, sunt mai dezvoltate decât germenii şi mai mici decât plantele "petit" şi "baby". Plantele legumicole de tip microgreens pot fi considerate un plus vizual, dar şi nutriţional pentru orice farfurie. Principalul avantaj al acestui tip de cultură este perioada de vegetaţie, care este foarte scurtă. Lucrarea de faţă prezintă câteva aspecte importante ce vizează tehnologia de producere a plantelor de tip microgreens şi reuşita acesteia.*
Cuvinte cheie: microgreens, cultura, specie.

INTRODUCTION

The history of microgreens is relatively recent, the first occurrence being reported in America in 1980 in San Francisco, the concept being thought of by some chefs who have decided to give a bit of color and diversity to the dishes of food. Large-scale production began in California in 1990, with a wide variety of species (broccoli, cabbage, red beet, basil) (Di Gioia and Santamaria, 2015).

This growing stage of cotyledonous seedlings is found in the case of any species that grow generatively (by seeds), the latest studies performed demonstrating the beneficial properties of plants at this age, some species containing large amounts of antioxidants, anti-inflammatory substances, with a

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very high potential in the prevention, protection and therapy of a high number of diseases (Xiao, 2013).

Recent studies in several US universities have shown that plants at this stage of growth can be up to 40 times more concentrated in beneficial nutrients, vitamins and minerals. Unlike germs, microgreens plants accumulate nutrients from three parts: from the peat-based organic substrate, the photosynthetic solar light from the plant and the seed reserve (Eric and Jasmine, 2009; Xiao, 2013; https://extension.msstate.edu/sites/default/files/publications/publications/p2884.pdf).

MATERIAL AND METHOD

In this paper the studies were conducted using existing information in the literature and the method used was the comparison information used in development work.

RESULTS AND DISCUSSIONS

Results on species selection

In terms of gastronomy and nutrition, something that makes culture microgreens to be interesting is the possibility of using species and varieties whose leaves are characterized by - a wide range of shapes, colors (green, purple, red, yellow), crisps (succulent) and taste (sweet, sour, spicy) (Di Gioia and Santamaria, 2015). The vegetable species most commonly used to produce microgreens belong to several botanical families (fig. 1), including:

- Fam. *Brassicaceae* (cauliflower, broccoli, cabbage, Chinese cabbage, radish)
- Fam. *Asteraceae* (salad, andive, chicory)
- Fam. *Apiaceae* (dill, carrot, fennel, celery)
- Fam. *Amarillydaceae* (usute, onion, leeks)
- Fam. *Amaranthaceae* (amaranth, beet, spinach)
- Fam *Cucurbitaceae* (melon, cucumber)
- Fam. *Leguminiaceae* (chickpeas, beans, lentils, peas)

including aromatic plants such as basil, cumin, coriander, lemon, parsley etc. (https://www.greenharvest.com.au/DownLoads/SproutingBooklet.pdf; https://extension.msstate.edu/sites/default/files/publications/publications/p2884.pdf; Di Gioia and Santamaria, 2015; Kyriacou *et al.,* 2016).

It is very important to pay special attention to the choice of species that can be used to produce microgreens by assessing their edibleness in the seedling stage. For example, species belonging to *Solanaceae*, such as tomatoes, eggplants, in the seedling stage cannot be edible due to the content in this phase of growth of some anti-nutrients; the selection of species for microgreens must be related in particular to the character in the seedling phase.

Fig. 1 Vegetable plants of the microgreens type
(photo source: https://economictimes.indiatimes.com/magazines/panache/serving-nature-on-a-plate-farm-to-fork-gets-a-twist-with-microgreens/articleshow/60956251.cms)

Results on the selection of production areas

The production of vegetable plants in the microgreens system is usually carried out in a controlled environment, in greenhouses or in high tunnels, with simple or advanced technologies, depending on the size of the farm and the climate conditions at its disposal (http://www.ecoffshoots.org/wp-content/uploads/2010/03/Guidelines-for-Growing-Microgreens-ECO-City-Farms.pdf).

Results on harvesting and preparation of culture vessels

Due to the short amount of time that microgreens vegetables spend in the used container, it can be any trays, a plastic vessel of different sizes. The most commonly used are the standard 20 x 10 cm plastic trays with drainage holes, and in some situations trays with water collection support can also be used (fig. 2,3,4).

These trays, which are actually those containers used for flower and vegetable seedlings, can be reused, but not prior to their preparation, by applying a disinfecting solution and a flushing with lukewarm water and then applying a drier (ttps://www.greenharvest.com.au/DownLoads/SproutingBooklet.pdf).

2 3 4

Fig. 2, 3, 4 Culture vessels for microgreens
(photo source: http://www.veganicchoice.com/http://www.seminte-ingrasaminte-turba.ro/produse/Categories-List/6672-Tavite-pentru-rasaduri)

Conclusions on leaching and preparation of the culture substrate

In order to ensure a good germination and optimal growth of seedlings, a good growth medium should have the following properties: a porosity of over 85% of the total volume, a suitable ratio between maco and micro pores to ensure good water exploitation (55-70% of total volume) and a good level of aeration (20-30% of total volume) of the root system (fig. 5, 6).

Culture media can be classified into organic and inorganic, in the first case they are made from biodegradable materials such as peat, while inorganic ones, such as perlite, are usually inert. The most commonly used culture substrates for the production of microgreens at commercial level are peat, perlite and vermiculite, which can be used individually or mixed.

Another alternative for peat is coconut shell, which has the advantage of obtaining it from a renewable source, and when we choose to use it, it is important to consider, due to the particle size, that the substrate properties can remarkable change.

Among the substrates specially developed for the production of microgreens are also mats made of natural materials (coconut fiber, jute fibers, cotton fibers, algae and paper pastes) or synthetic (polyethylene-PET products). Typically, these commercial mats are defined by standardized physical, chemical and agronomic properties and have a good balance between water-holding capacity, good aeration and good hygienic-sanitary quality (Di Gioia and Santamaria, 2015).

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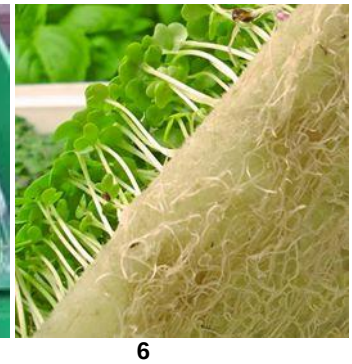

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Fig. 5, 6 Culture media for microgreens
(photo source: https://gardenculturemagazine.com/garden-inputs/growth-media/compostable-hydroponic-media/)

Results on regulating growth and development

Beginning with seed germination, temperature management will be based on species requirements (Ipătioaie *et al.,* 2016; Voicu *et al.,* 2017). Thus, after seed germination has taken place, the temperature will be lowered by 5-7°C for 4-7 days, saving seed resources, uniformizing plant growth and inducing phases of plant growth.

The greenhouse temperature will be closely related to the intensity of the solar radiation. This is necessary because solar radiation represents a contribution of thermal energy in the protected space, through the greenhouse effect, but also influences the intensity of the physiological processes such as: photosynthesis, breathing, sweating. For most microgreens, the optimal development temperature is between 18-28˚C. Relatively low humidity (20-30% ambient) causes microgreens to become soft at the touch, compared with plants that are relatively clean and fresh in relative humidity (50%).

Light conditions greatly influence microgreens morpho-physiology, biosynthesis and accumulation of phytochemicals, especially in controlled growth environments. Additional light sources commonly used in vegetable production include halogen lamps, fluorescent lamps with incandescence (HPS) (Bian *et al.,* 2015; http://www.ecoffshoots.org/wp-content/uploads/2010/03/Guidelines-for-Growing-Microgreens-ECO-City-Farms.pdf).

Results on irrigation and fertilization

During germination, the seeds are usually watered using a mist over the cover covering the substrate, but after germination, submerged systems are preferred, allowing the young seedlings to be irrigated, avoiding excess humidity and limiting the appearance of microbes. Although microgreens plants are small seedlings, fertilization is fundamental, in order to obtain good production, nutrients can be applied before sowing, by incorporation into the culture medium, or fertilization after the germination process (Stan and Munteanu, 2001; Stan *et al.,* 2003).

CONCLUSIONS

1. In recent years, people have a real interest in eating fresh vegetables with a high nutritional intake, so microgreens fits perfectly into this trend. Microgreens are a new range of vegetable products that contain a variety of tastes, colors, textures and unique look.

2. The choice of the culture substrate and the careful management of environmental factors are key links in the implementation of microgreens-type plant technology.

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STUDY REGARDING THE INFLUENCE OF VARIOUS TYPES OF MULCHING ON THE AGRO-PRODUCTIVE CAPACITY OF FOUR DIFFERENT BASIL CULTIVARS

STUDIU PRIVIND INFLUENȚA DIFERITELOR VARIANTE DE MULCIRE ASUPRA CAPACITĂȚII AGROPRODUCTIVE A PATRU CULTIVARE DIFERITE DE BUSUIOC

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Abstract. *The goal of this paper is to evaluate the effect of mulching on the yield of four basil cultivars, cultivated according to the ecological agricultural rules: Aromat de Buzau – green basil, Serafim – violet basil, Macedon – lemon-flavoured basil and a clove-flavoured basil local population. The experiment was carried out during 2018, in the experimental field of Vegetable Growing Discipline of U.S.A.M.V. Iasi. The crop was established via seedlings, at distances of 50 x 20 cm, resulting a density of 100 000 plants/ha. The obtained results showed that the factors cultivar and mulching application had a significant relevance on yield. Cultivars determined significant yield differences and mulching application determined an important increase of the yield (16.8%).*

Key words: *Ocimum basilicum* L., cultivar, mulch, yield

Rezumat. *Scopul acestei lucrări este de a evalua efectul mulcirii asupra producției a patru cultivare de busuioc cultivate după normele agriculturii ecologice: Aromat de Buzău-busuioc de culoare verde, Serafim-busuioc de culoare violet, Macedon-busuioc cu aromă de lămâie şi un cultivar cu aromă de cuişoare. Amplasarea experienței a fost efectuată în câmpul experimental al disciplinei de Legumicultură, din cadrul U.S.A.M.V. Iaşi, în anul 2018. Cultura a fost înființată prin răsad, la distanțe de 50 x 20 cm, rezultând o densitate de 100 000 plante / ha. Rezultatele obținute arată că factorii cultivar şi mulcire au avut relevanță semnificativă asupra producției. Cultivarul a determinat diferențe semnificative asupra producției, iar aplicarea mulcirii a determinat creşteri importante ale producției (16,8%).*

Cuvinte cheie: *Ocimum basilicum* L., cultivar, mulcire, producție

INTRODUCTION

The aromatic and spice plants represent a group of vegetable growing plants more and more cultivated, especially in the ecological agriculture. Basil

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(*Ocimum basilicum* L.) is one of the plants included in this group and its organic cultivation is justified mainly by the consumer's expectations (Stoleru *et al*., 2014; Onofrei *et al*., 2015; Burducea *et al*., 2016). The cultivars of this species are very different from the point of view of colour, leaf shape, height of the plant, achieved yield, aromatic compounds, antioxidant activity, content in volatile oil etc., this diversity confers multiple usages of this plant (Darrah, 1974). Basil is used in the preparation of various types of food, including the pesto sauce and the soft drinks (Putievsky and Galambosi, 1999). Due to its bioactive principles, especially, its volatile oils, and phenolic compounds, the basil is cultivated also as a medicinal plant (Lee and Scagel, 2009; Onofrei *et al*., 2017; Burducea *et al*. 2018). Ornamental value and nice smell recommend itself to be used in various folk rituals (Paton *et al*., 1999). Moreover, it is used as an accompanying plant in the ecological agriculture, preventing the attack of some pathogens (Galea *et al*., 2015; Teliban *et al*., 2016; Hamburdă *et al*., 2016).

To cultivate the basil is relatively simple: crop establishment is done by the direct sowing in the field or by seedlings; it requires little maintenance works and does not have many pathogens and pets. Some problems could be appeared because of weeds, especially in ecological agricultural, according to european rules (EU Reg. 834/2007). An effective method for weed control could be by mulching application (Stan, 2010).

Considering the above mentioned data, the goal of this study was to assess the effect of mulching application on the yield of certain different basil cultivars, cultivated according to the ecological agricultural rules.

MATERIAL AND METHOD

The research was organised in 2018 on the didactic and experimental field allocated to the Discipline of Vegetable Growing of U.S.A.M.V. Iasi. The activity was carried out on a cambic chernozem soil, averagely leached and supplied with nutritious elements, with 3% organic matter and pH = 6.5. The meteorological data recorded during vegetation period were favourably average for basil crop (tab. 1).

Table 1

The weather conditions in the vegetation period for the basil crop in 2018

Month	Decada	Average temperature (^{o}C)	Relative humidity (%)	Rainfall (mm)
May	I	19.7	62.0	5.1
	II	16.4	68.3	11.2
	III	20.2	54.3	0.0
June	I	22.2	58.5	6.6
	II	22.4	77.8	104.2
	III	19.1	77.5	92.0
July	I	20.4	72.4	11.4
	II	22.3	75.1	17.1
	III	22.7	84.3	138.9
August	I	23.5	69.6	12.0

The experimental protocol foresaw the organisation of a bifactorial experience consisting in a split plot design with three replicates the two experimental factors were:

- factor A – assortment with four grades: a1 = Aromat de Buzau (green basil); a2 = Serafim (violet basil); a3 = Macedon (lemon-flavoured basil) and a4 = clove-flavoured basil.
- factor B –mulching application with two grades: b1 = non-mulched and b2 = mulched with a standard black light density polyethylene film, 15 µm thick (LDPE 15 µm).

The sowing date for seedlings producing was done on 16.04.2018 in alveolar trays, with 2.5 x 2.5 x 5.0 cm dimensions of alveole. The planting date was on 21.05.2018, using 35 days seedling. The planting distances were of 50 cm between the rows and 20 cm between the plants in the row, resulting a density of 100 000 plants/ha.

During the vegetation period the works recommended by the scientific literature (Stan *et al*., 2003; Stoleru *et al*., 2014) were carried out. Two works were applied for combating the weeds, hoeing and weeding, in the case of the non-mulched variant, namely two weeding works, in the case of the mulched variant. The irrigation was carried out by dripping with the role of replacing the precipitations when these were insufficient, thus maintaining a constant growth of the crop (fig. 1).

During the entire vegetation period of the plants, no protection treatment against pathogenic or harming agents was carried out; moreover, no herbicides were applied, weed control being carried out manually.

The harvesting was carried out by cutting the plants 5 cm above the ground, during the mass plant blooming. It was complied with the plants vegetation period: Aromat de Buzau was the first cultivar harvested (03-04.08.2018), followed by the lemon-flavoured basil (06-07.08), the clove-flavoured basil (08-09.08) and finalising with the Serafim cultivar (10-11.08).

In order to analysed the significance of the yield the experimental data were processed via statistical and mathematical adequate methods (Săulescu and Săulescu, 1967; Jităreanu, 1999).

Fig. 1 – Aspects of the basil experience

RESULTS AND DISCUSSIONS

The yield results for the basil cultivars included in the study (tab. 2) vary from 14676.7 kg/ha, in the case of the Serafim cultivar, to 34050.0 kg/ha, in the

case of the lemon-flavoured basil, with very significant differences compared to the experimental average (24138.8 kg/ha), namely, negative differences of 9462.1 kg/ha in the case of the Serafim cultivar and positive differences of 9911.2 kg/ha in the case of the lemon-flavoured basil.

The Aromat de Buzau cultivar registered an average production of 22740.0 kg/ha, and the clove-flavoured basil a yield of 25088.3 kg/ha with insignificant negative differences, namely positive compared to the experimental average.

The production differences between the basil varieties included in the study are highly significant (80.26 % between the minimum and maximum yield value), meaning that the selection of the cultivars determines greatly the value of the production, in this case, the differences being justified by the basil cultivar.

Table 2

Comparative yield analysis according to the cultivar

Nr. crt.	Cultivar	Yield			
		kg/ha	% compared to the average	Diference compared to the average	Difference significance
1.	Aromat de Buzău	22740.0	94.21	-1398.8	-
2.	Serafim	14676.7	60.80	-9462.1	000
3.	Macedon	34050.0	141.06	9911.2	xxx
4.	Clove-flavoured basil	25088.3	103.93	949.5	-
5.	Average	24138.8	100.00	0.0	C

DL 5% = 2401.4 kg/ha; DL 1% = 3636.4 kg/ha; DL 0.1% = 5841.7 kg/ha

The yield results achieved following the mulching variants are presented in table 3.

Table 3

Yield comparative analysis according to the cultivars

Nr. crt.	Mulch type	Yield			
		kg/ha	% compared to the average	Diference compared to the average	Difference significance
1.	Non-mulched	22111.8	91.60	-2027.0	-
2.	LDPE 15 µm	26165.8	108.40	2027.0	-
3.	Average	24138.8	100.00	0.0	C

DL 5% = 677.6 kg/ha; DL 1% = 985.5 kg/ha; DL 0.1% = 1478.3 kg/ha

From the data presented it is can be noticed that the non-mulched variants resulted in a smaller yield values (22111.8 kg/ha), compared to the mulched variants with 15 µm polyethylene foil (26165.8 kg/ha), yet the differences obtained compared to the experimental average are insignificant.

The interaction of the two studied factors, variety x mulching (tab. 4) generated results varying from 13520.0 kg/ha, Serafim x non-mulched and 36800.0 kg/ha, in the case of the lemon-flavoured basil x 15 µm LDPE combination.

Very significant positive differences compared to the experimental average was registered by the lemon-flavoured basil, regardless of the mulching variants,

proving the yield potential of this cultivar. Moreover, positive differences, but distinctly significant, were also recorded by the clove-flavoured basil mulched with 15 µm LDPE.

At the opposite pole, with very significant negative differences, compared to the experimental average, it is found the red-Serafim basil, with the highest differences compared to the experimental average (43.99% in the case of the non-mulched variant and 34.41% - LDPE 15 µm) and the Aromat de Buzau non-mulched variant (15.38 %).

Table 4

Comparative results among the cultivars x mulching combination (A x B)

Nr. crt.	A x B	Yield			
		kg/ha	% compared to the average	Diference compared to the average	Difference significance
1.	Aromat de Buzău x non-mulched	20426.7	84.62	-3712.1	000
2.	Aromat de Buzău x LDPE 15 µm	25053.3	103.79	914.5	-
3.	Serafim x non-mulched	13520.0	56.01	-10618.8	000
4.	Serafim x LDPE 15 µm	15833.3	65.59	-8305.5	000
5.	Macedon x non-mulched	31300.0	129.67	7161.2	xxx
6.	Macedon x LDPE 15 µm	36800.0	152.45	12661.2	xxx
7.	Clove-flavoured basil x non-mulched	23200.0	96.11	-938.8	-
8.	Clove-flavoured basil x LDPE 15 µm	26976.7	111.76	2837.9	xx
9.	Average	24138.8	100.00	0.0	C

DL 5% = 1515.1 kg/ha; DL 1% = 2203.7 kg/ha; DL 0.1% = 3305.6 kg/ha

The other two variants registered non-significant differences compared to the experiment average, Aromat de Buzau x LDPE 15 µm, registering a positive difference of 914,5 kg/ha, while the clove-flavoured basil x non-mulched registered a negative difference of 938,8 kg/ha compared to the experience average.

As it can be observed in the above table, all the basil cultivars reacted well to mulching, achieving yield increases compared to the non-mulched variants. Thus, the mulching of basil crop can be recommended as an important technological link, if considering both the achieved yield increase, and the elimination of weed combating works and obtaining a superior quality production (herba lacking soil impurities on the leaves and weed impurities).

CONCLUSIONS

1. The yields for the *Ocimum basilicum* L. species vary a lot according to the type of cultivated basil, the largest yield being achieved by the lemon-flavoured basil, and the smallest by the violet basil.

2. Mulching the basil crop influences positively the yields achieved, all the basil cultivars in the study achieving larger yields in the case of the mulched variants compared to the non-mulched variants.

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RESEARCHES CONCERNING THE BEHAVIOUR OF CHERRY VARIETIES WITH DIFFERENT RIPPENING PERIODS IN THE CONDITIONS OF THE NORTHEAST OF ROMANIA

CERCETĂRI PRIVIND COMPORTAREA UNOR SOIURI DE CIREŞ CU DIFERITE EPOCI DE COACERE ÎN CONDIŢIILE ZONEI DE NE A ROMÂNIEI

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Abstract: *The aim of this study is to improve the sweet cherry tree assortment for the Northeast area of Romania by promoting the new cultivars created at RSFG Iasi, renewing the current sweet cherry tree assortment with new quality cultivars and especially extending the sweet cherry season, filling the existing gaps during the consumption period. At this time, the market is unbalanced in favor of cultivars in the first part of the fruit season. The tendency is towards rebalancing, by reducing the proportion of cultivars with medium season maturity and increasing the early and the late ones. In terms of productivity, the three-year average production (2016-2018) cultivars as followes Golia (19.7 kg / tree), Margonia (23.3 kg / tree) and Bucium (24.7 kg / tree) was remarkable. Regarding the average weight of the fruit, it recorded values between 4.8 g (Cetatuia) and 7.6 g (Bucium).*

Key words: cherry tree , cultivar, early, late, fruit

Rezumat: *Scopul acestui studiu vizează îmbunătăţirea sortimentului de cireş pentru zona de NE a României prin promovarea soiurilor noi create la SCDP Iaşi, reînnoirea actualului sortiment de cireş cu noi soiuri de calitate şi îndeosebi, prelungirea sezonului de cireşe, completarea golurilor existente în perioada de consum. În acest moment, piaţa este dezechilibrată în favoarea soiurilor din prima parte a sezonului de maturare a fructelor. Tendinţa este spre reechilibrare, prin reducerea ponderii soiurilor cu epocă mijlocie de maturare şi a sporirii celor extratimpurii şi târzii. Sub aspectul productivităţii s-au remarcat prin producţiile medii pe trei ani (2016-2018) soiurile Golia (19,7 kg/pom), Margonia (23,3 kg/pom) şi Bucium (24,7 kg/pom). Referitor la greutatea medie a fructului, aceasta a înregistrat valori cuprinse între 4,8 g (Cetăţuia) şi 7,6 g (Bucium).*

Cuvinte cheie: cireş, soiuri, timpurii, târzii, fruct

INTRODUCTION

The soil and climate conditions in Iaşi County are particularly favorable for the sweet cherry growing, here originating varieties like Crăieşti de mai, Crăieşti

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Moldoveneşti, Boambe de Cotnari, Crăieşti de Comarna. Due to the attributes of having an earlier ripning age in comparison to other fruit tree species (since May), cherry tree is the first link in the annual fruit production chain (Budan and Gradinariu, 2000; Grădinariu and Istrate, 2004; Petre, 2006; Iurea *et al*., 2016).

The purpose of this study is to improve the sweet cherry assortment for the Northeastern area of Romania by promoting the new varieties created at RSFG Iasi, renewing the current cherry assortment with new quality varieties, esspecially extending the cherry season, filling existing gaps during the consumption period, specifying the areas where the varieties give the best results.

MATERIAL AND METHOD

The studies were carried out between 2016 and 2018, having as research material six cherry varieties created at RSFG Iasi, approved in the years 1999 – 2015 (Cetățuia, Cătălina, Bucium, Golia, Margonia–and George). Of the six genotypes studied, two are maturation early (Catalina, Cetățuia), two with medium maturation (Bucium, Golia) and two with late maturation (Margonia, George). The comparison of varieties was made with the Boambe de Cotnari zonal control cultivar. The trees were grafted on the mahaleb.

The comparative competition culture was placed in three rehearsals of 3 trees at a distance of 5 x 4 m and guided as a free flattened palmette without a support system.

On the row of trees, the soil was plowed with the side disc with the touch probe, between the rows of trees the soil is rooted. Fighting diseases and pests was done as a response to warnings received, therefore, phytosanitary treatments were done.

Observations and determinations were made regarding the vigor of trees, the main fructification phenophases (Fleckinger., 1960), the behavior of the cherry-specific diseases (Cociu and Oprea, 1989), the fruit production and the main physical and chemical characteristics of the fruit according to the questionnaire UPOV).

The experimental data were statistically interpreted by variation analysis and the coefficient of variation (s%) for which the following values are arbitrarily admitted:

- 0 - 10% - low variation coefficient;
- 10 - 20% - average variation coefficient;
- 20 - 30% - high variance coefficient.

RESULTS AND DISCUSSIONS

The vigor of the trees in the cherry varieties studied is medium, just like the control variety with the exception of the Golia low variety (tab. 1). The period of blooming took place between April 1st and 23rd, so in the Cetățuia and Cătălina varieties the blooming was early and the varieties George and Margonia showed a late blooming process (tab. 1). In 2016, blooming took place earlier than in 2017 and 2018 with 3-10 days.

The harvest maturity was recorded in the third decade of May (Cetățuia and Cătălina), the first decade of June (Bucium, Golia) the end of the third decade of June (Margonia) - the first half of July (George) , and the number of days at the

end of the blossom at maturation ranged from 34-86 days, showing a large variation coefficient (28.9 - 27.7%) (tab. 1).

Table 1

The vigor of trees and the main stages of fructification in cherry varieties

Variety phenophase	Tree vigor	Beginningof blooming (fase E)	End of blooming (fase G)	Date of fruit maturation	No. of days from blooming to maturation
Deadlines in 2016-2018 (earliest-at the latest)					
Cetățuia	average	01 - 09.04	08 - 17.04	11 - 22.05	34 - 36
Cătălina	average	02 - 10.04	10 -19.04	17 - 27.05	38 - 39
Bucium	average	06 – 13.04	14 – 20.04	07 – 08.06	50 - 55
Golia	low	05 - 10.04	14 - 19.04	06 - 10.06	53 - 54
Margonia	average	09 - 15.04	15 - 23.04	20 - 24.06	63 - 67
George	average	04 - 14.04	14 -21.04	07 - 15.07	85 - 86
Boambe de Cotnari (control)	average	04 - 10.04	12 - 19.04	06 – 16.06	56 - 59
Variation coefficient (%)	x	55.1-19.0	19.2-8.9	47.3 -30.1	28.9-27.7

With regard to disease resistance, the years 2016 and 2018 being rainy years (with a surplus of 173 mm in 2016 and 73.5 mm in 2018 by 31 July), favorable years for the evolution of pathogens (moniliose and anthracnose) they showed a slight sensitivity to both anthracnose (the frequency of the attack was between 2.0-3.8%) and to moniliosis (the frequency of the attack was between 2.1-3.3%) (tab. 2).

Table 2

Resistance of the five varieties to the limiting factors of production (2016-2018)

Variety	Resistance to leaf Anthracnose* (*Coccomyces hiemalis* Higg.)			Resistance to fruit Moniliosis* *(Monilinia fructigena)*		
	F%	I%*	G.A.%	F%	I%*	G.A.%
Cetățuia	2.0	3	0.060	2.9	8	0.232
Cătălina	2.1	3	0.063	2.8	5	0.140
Bucium	2.3	2	0.046	3.3	5	0.165
Golia	2.5	2	0.050	2.2	4	0.088
Margonia	2.4	1	0.024	2.9	8	0.232
George	3.8	1	0.038	2.1	5	0.105
Boambe de Cotnari (control)	2.6	3	0.078	2.5	8	0.200

*note the intensity of attack on the scale 1-6: 1 = 1-3% the surface attacked 2=4-10%; 3=11-25%; 4=26-50%; 5=51-75%; 6=76-100% (Cociu and Oprea, 1989).

From the group of early varieties, representative of Cetățuia and Cătălina, we notice the higher production at Cetățuia (16.7 kg/tree) compared to Cătălina (9.3 kg/tree) (tab. 3).

The group of medium-maturate varieties is evidenced by the fruit production of the Bucium variety (24.7 kg/tree) compared to that of the Golia

variety (19.7 kg / tree) and in the late maturating varieties the highest yield of fruit registered in the Margonia variety (23.3 kg/tree). From a statistical point of view, it is noted that there were insignificant production differences compared to the Boambe de Cotnari (15.7 kg /tree) (tab. 3).

Regarding the average weight of the fruit, it recorded values between 4.8 g (Cetatuia) and 7.6 g (Bucium). From a statistical point of view, the differences are insignificant compared to the control (tab. 3).

As for the kernel size, the varieties recorded a weight of 0.27-0.35 g, being small to medium in size according to the UPOV questionnaire.

The percentage of fruit kernel weight recorded between 4.04% (Golia) and 5.76% (George). From a statistical point of view, the differences are insignificant compared to the control (tab. 3).

Table 3

Fruit production and physical properties of cherry varieties (2016-2018)

Variety	Average production of fruits (kg/tree)	Average fruit weight (g)	Average weight of the kernel (g)	Kernel of fruit weight (%)
Cetățuia	16.7	4.8	0.27	5.56
Cătălina	9.3	7.5	0.33	4.36
Bucium	24.7	7.6	0.33	4.29
Golia	19.7	7.3	0.30	4.04
Margonia	23.3	7.0	0.35	4.98
George	15.7	5.8	0.33	5.76
Boambe de Cotnari (control)	17.7	7.6	0.37	4.86
LSD 5%	14.2	4.6	0.18	3.92
LSD 1%	20.2	6.6	0.25	5.57
LSD 01%	29.2	9.5	0.37	8.07

As far as the color of the fruit is concerned, red has been dominant with shades of bright red (Bucium) to dark red (Cetățuia, Cătălina, Golia, George). Only Margonia variety has the color of the yellow fruit epidermis (tab. 4) (fig. 1).

Table 4

Physical and chemical properties of fruits (2016-2018)

Variety	The color of the epidermis	Firmness of the pulp	Form of the fruit	SDM (%)	Grip of the kernel to the pulp
Cetățuia	dark red	semifirm	reniform	14.5	Semi-adherent
Cătălina	dark red	semifirm	cordiform	19.3	Non-adherence
Bucium	bright red	firm	cordiform	19.4	Non-adherence
Golia	dark red	firm	cordiform	17.3	Non-adherence
Margonia	yellow	firm	cordiform	16.9	Non-adherence
George	dark red	firm	cordiform	16.0	Non-adherence
Boambe de Cotnari (control)	bicolour	firm	cordiform	18.9	Non-adherence

Firmness of the pulp is an important quality element, especially for fruit intended for fresh consumption. In our case, early varieties (Cătălina, Cetățuia) have the semifirm pulp, and the other varieties have firm pulp.

The soluble dry matter content was between 14.5% (Cetatuia) and 19.4% (Bucium) (tab. 4)

Regarding the destination, fruits of early varieties are destined for fresh consumption (Cetățuia and Cătălina), and the medium and late maturing varieties are destined for both fresh consumption and processing (Bucium, Golia, Margonia, George).

Fig. 1 The cherry varieties studied

CONCLUSIONS

1. The varieties studied were marked by early ripening stage (Cetățuia, Cătălina), tardivity (Margonia, George) and special fruit quality, all showing precocity and good resistance to cherry-specific diseases (anthracnose and moniliose).

2. Early ripening cherry varieties (Cetățuia, Cătălina) and late (Margonia and George) fruits provide an extension of the fresh fruit season and processing for 9-12 days.

3. The studied varieties ensure the fresh fruit consumption for 55-58 days, with special taste qualities offered by the unique microclimate found in the Iasi area.

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THE IMPACT OF ECO-AGROTEHNIC FACTORS ON GRAPE QUALITY FOR ROSÉ WINE PRODUCTION

IMPACTUL FACTORILOR ECO-AGROTEHNICI LA FORMAREA CALITĂȚII STRUGURILOR PENTRU PRODUCȚIA DE VINURI ROZE

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Abstract. *This article contains state-of-the-art data in technology of rosè wines production and their colour indices. In addition, a complex of factors is presented, all required for tipical colour formation during the primary stages of winemaking and extraction of antocyans obtained from red grapes is presented. New technologies were proposed for obtaining rosè wines with a low and high content of phenolic components. Some hypotheses are formulated regarding the technological requirements for rosè wines and a number of important challenges in modern winemaking are registered.*
Keywords: indigenous varieties, red grapes, ecological factors, rosè wines

Rezumat. *Acest articol conține dele mai noi informații referitoare la tehnologia producției vinurilor roze şi indici de culoare. În plus, este prezentat un complex de factori, necesari pentru formarea culorii tipice în etapele primare de vinificație şi extracție a antocianilor din struguri negri. Au fost propuse noi tehnologii pentru obținerea vinurilor rosé cu un conținut scăzut şi ridicat de compuşi fenolici. Unele ipoteze sunt formulate cu privire la cerințele tehnologice pentru vinurile rosé şi sunt înregistrate o serie de provocări importante în vinificația modernă.*
Cuvinte cheie: soiuri autohtone de struguri, struguri negri, factori ecologici, vinuri roze

INTRODUCTION

The recent growth in rosè wines is easily explained: easy to understand, optimal content of aromatic and flavonic compounds, active biologic compounds and compared to red wines, the grapes do not require a perfect phenolic maturation degree. In the Republic of Moldova, there are some wineries that produce good rosè wines (Purcari, Fautor, Cricova, Migdal-P, Chateau Vartely, Mimi and some small producers). Of course, the wines' quality will depend on the state of the raw matter, eco-pedological factors, so not all will have the typicity of the terroir. During development and maturation, the grapes depend on abiotical (light, water, heat, mineral substances) and biotical (the soil microbiota) factors, with a more important role on wine quality (Georgescu *et al,* 1991).

The complex factors (vineyard, grape variety and technology) insure a good typicity year after year, maintaining the authenticity, tradition and culture of the

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geographical area, especially in the case of IGP wines. Some traditional areas are: Ciumai, Romaneşti, Purcari, Raşcov, Cricova, Şişcani, Răzeni, Tigheci, Tomai, Speia, Talmaza, Răscaieți, Lăpuşna, Sălcuța, Cărpineni. The evolution of viticulture, the impact of humans in the environment, technical development, the green house effect, all underline the fact that we need to revise technologies and carefully evaluate the factors (Pițuc *et al*, 2001).

As phylloxera has reduced the surfaces planted with autochtonous grape varieties, loosing the fame of the area. Now, there are different resistant interspecific varieties that need promoting (Vacarciuc, 2016).

Fortunatelly, in some areas, the autochtonous varieties have been maintained and the producers need to promote them for export (Teodorescu *et al,* 1987).

MATERIAL AND METHODS

Qualitative vine cultivation is possible through a complex cooperation of ecological, agrotechnical, viticultural and pedological research. Agroecology studies the environmental factors in collaboration with the dinamics of the area- a complex factor named terroir. The formation and maintainence of colour compounds are very important (Vacarciuc, 2004), in direct relation to the factorial relation: variety* - climatic factors* - agriculture* - soil* - technology* - human resources*.

In the last five years, different varieties for red wines from the „Codru" region, were harvested at 180-200 g/L and total acidity of 4-5 g/L tartaric acid, allowing to test some these factors on slopes with 4-10 % in Răzeni-Zâmbreni, Stăuceni-Codru (IŞPHTA) and Romaneşti-Bucoveț. Field and lab analysis, as well as phenological, agro-biological and physical-chemical analyses were done according to standards in specific literature (Țârdea, 2007).

The study used local grape varieties. The authors want to underline that the varieties used traditionaly in other countries such as Grenache, Cinsaut, Merlot, Syrah, Gamay freux, Aleatico, Alicante Bouchet, Odeskiiciornii, Saperavi can be partially used for rosè wines (Somers and Evans, 1979). Some grape varieties were not taken into study as they present malvidin 3,5- diglucoside (Bejan, 2007).

RESULTS AND DISCUSSIONS

The grape varieties that were taken into study were Cabernet Sauvignon, Pinot Noir as well as Feteasca regală, Feteasca neagră, Rara neagră, Codrinschii, Riton, Viorica, Floricica, Legenda, Flacăra, the last six being new interspecific varieties. Even if the global tendency registers a 100 % increase in Sauvignon, Chardonnay, Pinot noir, Cabernet Sauvignon and Syrah, the market is over saturated and needs some new wines (Vacarciuc, 2015). The local grape varieties expresses the local specific and added value to oenoturism.

For producing dry, demi-dry and demi-sweet rosè wines, as seen in previous studies (Cazac *et al.,* 2013), aromatic grape varieties were tested. The OIV rules that white musts can also be used in the blend (up to 20 %). The use of new clones is welcomed in rosè wines production (tab. 1). A study drawn over 7 years udnerlines the frost resistance of clones Pinot noir SMA201, Cabernet-Sauvignon

FV5. Eight varieties were chosen for the production of rosè wines. They are resistant to abiotic factors, a moderate productivity and a high sugar content 202-230 g/L and the sensorial evaluation ranges betwenn 7.8-8.1/10.

Table 1

Agrobiological indices*, productivity and quality of the studied clones

No.	Name of clone	R.g* %	L.f, %	K.a	m,s g	P.b kg/b	P t/ha	Z, g/L	A, g/L	N.d
1	Feteasca N, II -18 -10	13	88.0	1.2	220	7.8	11.7	230	8.3	8.0
2	Feteasca N, IX -21 -7	11	90.0	1.1	239	5.6	9.3	221	9.4	7.9
3	Pinot noir SMA201	25	88	1.7	139	5.1	11	230	8.8	7.7
4	Pinot noir INRA 115	17	79	1.6	119	4.0	8.6	216	8.7	7.8
5	Malbec INRA 594	15	65	1.6	106	4.1	8.7	177	7.8	7.65
6	Cabernet Sauv.- FV-5	19	75	1.6	132	5.0	9.6	202	8.2	8.1
7	Cabernet franc VSP 10	16	75	1.3	144	6.0	10	202	8.2	7.8
8	Merlot INRA 314	26	67	1.5	180	4.4	9.3	216	7.4	7.8

-R.g** –frost resistance (dead buds, %) **L.f** – fertile shoots; **K.a** –absolute coefficient of fertility, **m.s** –grape mass; **P.b** –productivity / vine, **P** – productivity/ha, **Z**-sugar concentration, **A** - acidity, **N.d** – sensorial evaluation, 10/10.*

Of the presented clones, a good percentage of fertile shoots and absolute fertility coefficient was registered in the case of Pinot noir and Fetească neagră. The mass of a grape is higher in both Fetească neagră clones, while the sensorial evaluation was better for Fetească and Cabernet.

Studies covering the last 10 years (Vacarciuc, 2008) underline some specific eco-climatic requirements. For obtaining rosè wines, active temperature sum of 2700-3200 ^{o}C and rainfall between 400-600 mm are needed. The analysis of quality indices in the raw matter is recommended: full maturity (I.m.c.) and technical maturation (I.m.t.=% sugars x pH ^{2}) ranges between: Imc=100-115;-Imt=160-220.

Relief, slope, terrain exposition, altitude, all influnce the climatic factors, different in space and time, plants have to adapt to these factors, but of course, this is limited by their genetic profile. The complex of vegetation factors is very difficult to define. Theoretically, a good rosé is obtained on slopes with South-Eastern exposures, at altitudes of 100-300 m. The agro-phytotechnic system created by mankind in the three studied areas (Răzeni, Stăuceni, Romaneşti), underlines the need of using more local grape varieties for a better image and export (Vacarciuc *et. al.,* 2015).

Agrotechnical measures in viticulture, as bud concentration – Kc=2, ensures an early harvest, with sugar concentration of at least 180 g/L and acidity expressed in tartaric acid – 4 g/L (pH=3,0), with a production of 10-11 t/ha. Using fertilisers as nitrogen 60 kg/ha, but also Zn, Mg, Ni,Co, B – improving the photosynthethis and the respiration process; Mn $^{2+,\ 4+,7+}$ ions take part in oxido-reduction processes, increase the ration between fructose and glucose and the activity of ascorbic acid. The Moldavian viticultural products can be competitive on the Euopean wine market if the vinetds produce at least 10 t/ha, while wine quality is assured by 2,0 – 4,0 kg grapes/trunk, plant density -4000 plants /ha, Guyot or Royat, with a 60:40 ration between classic and local grape varieties.

The tendency of the current vineyard management is not favourable (turning from reduced labour of 100 h/ha to 1000 h/ha), with a very negative social impact. A correct design of vineyards areas, slope and altitude selection is therefore very important for maintaing the IGP and DOC wines.

Soil is an important factor, dependent on structure and composition and will determine the number of treatments, quantity of necessary fertilisers, good ventilation, use of irrigation in exceptional cases only. For quality ros*é* wines, soils with a good coefficient of heat trsnsmission will be chosen.

The technological factor* follows the formation and conservation of colour (Vacarciuc, 2008). Taking into account that three forms can appear A-H^+ , A-OH^- and La-OH^- it can be very difficult to obtain a certain colour.

Feteasca neagră grapes were used as follows: 1-pressing whole grapes; 2-destemming- crushing with enzymatic maceration for 8 h; 3- carbonic maceration for 48-72h at 20 ^oC. The control sample obtained by crushing and normal maceration for 12 h. The data can be seen in table 2.

Table 2

Composition and quality of rosè wines of the obtained technological variants

Physical-chemical indices Feteasca neagră	Control and technological variants			
	Control sample	1-Direct pressing	2-Enzymatic maceration	3-Carbonic maceration
Alcoholic concentration, vol,%	10.4	11.2	11.0	11.1
Remanent sugars, g/L	3.0	2.0	2.1	2.5
Non-reductive extract, g/L	19	18	17	19
Total acidity, g/L	7.1	7.0	7.2	7.3
Volatile acidity, g/L	0.6	0.4	0.3	0.3
Total SO_2, mg/L	50	50	50	50
Phenolic compounds (F), g/L	0.610	0.530	0.640	0.550
Anthocyans (A); mg/L	52	31	73	60
Leucoanthocyanidins (L), g/L	90	82	120	110
L/A ratio	1.73	3.9	1.64	1.83
A/F ratio x 100 %	8.52	5.8	11.4	10.9
Colour intensity (I), k -1 mm	0.33	0.25	0.40	0.54
Tone (T)	1.0	0.8	0.9	0.85
Polymerisation index, %	76	56	44	60
Sensorial evaluation 10/10 p	7.9	8.1	8.0	8.1

Regarding the typical model for a rosé wine, options 1 and 3 are recommended, following other conditions, as such.The maceration must not extract more than 600 mg/dm^3 – phenolic compounds (F), not more than 100 mg/dm^3 – coloured substances (A), not more than 130 mg/dm^3 – leicoanthocianidins (L), that will persist as L/A = 1,8...2,6 and – A/Fx100 = 4...10.

Prevention of oxidation is done by ascorbic acid (Vivas and Glories, 1979), while sulphitation, 40-60 mg/L, does stop condensation of chinions and its radicals.Acces of oxygen in new must is limited to 10 mg/l, redox potential – up to 250 mV, heavy metals up to 7 mg/dm^3 and pH up to 3,2, while grape processing should not pass over 4 hours:

Carbonic maceration of grapes, for 3 days, at ambient temperature, causes moderate extraction of colour, specific sensorial profile formation, polymer hidrolisation etc.

For rosé wines, the following chromatic charcteristics should be obtained: luminosity – (L =30-60 %), dominant wave length - (JId=590-610), colour purity – (15-45 %), intensity – (I = D_{420} + D_{520} + D_{620} = 0,25-0,45) and tonality – (T = D_{420} / D_{520} = 0,5-0,8).

Fermentation at 17 ^{o}C allows to keep the pigment complex, enriches the product with volatile acids, esters, terpenic compounds etc; maintaing the thin deposit will last up to 3 weeks, while acidity should not drop below 7,5 g/dm^3.

CONCLUSIONS

1. The 5 year mean regarding climatic factors, soild, altitude etc should be taken into conideration.
2. The variants obtained from Feteasca neagra with the best results are 1 and 3.
3. It is necessary to classify wines according to vineyards (IGP) of exceptional quality –„grand wines”.
4. Rural landscape – ecology – social relations on one side, and applied technologies – agrotechnics – cultural level – tradition – gastronomy are all connected.

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EVALUATION OF THE AROMA AND SENSORY CHARACTERISTICS OF PLUM DISTILLATES OBTAINED IN THE ARGES REGION

DETERMINAREA CARACTERISTICILOR SENZORIALE ALE UNOR PROBE DE DISTILAT DE PRUNE OBŢINUTE ÎN REGIUNEA BAZINULUI POMICOL ARGEŞ

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Abstract. *Plum distillate is an alcoholic drink obtained by the fermentation and distillation of plums. Its quality is determined by many factors, such as climate characteristics, soil, plum varieties and technological process. The aim of this study was to analyze the sensorial characteristics of plum distillate samples produced through an authentic manufacturing process in Argeş region, Romania (purchased from different producers). A total of 26 samples were analyzed. A sensory analysis was done by qualified professional tasters, according to the method of positive scoring. Each sample was marked from 0 to 5, the average representing the intensity level of each item. The analyzed characteristics may constitute a basis for the identification and authentication of the quality of these products.*
Keywords: plum distillates, brandy, sensorial analysis

Rezumat. *Ţuica este o băutură alcoolică obţinută prin distilarea prunelor fermentate. Calitatea acesteia este dată de diverşi factori, precum condiţii climatice, caracteristicile solului, soiul şi varietatea prunelor utilizate şi tehnologia folosită în procesul de fabricaţie. Această lucrare îşi propune analizarea caracteristicilor senzoriale ale unor probe de ţuică obţinute din soiuri autentice din regiunea bazinelor pomicole din judeţul Argeş. Probele au fost achiziţionate de la producători diferiţi. În vederea realizării analizei senzoriale, au participat la degustare persoane specializate în acest domeniu, probele au fost notate cu note de la 0 la 5, media acestora reprezentând nivelul de intensitate al fiecărui marker urmărit. Caracteristicile înregistrate în urma analizelor efectuate pot constitui o bază pentru identificrea şi autentificarea calităţii acestor produse.*
Cuvinte cheie: distilat de prune, ţuică, analiză senzorială.

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INTRODUCTION

Among the wide selection of fruit distillate products, plum distillate, called *ţuică*, is the most popular distillate in Romanian regions. It is mainly made in small production batches, following a traditional process.

This beverage is quite well known in Central Europe (Hungary, Poland, Czech Republic, Slovakia), and similar plum brandies are produced in Germany, Austria (*Zwetschgenwasser*), France (*eau de vie de prune*), and Switzerland (Pflümli wasser). Poland also has a long tradition of making *slivovitz* (Satora and Tuszyński, 2008).

Distillation is the separation process involving the passage of a liquid mixture in the vapor state by boiling, followed by the condensation of the obtained vapors. It is, therefore, a physical process that occurs in two stages: the transition from the liquid state to a gaseous state, followed by obtaining a distillate from the gaseous state (Dabija, 2002).

The distillates obtained from fruit products represent a secular tradition. Distilled alcoholic beverages contain an amount of ethyl alcohol ranging from 20-55% vol., alcohol obtained after the distillation process of agricultural products which have been previously subjected to alcoholic fermentation. Due to the wide range of fermentable plant products and production technologies, distillates are found in a wide range of varieties that have specific organoleptic characteristics (Gavrilescu, 1998).

The plum distillate has an alcohol content of 24 to 52% vol. and is obtained by the distillation of a marc which may come from different varieties or local plum populations. The quality of these beverages largely depends on the quality of the raw material used for fermentation and distillation (Satora *et al.,* 2017).

The preparation of fruit distillates (especially plums) has an old tradition in Romania and is still the main activity for many inhabitants from different fruit tree growing areas.

Fruit growing was established in 1971 in Argeş County, considered the first in the country regarding the number of fruit trees (8.5% of the country's stock) and fruit production (8.7% of the total), while the plum orchards and the trade with plum brandy brought fame to the county. The favorable geographical environment has provided very good conditions for the adaptation of some species and varieties that have become traditional to this area (Pomohaci, 2002).

From the analysis of the present situation of orchards surfaces in Argeş county, the dominance of plum and apple species can be observed (cca. 90%) and poor representation of other species. Thus, out of a total of 20151 ha, the plum species occupy the area of 13609 ha (64.9%), while the apple orchards reach 5.471 ha, which represents 27.2% of the total orchards. Strong fragmentation of the relief, approximately north-south orientation of the hills, but also their position at the foot of the Southern Carpathians (functioning as a protective wall that prevents the appearance of cold atmospheric currents), are factors that favor the intensive cultivation of fruit trees. The orchards ascend up

to 800 m altitude, but there are also cases when they are met at over 900 m (Băcăuanu, 1992).

MATERIAL AND METHOD

Production of plum brandy can be roughly divided into phases: selection of raw material and fermentation, distillation, and in some cases, maturation and stabilization/fining of the product.

The raw material used to obtain the plum distillates was represented by the fruits harvested at full maturity, of the *Prunus domestica* variety.

The fermentation of crushed fruits was carried out at approximately 19°C. Monitoring of fermentation was performed every day and fermentation lasted until the concentration of sugar decreased to 4°Brix taking care to avoid other fermentations (like acetic fermentation, lactic fermentation). Fermentation was done in oak barrels and the process was carried out for about 35 days. For the distillation of plum beverages, a simple copper distiller with a deflector and a stirrer was used. Water was used in the condenseras cooling agent. All samples were aged in oak barrels for one year, except for the 2005 sample that has been stored in the barrel for 12 years.

The organoleptic analysis aimed at highlighting the quality characteristics of the distillates and was realized by qualified professional tasters with experience in tasting techniques. The evaluation took place in the tasting room belonging to the "Ion Ionescu de la Brad" University of Agricultural Sciences and Veterinary Medicine Iaşi. They awarded points from 0 to 5, depending on the intensity of each flavor.

RESULTS AND DISCUSSIONS

In this article, the results of the organoleptic analysis for 10 of the 26 samples are presented. 9 samples were obtained in 2016 and the last one is from 2005 (the oldest of the samples), being used as a control sample. In table 1, one can see the description of the analysed samples.

Table 1

Experimental distillate variants taken into analysis

V1	Topoloveni village, Argeş, 2016
V2	Costeşti village, Argeş, 2016
V3	Valea Vîlsamului village, Argeş, 2016
V4	Domneşti village ,Argeş, 2016
V5	Morăreşti village, Argeş [1], 2016
V6	Morăreşti village, Argeş [2], 2016
V7	Morăreşti village, Argeş [3],2016
V8	Morăreşti village,extra, Argeş, 2016
V9	Morăreşti village,Argeş [4], 2016
V10	Morăreşti village, Argeş , 2005

Generally, plum distillate is characterized by an intense fruit aroma as well as often a typical pungent flavor owing to its production in an empirical manner. The flavor of alcoholic beverages is affected by a very large number of compounds (acids, higher alcohols, esters and carbonyl compounds) present in small amounts but with a large influence on the bouquet.

The results of the tasting (which was done with the help of qualified professional tasters, according to the method of positive scoring, based on sensorial experiences) were centralized and are presented in table 2.

As a result of the organoleptic analyses of the 10 samples, it was found that the oldest sample (V10-Morăreşti Argeş 2005), which was aged 12 years before being analyzed, recorded the richest sensory profile (the highest average values). This proves that oak wood has had a positive influence on the organoleptic profile of the distillate, giving to the final product a stronger structure, greater consistency and higher persistency. All of these markers are indices that confirm the quality of distillates. Time and storage conditions also have a significant influence on the quality of the products. As the distillate has been stored in oak barrels, chemical reactions have taken place, such as: micro-oxygenation (favored by small amounts of oxygen entering the mass of the product through the oak stave), alcohol evaporations, exchanges of compounds between stave and distillate, all of which result in the enrichment of V10 from a chemical point of view, enrichment that was also reflected in the three indices: body, structure and persistence.

Of the 9 samples obtained in 2016, one can also note: V3 from the point of view of fruitfulness (strong aromas of plums and pears have been identified); in case of sample V8 the exotic aromas were strongly felt.

The experimental sample V7 showed stronger woody notes, compared to the other variants obtained in the same year, which may indicate that the barrel used to keep the distillate for aging is at first use, or the degree of wood burning is more intense. This fact is also proven by high values of the parameters: body, structure and persistency of this sample compared to the samples obtained in the same year.

As a result of tasting - from the category of unwanted flavors - animal and pharmaceutical notes were identified in all analyzed samples, but these markers recorded very low averages, so their influence was minimal. Also, we can observe that the sample from 2005 recorded the smallest values regarding these two parameters. So, the positive effects of the long aging process into oak barrels on the evolution of the organoleptic characteristics are again confirmed.

Tablë 2

Results of the of the organoleptic analysis

No	Marker	Average (the intensity of the marker)									
		V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
1	FRUITY (ripe-plum, pear, apricot)	3	3.17	4.33	3.17	3.5	3.17	3.83	3.2	3.8	3.67
2	HERBACEOUS (hay, mint)	1	0.5	1	1.5	1.5	2	1.33	1.6	1	2.17
3	MINERAL (earth, rock)	0.67	0.83	0.67	1	0.5	1.33	0.83	1	0.8	0.67
4	FLORAL (roses, iris)	2	1.83	2.83	1.83	2.33	1.5	3	2.6	1.8	2.5
5	WOODY (oak, coffee, tobacco)	1.33	1.83	1.83	1.5	1.33	1	2.83	2.8	2.4	2.83
6	BALSAMIC (resin, pine)	1.17	1	0.83	1.5	1.67	1.17	1.33	1.4	2	1.5
7	CHEMICAL (pharmaceutical notes)	1.5	1.83	1.17	3.33	2.83	2	1.67	1.8	2.8	1
8	ANIMAL (leather, musk)	0	0.33	0	0.17	0.17	0.33	0.33	1	0.8	0.17
9	ACID	1.67	1.33	1.33	2.17	2	0.83	1.33	1.4	1.2	2
10	SWEET	2.17	1.83	2.33	1.33	1.5	1.83	2	2.4	2.2	2.17
11	BITTER	0.67	0.50	1.67	0.83	0.83	1	0.83	1	1.4	0.67
12	ONCTUOSITY	1.67	1.83	2.5	2.33	2	1.83	2.67	2.6	3	2.83
13	ASTRINGENCY	1.33	1.33	1.33	2.17	2.17	1.33	2	1.8	1.6	1.67
14	CHEMICAL HEAT	2.17	2.5	1.67	2	2.33	2.33	2.33	2.6	3.4	2.67
15	BODY	2.33	2.5	2.5	2.33	2	2.5	3.2	2.8	3	3.33
16	STRUCTURE	2.33	2.5	3.5	2.17	2.67	3.17	3.83	3.6	3.2	4.17
17	PERSISTENCY	2.17	3	3	2.67	3.33	2.67	3.83	3.6	3.6	4

CONCLUSIONS

1. The oldest sample (*V10*-Morăreşti Argeş 2005), which was aged 12 years before being analyzed, recorded the richest sensory profile (the highest averages values), so the aging process influenced positively the sensorial profile of this sample.

2. Of the 9 samples obtained in 2016, one can also note: *V3* from the point of view of fruitfulness (strong aromas of plums and pears have been identified); in case of sample *V8* the exotic aromas were strongly felt and the experimental sample *V7* showed stronger woody notes, compared to the other variants obtained in the same year.

3. As a result of tasting - from the category of unwanted flavors - animal and pharmaceutical notes were identified in all analyzed samples, but these markers recorded very low averages, so their influence was not considered a problem.

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STUDIES ON THE AGROBIOLOGICAL AND TECHNOLOGICAL VALUE OF GRAPE VARIETIES FOR AROMATIC WINES CULTIVATED IN THE IASI VINEYARD

STUDII ASUPRA VALORII AGROBIOLOGICE ŞI TEHNOLOGICE A SOIURILOR DE STRUGURI PENTRU VINURI AROMATE CULTIVATE ÎN PODGORIA IAŞI

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Abstract. *The purpose of this paper is to study the climatic conditions of 2017 and to correlate them with the quality of the grape varieties for aromatic wines (Busuioacă de Bohotin, Tămâioasa românească and Muscat Ottonel), from the Ampelographic Collection of the Faculty of Horticulture Iasi. The climatic conditions specific to 2017 and their influence on production (grape mass, sugars, acidity, mass of 100 berries, etc.) were analyzed. The line of production specific to Iasi vineyard, namely the production of aromatic wines, should be maintained also under the current climatic conditions.*
Key words: aromatic grape varieties, climatic conditions, production indices

Rezumat. *Scopul acestei lucrări este de a studia condiţiile climatice ale anului 2017 şi de a le corela cu calitatea strugurilor soiurilor pentru vinuri aromate (Busuioacă de Bohotin, Tămâioasă românească şi Muscat Ottonel), din Colecţia ampelografică a Facultăţii de Horticultură Iaşi. Au fost analizate condiţiile climatice specifice anului 2017 şi influenţa acestora asupra producţiei (masa strugurilor, zaharuri, aciditate, masa a 100 de boabe, etc). Direcţia de producţie specifică podgoriei Iaşi, respectiv obţinerea de vinuri aromate, trebuie menţinută şi în condiţiile climatice actuale.*
Cuvinte cheie: soiuri de struguri aromaţi, condiţii climatice, indice de producţie

INTRODUCTION

Viticulture is famously sensitive to climate, with temperature and moisture regimes being among the primary elements of terroir, while growing season temperature being particularly important in delimiting regions suitable for growing wine grapes (Schultz, 2008). Global changes in suitability for wine production caused by climate change may result in substantial economic and

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conservation consequences (Jones *et al.,* 2005). The aromatic grape varietes of Romania (Muscat Ottonel, Tămâioasă românească and Busuioacă de Bohotin) are of high importance to the local viticultural and winemaking industry, as they are extremely well evaluated and present are able to produce elegant wines.

MATERIAL AND METHOD

Climatic factors of 2017 were registered by the meteorological facility of SCDVV Iasi. Three aromatic grape varieties (Busuioacă de Bohotin, Tămâioasă Românească and Muscat Ottonel) were taken into study at harvest. All three were harvested from the Ampelographic Collection of USAMV Iasi on the 26th of September 2017. Grape quality analysis was registered.

RESULTS AND DISCUSSIONS

As it can be seen in table 1, year 2017 was characterized by temperatures that surpass the multi-annual means (a 10% increase), a lower quantity of rainfall (a 6% decrease) and higher sunshine periods (9% increase). Moreover, during summer months, responsible for the maturation profile of grapes, a 1.6% increase in temperatures, on average, was noted. At the same time, a decrease of rainfall during the vegetation period of almost 100 mm was registered.

Table 1

Comparative analysis of climatic elements between the year 2017 and the multi-annual mean of the last 20 years

Climatic elements	Multi-annual mean	2017
Global heat balance, (∑t°g)	3168.4	3335.7
Useful heat balance, (∑t°u)	1386.0	1566.8
Average temperature in July, °C	21.0	21.8
August,°C	20.3	22.8
September, °C	15.6	17.1
Absolute minimal temperature in air,°C	-27.2/ 28.12.1996	-18.7/20.01.
Annual average temperature T°C	9.8	10.8
∑ annual rainfall, mm	579.6	547.8
∑ rainfall in vegetation period, mm	398.1	293.4
∑ sunshine hours in vegetation period	1448.2	1580.4
Mean of maximal temperatures in August,°C	26.9	29.8
No of days with maximal temperatures > 30°C	17.3	39
Real heliothermal index (IHr)	2.0	2.5
Hidrothermal coefficient (CH)	1.3	0.9
Huglin heliothermal index (IH)	-	2238
Year characterization		Dry

The year was characterized as Dry, with a 130 % increase in the number of days with temperatures higher than 30 ^{o}C registered in August.

Figure 1 and figure 2 paint a very clear picture of the huge climatic changes that arise in present times. Taking into account that the composition of grapes is extremely sensible to climate characteristics, we expect to see some modifications from the usual profile.

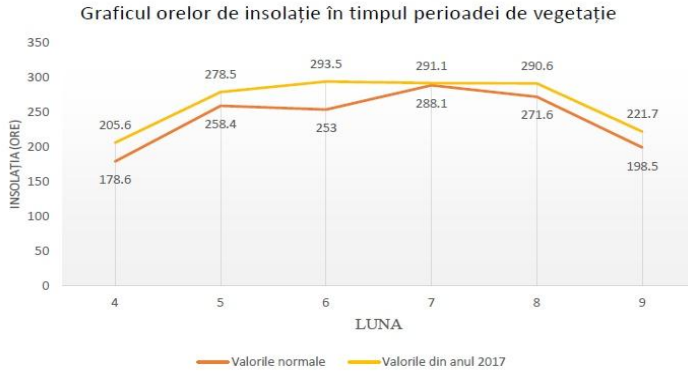

Fig. 1 Sunshine (hours) and rainfall (mm) during multi-annual mean of the last 20 years compared to values of 2017

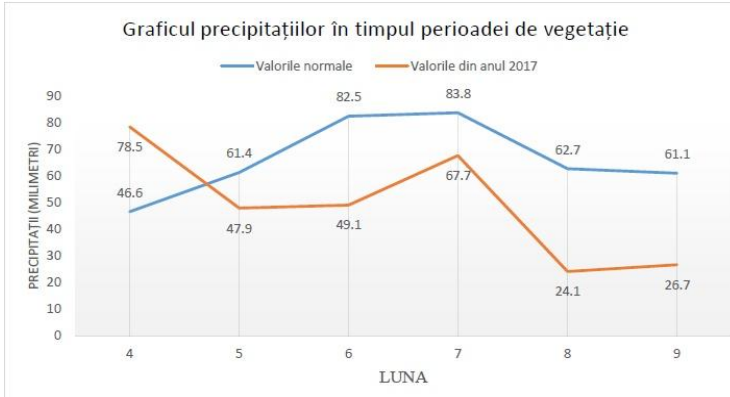

Fig. 2 Rainfall (mm) during multi-annual mean of the last 20 years compared to values of 2017

The quality analysis on the three grape varieties demonstrated the hypothesis to be true. Not only was the berry mass at the lower part of the range expressed in specific literature (Dobrei *et al.,* 2017), due to decreased rainfall, but also, the sugar content was unusually high. As the grapes were harvested on the 26th of September, there was a possibility of an even higher sugar concentration, if the over-ripening option would have been taken into account.

Table 2

Compositional characteristics of grapes harvest of 2017 in Iasi vineyard

Grape variety	Berry mass (g)	Berry mass in literature (g)	Sugars (g/L)	Sugars in literature (g/L)	Total Acidity (g/L H_2SO_4)	Total Acidity in literature (g/L H_2SO_4)
Muscat Ottonel	175	170-210	209	190-210	3.86	3.8-4
Tămâioasă Românească	208	200-250	248	240-250	4.85	4.5-5
Busuioacă de Bohotin	204	190-230	234	185-200	4.56	4-5

The total acidity can be considered low, taking into account that Iasi vineyard is one of the most northern regions of Romania and that here, acidity should be almost at a maximum (Bucur and Dejeu, 2017).

CONCLUSIONS

During the last decades, significant warming trends were observed. This trend of temperature increase is almost certainly going to continue in a future warmer climate. The results of grapevine responses to climate change (tendency to reduce grape yield, a highly significant increase of sugar content, reducing must acidity) are very important for the winegrowers because the three studied varieties are the the most important aromatic cultivars in Romania. The results of this study can become the basis for viticultural zoning in the new conditions. Starting from the current situation of global warming and predictions for the future, adaptation measures in viticulture should be implemented.

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STUDIES REGARDING THE PRODUCTION OF ROMANIAN BITTER

CERCETĂRI PRIVIND PRODUCEA BĂUTURILOR DE TIP BITTER

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Abstract. *The present study has as main objective the evaluation of the methods of obtaining a bitter type curative beverage to evaluate the possibility of superior utilization of the medicinal plants. Aromatic and condimentary plants have been used. Among the plants used: Angelica archangelica, artichoke (Cynara scolymus), basil (Ocimum basilicum), Thymus serpyllum, Achillea millefolium, Juniperus communis, Hyssopus officinalis, Salvia officinalis, Origanum vulgare, Glycyrrhiza glabra, Mentha piperita, Melissa officinalis and Fir resin. The variants used were V1 - sweetening sugar, V2 - sweetening with liquorice V3 - unsweetened and V4 - alcohol of 50 %vol. The analyzes were performed according to scientific literature. Alcoholic strength, pH, phenolic compounds and sensory analysis were evaluated. The study shows that it is appropriate to prepare an herbal beverage. The medicinal plants used imprinted the beverage with hints of wild flowers, coniferous trees and other aromatic plants. The liquorice sweetened variant was the most appreciated by the tasters*

Key words: phenolic compounds; spectrophotometry; plate reader.

Rezumat. *Studiul de faţă are ca scop principal evaluarea metodelor de obţinere a unei băuturi tip bitter cu rol medicinal, curativ, de a evalua posibilitatea valorificării în mod superior a plantelor medicinale. Au fost folosite plante aromatice si condimentare Dintre plantele folosite se pot mentiona: angelica (Angelica archangelica), anghinare (Cynara scolymus), busuioc (Ocimum basilicum), cimbrişor (Thymus serpyllum), coada şoricelului (Achillea millefolium), ienupăr (Juniperus communis), isop (Hyssopus officinalis), salvie (Salvia officinalis), sovârf (Origanum vulgare), lemn dulce (Glycyrrhiza glabra), mentă (Mentha piperita), roiniţă (Melissa officinalis) şi răşină de brad. Variantele utilizate au fost V1 - îndulcire cu zahăr, V2 – îndulcire cu lemn dulce, V3 – neîndulcit şi V4 – alcool de 50 %vol . Analizele au fost efectuate pe baza metodelor din literatură de specialitate. Au fost analizate concentraţia alcoolică,*

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pH, compuşi fenolici şi analiză senzorială. În urma studiului efectuat se constată că este oportună preparea unui lichior din plante medicinale. Plante medicinale utilzate au imprimat băuturii o nuanţă de conifere, montană. Varianta îndulcită cu lemn dulce a fost cea mai apreciată de către degustători.

Cuvinte cheie: compuşi fenolici, spectrofotometrie, spectrofotometru cu microplăci

INTRODUCTION

According to the New Universal Dictionary of Romanian Language 2007, bitter is "a bitter beverage consumed as an appetizer." This term has multiple origins, coming from English, French or German, the original word coming from the Dutch word bitter.

Bitters are hydroalcoholic tinctures, macerations or infusions in which various spices and aromatic plants such as cinnamon, cloves, orange peel or cardamom are mixed (Hawkins, 2008). These flavors are enhanced in the presence of alcohol, quinine and medicinal plants such as wormwood, artichoke, dandelion, valerian, which have precious medicinal qualities (Vârban *et al.,* 2005). The aerial part of plants (leaves, flowers, buds, stem, seeds, bark) or underground (roots, tubers, rhizomes) can be used to prepare bitters.

One of the most popular beverages of this type consumed in the world is Campari. Many people consider it a liquor as it is sweet, but its producers insist on calling it bitter, connecting it to its bitter taste, given by quinine and wormwood in its composition. The bitter was first prepared in 1860 in Italy by Gaspar Campari. This drink has an intense red color and was colored at first with an extract from the female insect bodies of the *Coccinela* species (Trebent, 1978). Besides these ingredients, the recipe still contains 65 other plants such as root spices, shells and tree bark, macerated in hydroalcoholic solution.

The present article aims at highlighting the local resources that can be used for obtaining bitter-type beverages and to evaluate their quality.

MATERIALS AND METHODS

For the preparation of bitter, only plants found in the local spontaneous flora or coming from areas close to Romania and introduced into culture for a long time were chosen. These plants are: *Angelica archangelica, Cynara scolymus, Basilicum basil, Thymus serpyllum, Achillea millefolium, Juniperus communis, Hyssopus officinalis, Salvia officinalis, Origanum vulgare, Glycyrrhiza glabra, Mentha piperita, Melissa officinalis* and fir resin. The plant material used was harvested in 2017. The plants were harvested at the optimum time for each species. The plants were milled and then macerated in ethanol. After maceration, the solution was diluted to approximately 40 %vol and sweetened. The following variants were obtained: V1 - sugar sweetening, V2 - sweetening with liquorice, V3 - unsweetened and V4 - maceration with alcohol of

50% vol. All variants have passed through a sensorial evaluation but also in terms of alcoholic concentration, pH, acidity, sugar concentration, concentration in phenolic compounds, to determine which experimental variant is the most balanced. Chemical parameters analysis and sensorial evaluation were performed according to the International Organization of Wine and Wine Methods of Analysis.

RESULTS AND DISCUSSIONS

Table 1 presents the results of the main characteristics of the bitter-type beverage samples.

Table 1

Characteristics of the bitter-type beverage samples

Sample	Alc. Conc (%vol)	Sugars (g/l)	pH
V1	27.5	55.2	3.86
V2	28.8	41.2	3.6
V3	29.7	12.4	4
V4	27.7	25.2	3.89

It is clear that the dilution from adding sweetened solution, either sugar or liquorice, had its effect on the final alcoholic concentration of the samples. They range from 27.5% in V1- variant sweetened with sucrose solution to 29.7% in the unsweetened variant (V3). The sugars concentration varies between 12.4 g/L (V3) to 55.2 g/L (V1).

After sensorial evaluation (fig. 1 and fig. 2), the first olphactory characteristic most of the tasters felt was pine buds (forest, vegetal, coniferous) and, secondly, an aroma similar to tea leaves. Other major aromas were thyme, wild flowers and juniper. Therefore, the premises for creating a bitter-type beverage with a strong, herby aroma, are very promising. The mouthfeel brought forward the powerful bitter taste (juniper, *Achillea millefolium, Cynara scolymus*) that was very well complimented by the high alcoholic concentration and the floral indices, bringing thus a special freshness to all the analysed variants. Although, variant no. 3 was processed without any sweetener addition, it was considered to be the most equilibrated and pleasant, with a high persistency of the aroma profile.

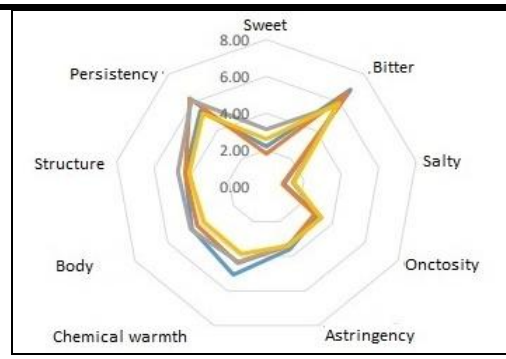

Fig. 1 Sensorial characteristics – mouthfeel indices

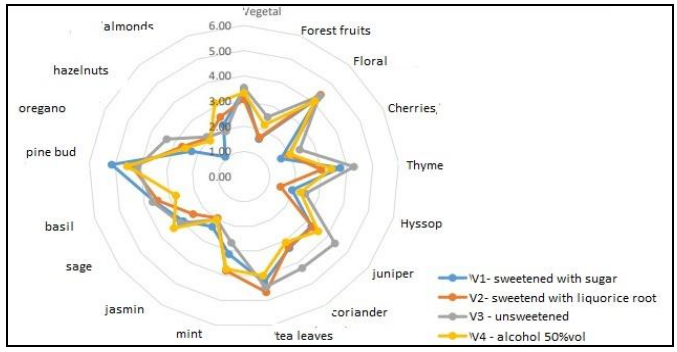

Fig. 2 Sensorial characteristics – aroma indices

CONCLUSIONS

The study shows that there are possibilities for obtaining locally sourced bitter-type beverages. The used plants have imprinted the beverage with hints of coniferous trees, vegetal and floral notes.

Sweetened variant was most appreciated by tasters while the opaque variant is not attractive from a commercial point of view, but it is the richest in aromatic phenolic compounds.

It can be concluded that the hydroalcoholic maceration produces a valuable beverage from the range of spirits, opening up a new potential for capitalizing on local medicinal plants.

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INFLUENCES OF DIFFERENT MEASURES ON THE QUALITY OF SPARKLING WHITE WINES

INFLUENȚA DIFERITELOR MĂSURI ASUPRA CALITĂȚII PRODUSELOR DE TIP VIN ALB SPUMOS

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Abstract. *Currently winemaking sector highlighted the necessity of investigating and promoting new blends obtained from newly created and classic European varieties to produce high quality sparkling wines. Therefore it was necessary to specify the optimal composition of these blends. In this article, the European grape varieties used were Chardonnay, Riesling, Aligote, Sauvignon, Pinot blanc, Pinot gris and newly created grape varieties as Muscat de Ialoveni, Floricica, Viorica, Hibernal. It was determined that the use of base wines from classic European varieties blended with wines from newly created grape varieties influences to different extents the quality of the final product.*

Key words: Sparkling wine, blend components, classic varieties, newly created grape varieties

Rezumat. *În prezent, sectorul vitivinicol a subliniat necesitatea de a investiga şi de a promova soiurile de struguri nou create şi soiurile clasice europene pentru a produce vinuri spumante de înaltă calitate. Prin urmare, a fost necesar să se precizeze compoziția optimă a amestecurilor vinuri albe de bază pentru spumante, utilizând soiurile europene clasice şi cele nou create. În această lucrare, au fost studiate soiurile clasice europene: Chardonnay, Riesling, Aligote, Sauvignon, Pinot blanc, Pinot gris şi cele nou create: Muscat de Ialoveni, Floricica, Viorica, Hibernal. S-a constatat că utilizarea vinurilor de bază obținute dintr-un cupaj din soiuri clasice europene şi varietățile nou create influențează în diferite proporții calitatea produsului finit.*

Cuvinte cheie: vinuri spumante, parteneri de cupaj, soiuri de struguri nou create

INTRODUCTION

Over the past decades obvious changes in organoleptic parameters and physico-chemical composition of the base wine for sparkling wines production, were registered, due to climate change as result of global warming. Produced wines are characterized by higher alcohol content and deficiency of total acidity, also they lose organoleptic typicality as young fine wine, therefore is more difficult to guarantee quality of product (Dumanov, 2012).

Formation of typical properties at sparkling wines production depends of numerous factors as: ecological, pedological, climatic conditions, the physico-chemical composition of the grapes in the defined winemaking regions,

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technology of base white wines, methods of treatment and processing of assemblage and blends etc. (Taran and Soldatenco, 2011).

Therefore, the necessity to diversify and improve quality of produced white sparkling wines appears, but also the need to study the potential of new selection vine varieties as blending partners for white sparkling wines. It is necessary to ensure that the obtained blends will provide new, original and high quality sparkling wines, competitive on national and external wine market (Taran *et al.,* 2001).

MATERIAL AND METHOD

The research was conducted in the laboratory of "Biotechnology and Microbiology of Wine" and section of "Microvinification" from Scientific-Practical Institute of Horticulture and Food Technologies (SPIHFT).

As objects of research the dry white wines produced from different newly created grape varieties by SPIHFT (Viorica, Floricica, Muscat de Ialoveni, Hibernal) and European varieties (Chardonnay, Aligote, Riesling, Sauvignon, Pinot gris, Pinot blanc), different blends of different base white wines.

In this research work physico-chemical methods of analysis recommended by the International Organization of Vine and Wine and those elaborated or modified at the SPIHFT were applied.

RESULTS AND DISCUSSIONS

For achieving the main objectives of optimization of blending components for white sparkling wine production, trials were performed:

1. Production of white sparkling wines by blending of base white wines from European varieties.
2. Production of white sparkling wines by blending of base white wines from European and newly created grape varieties.

Blending with use of base white wines from European grape varieties: **Blend 1:** Chardonnay (50%) + Pinot gris (50%); **Blend 2:** Chardonnay (50%) + Pinot blanc (50%); **Blend 3:** Chardonnay (50%) + Aligote (50%); **Blend 4:** Pinot Gris (25%) + Pinot blanc (25%) + Aligote (50%); **Blend 5:** Sauvignon (50%) + Riesling (50%); **Blend 6:** Riesling (70%) + Aligote (30%); **Blend 7:** Riesling (40%) + Sauvignon (40%) + Aligote (20%); **Blend 8:** Riesling (40%) + Sauvignon (40%) + Chardonnay (20%); **Blend 9:** Sauvignon (50%) + Chardonnay (50%).

Blending with use of base white wines from European and newly created grape varieties: **Blend 10:** Viorica (50%) + Chardonnay (50%); **Blend 11:** Viorica (50%) + Muscat de Ialoveni (50%); **Blend 12:** Floricica (50%) + Chardonnay (50%); **Blend 13:** Floricica (33%) + Muscat de Ialoveni (33%) + Hibernal (33%); **Blend 14**: Hibernal (50%) + Chardonnay (50%).

Analysis of physico-chemical parameters (tab. 1) indicates that all produced base white wines correspond to basic quality parameters. Alcohol content ranges from 10.1 to 13.0% vol. Titratable acidity, pH index and redox potential is within acceptable limits. Volatile acidity does not exceed 0.7 g/L.

Table 1

Physicochemical indices of wines obtained by blending of base white wines from European varieties (h.y. 2016)

Name	Alcohol content, % vol.	Total acidity g/L	Volatile acidity, g/L	pH	OR, mV	Reductive sugars, g/L	Reductive extract, g/L	Organoleptic note, points
Blend 1	13.0	5.3	0.66	3.20	217	2.8	16.5	7.85
Blend 2	12.4	5.6	0.66	3.13	220	2.4	15.9	7.90
Blend 3	12.8	5.6	0.56	3.16	219	1.9	16.6	7.90
Blend 4	11.9	6.1	0.59	3.06	225	1.6	16.9	7.85
Blend 5	11.2	6.8	0.53	2.90	234	1.2	17.1	7.95
Blend 6	10.9	7.6	0.63	2.87	236	1.3	17.2	7.95
Blend 7	10.1	6.8	0.53	2.93	233	1.2	16.2	7.95
Blend 8	11.7	6.4	0.66	3.01	228	1.9	16.4	7.90
Blend 9	12.4	5.5	0.53	3.20	216	3.3	16.3	7.85

In order to appreciate the quality of the initial blends of base material for the sparkling wines the organoleptic evaluation was carried out and the results are shown in Figure 1.

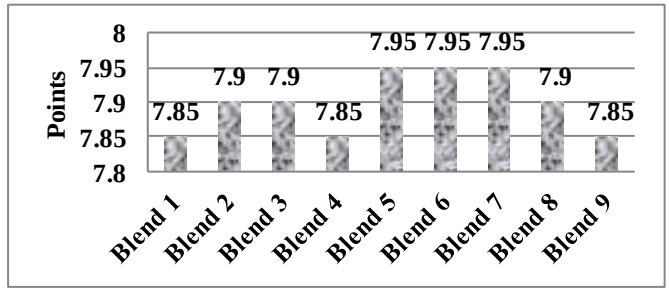

Fig. 1 Organoleptic evaluation of blends obtained from base white wines from European varieties

According to the organoleptic evaluation of obtained blends we can highlight those obtained by blending Riesling + Sauvignon, Riesling + Aligote and Riesling + Sauvignon + Aligote, that accumulated 7.95 points and were appreciated as balanced, with typical taste and with floral nuances in aroma. The lowest marks were obtained by blends from Pinot Blanc + Pinot Gris + Aligote, Chardonnay + Pinot Gris and Chardonnay + Sauvignon. All blends have accumulated a sufficient score and can be used for production of white sparkling classic wines. In order to appreciate the potential of newly created varieties for white sparkling wines, five blends in combination with European varieties were formed. The obtained results of the physico-chemical parameters are presented in table 2.

Analyzing the results from table 2 we can conclude that blending of base wines produced from newly created grape varieties with those from European varieties are high quality. Alcoholic concentration varies depending on the blend

composition. Blend 14 (Hibernal + Chardonnay) is characterized by an alcoholic concentration of 13.0% vol. while the lowest value is observed in blend 11 with 10.8% vol. of alcohol. Titratable acidity varies depending on the blend composition from 6.5 g/L up to 7.8 g/L. Volatile acidity doesn't exceed 0.7 g/L.

Table 2

Physico-chemical and organoleptic indices of blends obtained by mixing of white wines from European varieties and new selection varieties

Name	Alcohol content, % vol.	Total acidity, g/L	Volatile acidity, g/L	pH	OR mV	Reducing sugar, g/L	Reducing extract, g/L	Organoleptic note, points
Blend 10	12.3	6.5	0.53	3.04	226	3.8	16.3	8.00
Blend 11	10.8	7.4	0.60	2.79	241	1.5	19.1	7.95
Blend 12	12.6	7.1	0.60	2.99	229	4.0	16.3	7.90
Blend 13	11.7	7.8	0.59	2.86	237	1.6	19.5	7.95
Blend 14	13.0	6.5	0.66	3.14	228	2.4	16.4	7.90

Organoleptic evaluation allows to highlight wines produced from Viorica, Floricica and Muscat de Ialoveni varieties which were used in blends 10, 11 and 13 and have accumulated the highest organoleptic notes. All blends of wines were rated as qualitative, correspond to the basic technical requirements and can be used in white sparkling wines production.

CONCLUSIONS

After technological, physical-chemical and organoleptic appreciation of optimal blends composition, blends 5,6,7 were highlighted. They were produced from blending wines obtained from European varieties and blends 10,11,13 obtained by mixing wines from European varieties with those obtained from newly created grapes at SPIHFT and can be recommended for production of high quality white sparkling wines.

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THE INFLUENCE OF DIFFERENT COMPOSITION OF RED WINES BLENDS ON THE ORGANOLEPTIC INDICES AND ESTABLISHING THEIR PHYSIC-CHEMICAL PARAMETERS

INFLUENȚA DIFERITELOR PROPORȚII DE AMESTECURI DE VINURI ROŞII ASUPRA INDICATORILOR SENZORIALI ŞI STABILIREA PARAMETRILOR FIZICO-CHIMICI A ACESTORA

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Abstract. *Red sparkling wines produced in Moldova occupy a special place on the wine market, but to improve the quality of the finished product it is necessary to improve the technological regimes for manufacturing base wines for this category of wines. From these reasons, study was conducted on different raw red wines, from classical European varieties Cabernet Sauvignon, Merlot and Pinot Franc, comparing the influence of different composition of red wines blends on the organoleptic indices and establishing their physic-chemical parameters. As a result composition of blends from raw red wines and optimal content of phenolic substances including anthocyans, for red sparkling wine production was established.*
Key words: red sparkling wine, blend, coupage, red classical varieties, phenolic substances, anthocyanins.

Rezumat. *Vinurile spumante roşii produse în Moldova ocupă un loc special pe piața vinului, dar pentru a îmbunătăți calitatea produsului finit este necesară îmbunătățirea regimurilor tehnologice de fabricare a vinurilor de bază pentru această categorie de vinuri. Din aceste motive, studiul a fost realizat pe diferite vinuri roşii crude, din soiurile clasice europene Cabernet Sauvignon, Merlot şi Pinot Franc, comparând influența diferitelor compoziții de amestecuri de vinuri roşii asupra indicilor organoleptici şi stabilirea parametrilor lor fizico-chimici. Ca urmare a fost stabilită compoziția amestecurilor din vinurile roşii crude şi conținutul optim de substanțe fenolice inclusiv antociani, pentru producția de vin spumant roşu.*
Cuvinte cheie: vin spumant roşu, amestec, coupage, soiuri clasice roşii, substanțe fenolice, antocianine

INTRODUCTION

Moldova is a country that tends to assert increasingly active on the global market of wines, but to compete with developed countries (France, Italy, Spain and so on) that have developed winemaking traditions we must adapt winemaking technologies

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according to current requirements for ensuring quality of local wines. Therefore main objectives are improving production technologies, scientific argumentation of the used technological processes for reaching stabile quality of wines also diversification of production technologies and wine assortment (Macarov, 2008).

One of this kind of product are red sparkling wines, which are produced for decades in our country but till now there is no certain criteria's of quality for this category of wines, and often in production of this wines are used basically quality parameters as for white sparkling wines only lower titrate acidity, and are negated some basic compounds which are characteristic only for red wines.

Due to these requirements, appears necessity of development and scientifically improvement of existing technology process as: grape processing, fermentation processes, primary and secondary factors that determine the quality, color and chemical composition of red sparkling wine (Macarov, 2008). Also an important indicator of quality of red sparkling wines is the content of phenolic substances, which extraction occurs in grape skins during fermentation-maceration process. Content and composition of this group of components significantly affect the nutritional value and sensory quality of the wine. In particularly important are anthocyans, pigments specific for red wines (Taran, 2008).

Currently assortment of red sparkling wine is vast, and every producer uses different blending components of raw red wines. However, due to stringent market requirements there appeared the need of scientific research of improvement and argumentation of optimal blending components of raw red wines produced from European classic red grape varieties grown in the central region of the Republic of Moldova, in order to improve the quality of the obtained red sparkling wines.

In this context, the purpose of the study is the optimal composition of raw red wines from classical european verities for production of red sparkling wines and establishing optimal content of phenolic substances in coupage before secondary fermentation.

MATERIAL AND METHOD

The research was conducted in the laboratory of "Biotechnology and Microbiology of wine" and "Micro-winemaking" section from Scientific-Practical Institute of Horticulture and Food Technology (SPIHFT) in 2012-2016 years. As objects of research where used dry red wines produced from Merlot, Cabernet Sauvignon and Pinot Franc varieties. As technological treating adjuvant materials where used bentonite. In this research work where applied physicochemical methods of analysis recommended by the International Organization of Vine and Wine and those elaborated or modified at the SPIHFT (Tîrdea, 2007).

RESULTS AND DISCUSSIONS

In order to establish optimal quality parameters of red sparkling wines were occurred study among red sparkling wines produced in Republic of Moldova and oane sample from Ukraine (Crimea).

Wines were subjected to physico-chemical and organoleptic properties. The results on the quality parameters are shown in table 1.

Analyzing the obtained results, we can see that their deferent quality parameters of red sparkling wines commercialized on Moldavian retail market. And for establishing which of these parameters are most optimal for red sparkling wine were cured organoleptic analysis. Commission have decided that all red sparkling wines where qualitative without defects but the most appreciated was *classic red sparkling wine (2006) Cricova* and *Classic red sparkling wine (2008) "Crimscoe Igristoe",* it being understood that these wines have a comparatively high content of phenolic substances and alcohol concentration from 11.5 to 12 % Vol, being notified with rich aroma of dried fruit and an optimal degree of maturation.

Table 1

Organoleptic and Physico-chemical parameters of red sparkling wines from Moldavian retail market

Name	Alcohol concentration, % vol.	Concentration of			Organoleptic note, proms
		The titrable acidity, g/dm^3	Phenolic compounds, mg/ dm^3	Anthocyans, mg/dm^3	
Original Semisweet red sparkling wine (2010) Vismos	11.62	5.2	1194	57	9.2
Original Semisweet red sparkling wine (2012) Cricova	12.37	5.2	1166	62	9.0
Classic red Sparkling wine (2006) Cricova	11.97	5.3	1394	70	9.4
Original Semisweet red sparkling wine (2010) Milesti Mici	10.96	5.3	950	55	8.8
Classic red sparkling wine (2008) Crimscoe Igristoe	11.50	5.4	1459	81	9.5

Therefore it was determined that optimal concentration of phenolic substances in the finished product is 1300-1500 mg/dm³ and anthocyans 70-81 mg /dm³.

For determination of the influence of blending components on organoleptic parameters were selected raw red wines produced from european varieties Merlot, Cabernet Sauvignon and Pinot Franc. Physico-chemical parameters are represented in table 2.

Using raw red wines were formed experimental micro-coupages and tested organoleptic, according to obtained results were selected four coupages with different content of phenolic substances for red sparkling wines production.

Coupage 1: Pinot-Franc 60% Merlot + 40% (content of phenolic substances - 1193 mg/dm³);

Coupage 2: Pinot Franc Merlot 33% + 33% + 34% Cabernet Sauvignon (content of phenolic substances - 1398 mg/dm³);

Coupage 3: 70% Merlot + 30% Cabernet Sauvignon (content of phenolic substances-1584 mg/dm³);

Coupage 4: 20% Merlot + Cabernet Sauvignon 80% (content of phenolic substances - 1860 mg/dm³).

Table 2

Physicochemical indices of raw red wines from classical european verities (vintage year 2016)

Name	Alcohol concentra-tion, % vol.	Mass concentration of				OR , mV	Organolepti c note, proms
		titratable acidity, g/dm³	volatile acidity, g/dm³	phenolic compounds, mg/dm³	anthocyans, mg/dm³		
Cabernet-Sauvignon	11.9	6.9	0.30	1962	231	210	7.85
Merlot	12.0	5.3	0.56	1389	180	201	7.9
Pinot Franc	13.3	5.7	0.33	823	97	194	7.8

After the secondary fermentation and maturation in the bottle for 9 months sparkling wines were subjected to physico-chemical and organoleptic analysis, the results are shown in table 3.

Table 3

Physico-chemical and organoleptic indices of red sparkling wines after 9 months of maturation with different concentrations of phenolic substances

Name	Pressure kPa	Alcohol concentration, % vol.	Mass concentration of		pH	OR, mV	Organoleptic note, proms
			titratable acidity , g/dm3	volatile acidity , g/dm3			
Coupage 1	420	12.8	5.1	0.42	3.3	193	8.8
Coupage 2	380	12.7	5.3	0.36	3.3	196	8.8
Coupage 3	490	12.8	6.6	0.42	3.2	204	8.9
Coupage 4	450	12.2	5.6	0.49	3.3	210	8.7

Analyzing results from table 3, we can distinguished that all of the samples have accumulated in the bottle required pressure of CO_2, and the concentration of alcohol ranges from 12.2 to 12.8 % vol.. Concentration of titratable acidity varies between 5.1 - 6, 6 g/dm³. The volatile acidity is within acceptable limits for this category of wines. Therefore all coupages occurred secondary fermentation quality basic parameters correspond to all requirements.

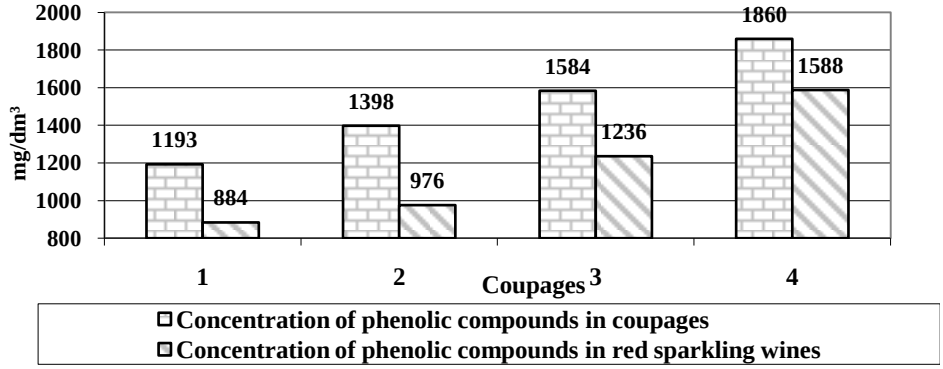

Fig. 1 Comparative analysis of phenolic substances concentration in red sparkling wines after 9 months maturation.

Analyzing the data from figure 1 had been noticed that after secondary fermentation and aging for 9 months at the process of red sparkling wines production, had decreases content of phenolic substance in all samples in average with 340 mg/dm³. This diminution is caused by the activity of the yeast during secondary fermentation, action of bentonite and phenol degradation during aging in the bottle.

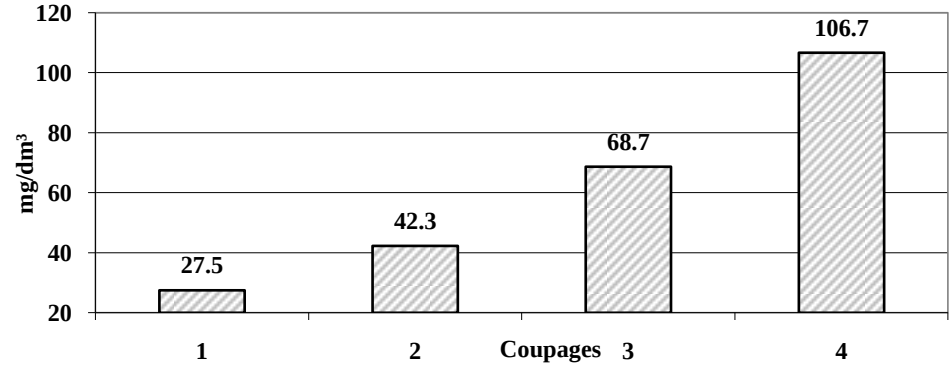

Fig. 2 Concentration of anthocyans in red sparkling wines after 9 months maturation

According to the results shown in figure 2 the concentration of anthocyans in red sparkling wines obtained from coupages 1 and 2 are 27.5 and 42.3 mg/dm³, at this level of anthocyans intensity of the color is to low which is considered insufficient for red sparkling wines. Coupages 3 and 4 had sufficient level of anthocyans reserve to ensure intense ruby red color after the secondary fermentation and maturation for 9 months.

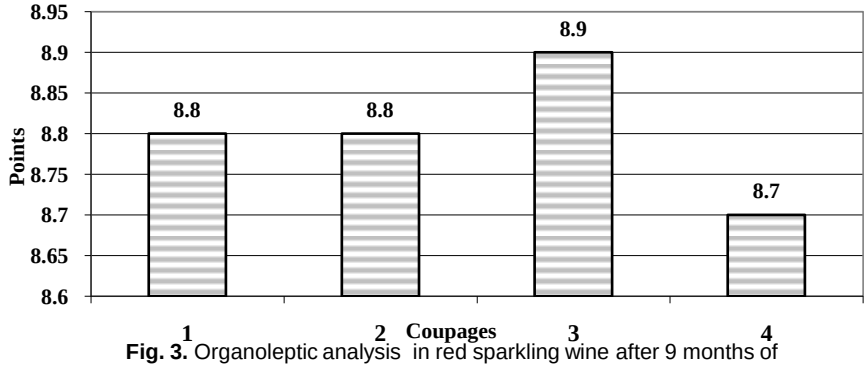

Fig. 3. Organoleptic analysis in red sparkling wine after 9 months of maturation obtained from coupages with different content of phenolic substances

Organoleptic analysis allowed to highlight red sparkling wine produced from coupage of Merlot (70%) and Cabernet Sauvignon (30%), being considered with complex aroma, balanced taste, intense ruby color, stable pearling and foaming. This formula of blending is recommended for red sparkling wine production. Red sparkling wines produced with using as blending partner red wines from Pinot Franc variety had obtained lower organoleptic assessment having lower tones of color, oxidation flavors and flat taste. Red sparkling wines produced with raw red wines from Cabernet Sauvignon variety, as basic blending partner in proportions of 80%. Have been appreciated with lowest organoleptic score, characterized by unbalanced taste due to excessive tanning substances, aromatic character are lower comparative to red sparkling wine obtained from 3 coupage with using of basic blending partner red wines from Merlot varieties.

CONCLUSIONS

It was determined the optimal reserve of phenolic substances in raw red wines material for the production of red sparkling wines, being between 1500-1700 mg/dm³. These content of phenolic complex allows to obtain wines with sufficient concentration of tannins for equilibrate taste of producing red sparkling wines with advanced quality parameters.

As a result of laboratory experiments have been studied different blending schemes using raw red wines produced from classical European varieties Pinot Franc, Merlot and Cabernet Sauvignon, grown in the central winemaking region of the Republic of Moldova. Following the organoleptic assessment was highlighted blending with the use of 70% Merlot and 30% Cabernet Sauvignon. Red sparkling wines produced under this coupage have stable pearling and foaming parameters, rich flavor and balanced taste.

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EVALUATION OF PHENOLIC COMPOUNDS BY AN ECOLOGICAL SPECTROMETRIC METHODS

EVALUAREA COMPUŞILOR FENOLICI PRIN METODE SPECTROMETRICE ECOLOGICE

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Abstract. *The study aimed to analyse phenolic compounds from wine samples using "ecological" spectrometric methods (low consumption of chemical reagents) comparing a traditional UV-VIS spectrophotometer to a microplate reader spectrometer. Different experimental wine samples were obtained using active charcoal, gelatine and anionic resins. The used wines were produced from Feteasca neagră grapes harvested at full maturity from Şuletea region, Vaslui County, with approx. 290 g/L concentration in fermenting substances. A total of 43 samples were analysed. The microplate reader was shown to be an extremely efficient and economic tool for analysing wines as the linearity of the used methods was shown to be comparative between devices. The time required for analysis is considerably reduced in this case and the versatility of the method allows better statistical evaluation of parameters within the limit of 10% of the relevant significance.*
Key words: phenolic compounds; spectrophotometry; plate reader

Rezumat. *Lucrarea îşi propune analiza compuşilor fenolici din probe de vin prin metode spectrometrice de tip „ecologic" (consum redus de reactivi chimici), utilizând un spectrofotometru tradiţional UV-VIS în comparaţie cu un Spectrofotometru cu micro-plăci. În acest sens, au fost utilizate 43 probe reprezentând vin din soiul Fetească neagră, variante tratate cu cărbune activ, gelatină şi răşini anionice. Strugurii utilizaţi la vinificare au fost recoltaţi la maturitate deplină din regiunea Şuletea, jud. Vaslui având o concentraţie în substanţe reducătoare de 290 g/L. Spectrofotometru cu micro-plăci s-a dovedit a fi un instrument extrem de eficient şi rentabil pentru a analiza vinurile roşii deoarece s-a demonstrat liniariatatea comparativă a metodelor investigate. Se reduce astfel considerabil timpul necesar desfăşurării analizelor comparative, iar versatilitatea metodei permite o mai bună evaluare statistică a unor factori direcţi în limita a 10% din semnificaţia relevantă.*
Cuvinte cheie: compuşi fenolici, spectrofotometrie, spectrofotometru cu microplăci

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INTRODUCTION

Grapes and wine contain a diverse group of phenolic compounds that serve as important oxygen sources and as substrates for browning reactions (Zoecklein *et al.,* 1990). The phenolic concentration in wines depends on many factors, including vineyard environment, wine-making technique and grape variety (Jungmin and Tarara, 2007).

Polyphenolic compounds are responsible for the quality of wines, especially red wines, with a major influence on antioxidant activity, astringency, bitter sensation and colour, their concentration in wine being influenced by variety, technology process and of course, analysis method. Measurement of wine phenolic compounds in red wine is an important part of quality control in beverage industry. Conventional methods are time consuming, include laborious process of reading individual samples in separate cuvettes, recording the results and analysing the values obtained, with large amounts of solvents and reagents, totally un-ecological. In this case, the need to identify a rapid and cost-effective way of performing these tests was stringent. The microplate reader represents an innovative way of normalizing the absorbance analysis in microplate wells (Attard, 2013).

MATERIAL AND METHOD

Chemical parameters' analysis were performed according to International Organisation of Vine and Wine methods of analysis. 43 samples representing wines obtained from Fetească neagră variety were tested. The grapes used for wine-making were harvested at full maturity from Şuletea region, Vaslui county.

In this article, the phenolic compounds of wines were analysed, the values collected with a microplate reader were compared with the values obtained using a traditional spectrophotometer. Different methods for quantification of phenolic compounds were used. Total phenolics and total anthocyanins were determined. The samples were analysed twice, at six months difference and the results were compared.

1. Total phenols were determined by reading the absorbance of the samples at 280 nm. This test is fast and efficient but certain molecules (cinnamic acids, chalcones) have no maximum absorption at 280 nm (Lorrain *et. al.,* 2013).

Another method for total phenolic concentration is the Folin-Ciocalteu test, based on the phenolic compounds with reductive properties. Phenolic compounds are oxidized by Folin Ciocalteu reagent. The blue coloration resulted has a maximum absorption at around 750 nm. Total phenols were expressed as mg gallic acid/L.

2. Tannins. Tannins were determined using the methyl cellulose precipitate tannin assay (MCP). The assay is based on polymer-tannin interactions - the formation of insoluble polymer tannin complexes that precipitates. The assay is based on subtracting the absorbance values recorded at 280 nm and not interfering with the assay. The epicatechin equivalent calibration curves were established on the UV-VIS traditional spectrophotometer that will be used for the tannin assay.

3. Anthocyanins. Anthocyanins content was determined by the pH-differential method, absorbance was read at 520-700 nm. The method is based on the change in

absorbance at 2 different pH values (0.6; 3.6). The total antocyanins content was expressed as Mv-3-gl mg/L.

4. Colour determination. The chromatic parameters of wine samples were calculated according to the CIE, using attributes of specific qualities of visual sensation: clarity, tonality, luminosity, chroma, saturation, hue (OIV-MA-AS2-11). Distilled water was used as a blank sample. Each sample solution was run in triplicate.

RESULTS AND DISCUSSIONS

The method of photometry is different in a microplate reader in comparison to a traditional spectrophotometer. It is necessary to calibrate the path length in the microplate to imitate the traditional method. In horizontal photometry, this is determined by the dimensions of the cuvette (1 cm thickness), the absorbance of a solution being analysed by transmitting light through the sample horizontally, but in vertical photometry, the path length is dependent on the volume in the well and adjustments need to be made (Heredia *et al.,* 2006). Generally, in the microplate method, because wells are too small for adequate blending, most of the incubation has to be performed in a tube and transferred to the microplate. The rest of the protocol is similar.

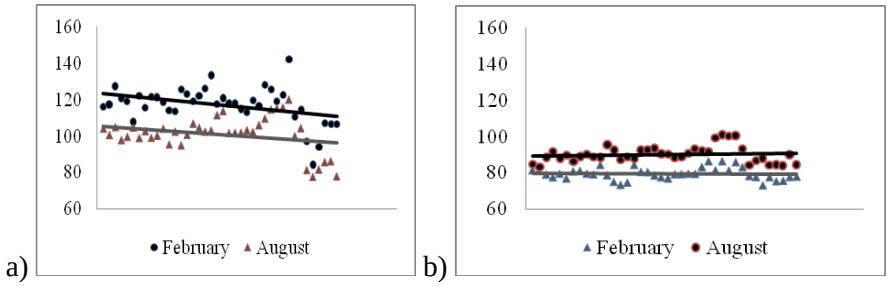


Fig. 1 Total phenolic compounds (mg/L gallic acid) – microplate reader (a) vs conventional UV-VIS spectrophotometer (b)

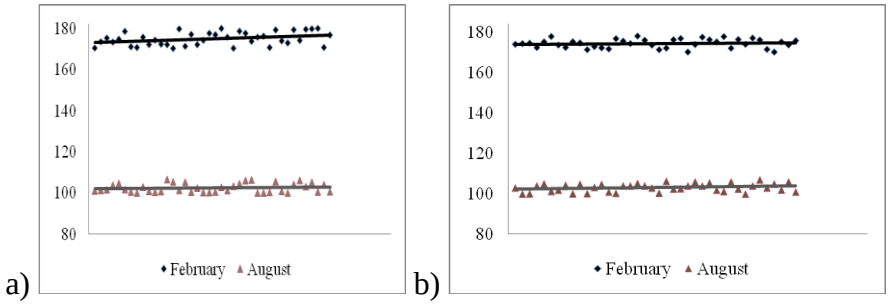
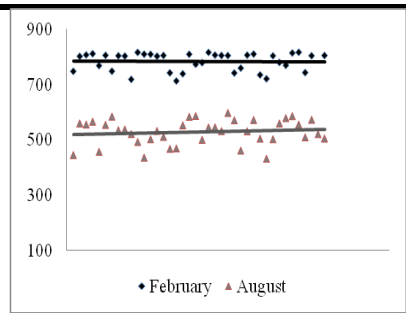


Fig.2 Folin Ciocalteu index (mg/L gallic acid) – microplate reader (a) vs conventional UV-VIS spectrophotometer (b)

a) 

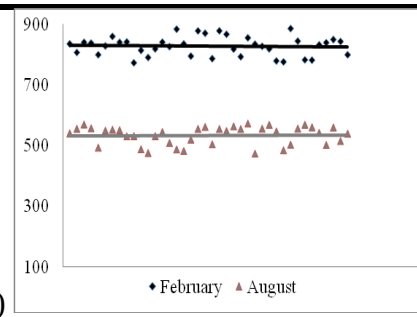
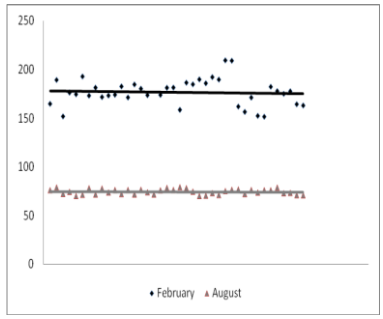
b) 

Fig 3 Tannins content (mg/L epicatechin) - microplate reader (a) vs conventional UV-VIS spectrophotometer (b)

a) 

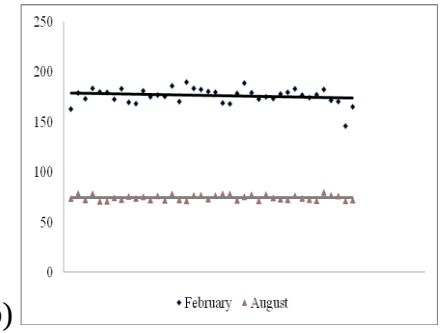
b) 

Fig 4 Anthocyanins content (mg/L Mv-3-gl) - microplate reader (a) vs conventional UV-VIS spectrophotometer (b)

Conventional methods are time consuming and laborious processes of reading individual samples in separate cuvettes, recording the values obtained and analysing the results and needs large amounts of solvents and reagents (Bobo-García, 2014). For example, it takes about 5 minutes to prepare a sample and read the absorbance on a traditional spectrophotometer. The microplate method saves time, reduces the quantity of sample, a higher number of samples can be processed in one experiment and also the repeatability of the results is improved, while also less reagents and solvents are consumed. Another advantage of using microplate reader is the low cost of the system and its energy saving profile (Zhang *et al.,* 2006; Galgani and Bocquene, 1991).

The values obtained with the microplate reader were more precise. The microplate reader allows for a variety of experiments to be measured simultaneously. The software is easy to use, with minimal instructions. Cuvette and microplate methods show different sensitivity and limits of detection (Horswald *et al*., 2011). Microplate method can identify wine components at extremely low concentration. A traditional UV-VIS spectrophotometer is versatile as it can operate at any wavelength between 200 nm and 950 nm. In the case of microplate method, usually the standard has fixed wavelengths, the versatility of this method consisting in the ability to read a large number of samples in a very

short time (Attard, 2013). The majority of data has a linear relationship, the correlation of the results obtained is shown in figures 1, 2, 3 and 4. A positive correlation of the values obtained can be observed. The highest error was recorded for total polyphenols and tannins content. A first reason would be the material of the cuvette. For the spectrophotometer quartz cuvette were used, while for the microplate reader, the cuvettes are made from plastic materials. This may cause differences between the absorbance obtained with the microplate reader and those obtained in the quartz cuvette with the traditional spectrophotometer. In that case, for UV parameters (D280, IFC, Tannins) it is preferable to use the traditional UV spectrophotometer and quartz cuvettes. The microplate method is a faster alternative for the determination of phenolic compounds in various samples (Attard, 2013).

New microplates with used microplates were used in parallel; the results obtained did not show significant differences. Differences in results may also be due to laboratory errors, or samples that containe particles in suspension that influence correct reading.

CONCLUSIONS

1. Spectrophotometry seems to be more accurate and gives the possibility to record a spectrum.

2. The cuvettes material significantly influences the absorbance obtained. For UV parameters (D280, IFC, Tannins) it is preferable to use the traditional UV spectrophotometer and quartz cuvettes.

3. The microplate method is a faster alternative for the determination of phenolic compounds. Microplate method can identify wine components at extremely low concentration. The microplate reader was shown to be an extremely efficient and economic tool for analysing wines because the linearity of the investigated methods was demonstrated to be comparative between devices. The versatility of this method consists in the ability to read a large number of samples in a very short time.

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CONTRIBUTIONS TO THE KNOWLEDGE OF THE COLEOPTERAN ENTOMOFAUNA IN THE APPLE FRUIT TREE ORCHARDS

CONTRIBUȚII LA CUNOAŞTEREA ENTOMOFAUNEI DE COLEOPTERE DIN PLANTAȚIILE POMICOLE DE MĂR

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Abstract. *The observations have been made in a fruit tree orchards owned by the Society S.C. Loturi Service SRL Deleşti,Vaslui country, Romania. The several varieties of apple are grown within this company: Golden delicious, Idared, Wagner, etc. The Barber soil traps were used to collect the biological material, and they functioned continuously from May to September or even October in 2017 six traps were used for each experimental variant. The experimental variants were set up, depending on the existing vegetal carpet . The samples were harvested at intervals of 7-14 days when we changed the fixing fluid, were filled in, or, if it was necessary it was replaced. The collected species were cleansed from all plant debris, other impurities and then separately selected coleopteran species, which by means of the determiners boocks were identified. The structure, dynamics and abundance of coleopteran species were then determined according to each experimental variant. The species of the coleopters, more frequently collected were: Dermestes laniarius Ill. Harpalus calceatus, Harpalus distinguendus, Amara eurynota, Phyllotreta nemorum, Opatrum sabulosum and Omias rotundus, etc.*
Key words: biological material, Barber traps, *Harpalus distinguendus*

Rezumat. *Observaţiile au fost făcute într-o plantaţie pomicolă de măr aparţinând Societăţii , S.C. Loturi Service Deleşti –Vaslui. În cadrul acestei societăţi sunt cultivate mai multe soiuri de măr şi anume: Golden delicious, Idared, Wagner etc. Pentru colectarea materialului s-au folosit capcanele de sol tip Barber, care au funcţionat în permanenţă, începând din luna Mai până în luna septembrie sau chiar octombrie, în anul 2017 s-au înfiinţat mai multe variante experimentale, în funcţie de covorul vegetal existent . Recoltarea probelor s-a făcut la intervale de 10-14 zile când şi lichidul de fixare, respectiv a fost completat sau, după caz a fos înlocuit. Speciile colectate au fost curăţate de toate resturile vegetale, şi determinate cu ajutorul determinatoarelor. S-a stabilit apoi structura, dinamica şi abundenţa speciilor de coleoptere, în funcţie de fiecare variantă experimentală. Speciile de coleoptere, mai frecvent colectate au fost: Dermestes laniarius, Harpalus calceatus, Harpalus distinguendus, Amara eurynota, Phyllotreta nemorum, Opatrum sabulosum şi Omias rotundus, etc.*
Cuvinte cheie: material biologic, Barber trap, *Harpalus distinguendus*

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INTRODUCTION

Among the most important insect families belonging to both the useful and harmful entomofauna belong to the order Coleoptera (Insecta Class), which includes species spread around the globe. The species of this family have a trophic regime largely entomophagic, but there are also species of mixed-phage or phytopofage (few species).

In agricultural crops, in fruit trees and even in forest areas, many of the species are particularly important ecological indicators, responding immediately to some human interventions, such as pesticides, which cause the paralysis or even the death of adult insects or larvae at shortly after treatment.

This paper presents some research results on the coleopteran population from a fruit tree plantation, where the fruits are destined for both fresh consumption and industrialization (Miller and Zubovski, 1917; Malcolm and Bell, 1997; Talmaciu *et al.*, 2016).

MATERIAL AND METHOD

Collection of entomological material was carried out using the soil traps type Barber method.

Samples of the collected biological material were labeled specifying: sample number, harvest date. Samples so labeled were shielded from sunlight and transported to the laboratory for analysis and determination.

Fig. 1. Soil trap type *Barber*

The Barber type soil trap method (fig.1) was used in the apple plant research at S.C. Farm. SERVICE lots, from Deleşti County, Vaslui county, from May to September, for establishing the structure and dynamics of the epigee entomofauna.

For this purpose, plastic cans with a volume of 500 ml were used, with a diameter of 10 cm and a height of 8-10 cm, and a salt solution in a concentration of 25% was used as the fixing liquid.

In the study station, six traps were placed on a row of trees on each of the 7 variants V-1, existing vegetal carpet from the spontaneous flora (witness), the V-2, the *Lotus corniculatus*, V-3 vegetal carpet, (*Tifolium repens*), V-4, vegetation overgrown with red clover (*Trifolium pratense*), V-5 vegetal overlay with lucerne (*Medicago sativa*), V-6, vegetal oat overlay with a mixture of 4 leguminous species and V-7 black field.

RESULTS AND DISCUSSIONS

To establish the structure and dynamics of the coleopter entomofauna, 6 traps were placed on a line of trees from the edge to the inside in a straight line, at a distance of 20 m from the edge and 6 - 7 m between traps in a row.

At Variant number 1, Existing vegetal carpet from the spontaneous flora (witness) were collected specimens of coleoptera belonging to a number of 11 species, in total, 14 specimens. A number of 3 species had two samples, these being: *Otiorrhynchus raucus* L., *Coccinella 7-punctata* and *Psylliodes chrysocephala* L. (tab. 1).

Table 1

The situation concerning the collection epigenous entomofauna V1 variant

No.	Name of species	Trap and number of samples						
		1	2	3	4	5	6	Total
1.	*Pseudophonus pubescens* Müller	1	-	-	-	-	-	1
2.	*Calathus fuscipes* G.	1	-	-	-	-	-	1
3.	*Cymindis humeralis* G.	1	-	-	-	-	-	1
4.	*Psylliodes cupreus* Koch	1	-	-	-	-	-	1
5.	*Otiorrhynchus raucus* L.	-	1	-	-	1	-	2
6.	*Coccinella 7-punctata* L.	-	2	-	-	-	-	2
7.	*Cantharis fusca* L.	-	1	-	-	-	-	1
8.	*Opatrum sabulosum* L.	-	-	1	-	-	-	1
9.	*Tachyporus abdominalis* Fabr.	-	-	1	-	-	-	1
10.	*Halyzia 22 punctata* F.	-	-	-	-	1	-	1
11.	*Psylliodes chrysocephala* L.	-	-	-	-	1	1	2
Total 11 species		4	4	2	-	3	1	14

At Variant number 2, Vegetable carpets over-sown with guides, were collected specimens of coleoptera belonging to a number of 11 species, in total, 55 specimens. The species with the most specimens collected were: *Calathus fuscipes* Goeze, *Opatrum sabulosum* L., with 9 copies, followed by the species *Psylliodes chrysocephala* Koch with 8 specimens, *Otiorrhynchus raucus* L., 6 specimens, *Coccinella 7 punctata* and *Cantharis fusca* L., with 5 copies each. The other 5 species had between 1 and 5 specimens (tab. 2).

Fig. 2. General aspects of variants

Table 2

The situation concerning the collection epigenous entomofauna V2 variant

No.	Name of species	Trap and number of samples						
		1	2	3	4	5	6	Total
1.	*Pseudophonus pubescens* Müller	1	-	-	-	-	-	1
2.	*Calathus fuscipes* Goeze	3	-	5	-	1	-	9
3.	*Cymindis humeralis* G.	1	1	-	1	-	-	3
4.	*Psylliodes chrysocephala* Koch	1	-	2	-	3	2	8
5.	*Otiorrhynchus raucus* L.	-	1	3	1	1	-	6
6.	*Coccinella 7-punctat* L.	1	2	-	1	-	1	5
7.	*Cantharis fusca* L.	-	1	3	1	-	-	5
8	*Opatrum sabulosum* L.	-	1	1	3	2	2	9
9.	*Tachyporus abdominalis* Fabr.	-	-	1	-	-	-	1
10.	*Halyzia 22 punctata* L.	1	-	-	1	1	1	4
11.	*Psylliodes chrysocephala* L.	-	1	1	-	1	1	4
Total 11 species		8	7	16	8	9	7	55

At Variant number 3, Vegetable carpets over-chopped with white clover, sample of Coleoptera belonging to a number of 14 species were collected, totaling 30 sample. The species with the most samples collected were: *Brachynus hirtus* B., with 9 samples, *Opatrum sabulosum* L., 5 samples, *Polydrosus flavipes* Sch., 4 samples and *Leistus ferrugineus*, 2 samples. The other species had one sample (tab. 3).

At Variant number 4, Vegetable carp topped with red clover, samples of Coleoptera belonging to a number of 9 species were collected, in total 109 samples. The most specimen species were: *Phyllotreta atra*, 20 samples, *Amara familiaris*, 17 samples, *Dermestes laniarius*, 15 samples, *Pterostichus cylindricus* and *Harpalus tardus*, each with 14 samples. The other species had between 1 and 11 samples (tab. 4).

Table 3

The situation concerning the collection epigenous entomofauna V3 variant

No.	Name of species	Trap and number of samples						
		1	2	3	4	5	6	Total
1.	*Harpalus tardus* Panz.	1	-	-	-	-	-	1
2.	*Leistus ferrugineus* L.	1	-	-	1	-	-	2
3.	*Mordellistena abdominalis* F.	1	-	-	-	-	-	1
4.	*Opatrum sabulosum* L.	1	-	-	3	1	-	5
5.	*Otiorrhynchus pinastri* Gyll.	1	-	-	-	-	-	1
6.	*Cymindis vaporariorum* L.	1	-	-	-	-	-	1
7.	*Cantharis fusca* L.	-	1	-	-	-	-	1
8.	*Amara eurynota* Panz.	-	-	1	-	-	-	1
9.	*Polydrosus flavipes* Sch.	-	-	1	3	-	-	4
10.	*Attagenus unicolor* Brahm.	-	-	-	1	-	-	1
11.	*Longitarsus anchusae* Boh.	-	-	-	1	-	-	1
12.	*Brachysomus hirtus* B.	-	-	-	9	-	-	9
13.	*Coccinella 7-punctata* L.	-	-	-	1	-	-	1
14.	*Harpalus calceatus* Duft.	-	-	-	-	1	-	1
Total 14 species		6	1	2	19	2	-	30

Table 4

The situation concerning the collection epigenous entomofauna V4 variant

No.	Name of species	Trap and number of samples						
		1	2	3	4	5	6	Total
1.	*Dermestes laniarius* Illiger	2	-	5	1	7	-	15
2.	*Amara familiaris* Duft.	-	1	9	4	3	-	17
3.	*Phyllotreta atra* F.	1	11	-	3	3	2	20
4.	*Pterstichus cylindricus* Hrbst.	4	1	6	-	3	-	14
5.	*Harpalus distinguendus* Duft.	-	3	1	1	2	2	9
6.	*Harpalus tardus* Panz.	5	1	1	2	2	3	14
7.	*Harpalus calceatus* Duft.	2	2	1	1	2	3	11
8	*Coccinella 7-punctata* L.	-	4	1	1	-	1	7
9.	*Pseudophonus pubescens* Müll.	1	-	-	-	-	1	2
Total 9 species		13	25	24	13	22	12	109

At Variant number 5, vegetable carpets overgrown with alfalfa, coleopteran specimens of 19 species were collected, with a total of 74 samples. Most samples collected had their species, *Opatrum sabulosum* L., with 27 samples and *Omias rotundus* L., with 17 samples. The other 17 species collected had between 1 and 5 samples.

At Variant number 6, vegetable carp topped with the 4 species of grasses and legumes were collected samples of Coleoptera belonging to a number of 18 species, in total, 214 samples. The most sampes species harvested were: *Harpalus calceatus*, 54 samples, *Dermestes laniarius*, 45 samples, *Harpalus*

tardus, 38 samples, *Opatrum sabulosum* L., 14 samples and *Harpalus aeneus*, 10 samples. The other species had between 1 and 9 samples (tab. 6).

Table5

The situation concerning the collection epigenous entomofauna V5 variant

No.	Name of species	Trap and number of samples						
		1	2	3	4	5	6	Total
1.	*Dermestes haemorrhoidalis* Kuster	1	-	-	-	-	-	1
2.	*Coccinella 7-punctata* L.	1	1	-	-	-	-	2
3.	*Omias rotundatus* Fabr.	4	7	2	-	3	1	17
4.	*Orchestes lonicerae* Olivier	1	-	-	-	-	-	1
5.	*Otiorrynchus ovatus* L.	2	-	-	-	-	-	2
6.	*Otiorrynchus pinastri* Hrbst.	4	-	-	-	-	-	4
7.	*Otiorrynchus obsidianus* Bohem	1	-	-	-	-	-	1
8.	*Acrolocha sulcula* Steph.	1	-	-	-	-	-	1
9.	*Opatrum sabulosum* L.	12	-	-	3	-	12	27
10.	*Sitona crinitus* Hrbst.	-	2	-	-	1	-	3
11.	*Meligetes maurus* Strm.	-	2	-	-	3	-	5
12.	*Tychius 5 punctatus* L.	-	1	-	-	-	-	1
13.	*Licinus cassideus* F.	-	2	-	-	1	-	3
14.	*Harpalus calceatus* Duft.	-	1	-	-	-	-	1
15.	*Harpalus tardus* Panz.	-	-	2	-	-	-	2
16.	*Otiorrhynchus fullo* Schrank	-	-	-	2	-	-	2
17.	*Mordella fasciata* Fabr.	-	-	-	-	1	-	1
18.	*Dermestes laniarius* Illiger	-	-	-	-	-	2	2
19.	*Leucoparyphus fullo* F.	-	-	-	-	-	2	2
	Total 19 specii	27	16	4	5	9	17	78

Table6

The situation concerning the collection epigenous entomofauna 6 variant

No.	Name of species	Trap and number of samples						
		1	2	3	4	5	6	Total
1.	*Curculio nucum* L.	1	-	-	-	-	-	1
2.	*Omias rotundatus* Fabr.	1	1	1	-	4	1	8
3.	*Pseudoophonus griseus* Panz.	3	-	2	1	2	1	9
4.	*Dermestes laniarius* Illiger	7	9	6	4	6	13	45
5.	*Pterostichus vulgaris* L.	2	-	-	-	-	-	2
6.	*Harpalus calceatus* Duft.	6	7	11	8	12	10	54
7.	*Calathus fuscipes* G.	1	-	2	-	1	-	4
8	*Pseudoophonus rufipes* Deg.	2	2	-	-	2	-	6
9.	*Epicometis hirta* Poda	1	1	-	2	1	1	6
10.	*Harpalus aeneus* F.	-	4	1	2	3	-	10
11.	*Harpalus tardus* Panz.	-	15	4	13	5	1	38
12.	*Otiorrhynchus raucus* Fabr.	-	-	1	-	-	1	2
13.	*Anisodactylus signatus* Panz.	-	-	3	-	-	-	3

Continued Table no 6

No.	Name of species	Trap and number of samples						
		1	2	3	4	5	6	Total
14	*Amara aenea* Djean.	-	-	-	3	-	-	3
15	*Opatrum sabulosum* L.	5	4	1	-	-	4	14
16	*Necrobia violacea* L.	-	-	-	1	-	-	1
17	*Harpalus distinguendus* Duft.	-	-	-	-	3	3	6
18	*Amara ovata* F.	-	-	-	-	-	1	1
Total 18 species		28	43	32	35	40	36	214

Table7

The situation concerning the collection epigenous entomofauna 7 variant

No.	Name of species	Trap and number of samples						
		1	2	3	4	5	6	Total
1.	*Dermestes laniarius* Illiger	1	-	-	-	-	-	1
2.	*Harpalus calceatus* Duft.	1	3	-	-	-	-	4
3.	*Omias rotundus* F.	-	1	-	-	-	-	1
4.	*Ephistemus globulus* Payk.	-	1	-	-	-	-	1
5.	*Carabus violaceus* L.	-	-	-	1	-	-	1
6.	*Pterostichus niger* Schaller	-	-	-	1	-	-	1
7.	*Harpalus tardus* Panz.	-	-	-	-	1	-	1
Total 7 species		2	5	-	2	1	-	10

At Variant number 7, Black field, specimens of Coleoptera belonging to a number of 7 species were collected, in total, 10 samples. With the exception of the species *Harpalus calceatus*, which had a number of 4 samples, the other species, *Dermestes laniarius*, *Omias rotundus*, *Ephistemus globulus*, *Carabus violaceus, Pterostichus niger*, *Harpalus tardus*, had one sample (tab. 7).

CONCLUSIONS

1. Following the six harvests that took place in May 2017, 510 specimens of coleoptera were collected in totel.
2. The situation of the collections on variants is as follows:

► V1 were collected 11 species with a total of 14 specimens.
► A total of 11 species with a total of 55 specimens were collected at V2.
► At V3 a total of 14 species were collected with a total of 30 specimens.
► A total of 9 species were collected at V4 with a total of 109 specimens.
► A total of 19 species were collected at V5 with a total of 214 specimens.
► A total of 19 species were collected at V6 with a total of 14 specimens.
► A total of 7 species with a total of 10 specimens were collected at V7.

3. The most common and common species of coleopterans were *Dermestes laniarius* Ill. *Harpalus calceatus, Harpalus distinguendus, Amara eurynota, Phyllotreta nemorum, Opatrum sabulosum* and *Omias rotundus*.

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RESEARCH ON THE COLEOPTERANS EPIGEUS FAUNA FROM SOME WHEAT CROPS

CERCETARI PRIVIND FAUNA DE COLEOPTERE EPIGEE DIN UNELE CULTURI DE GRAU

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Abstract. *The study of beetles (Coleoptera) appears as a necessary scientific and practical taking into account, in particular its frequency on the meridian of the Earth, the number of species that they comprise (250,000), the largest of the class Insecta, which groups more than one million species and the many species that cause damage to global agriculture.The material was collected using Barber soil traps, from a wheat culture for consumption in the town of Delesti, Vaslui County.The observations were made in 2017, the material was collected from May to October. The material was harvested at intervals between 8 and 17 days, with a total of 5 harvests.The species most frequently collected were Opatrum sabulosum L., Otiorrhynchus raucus F., cupreus Carabus L., Pseudophonus rufîpes, Harpalus aeneus Amara aenea F.şi Payk.*
Key words: diversity, Coleoptera, wheat, useful fauna, harmful fauna.

Rezumat. *Studiul coleopterelor (gândacii) apare ca o necesitate ştiinţifică şi practică având în vedere mai ales frecvenţa lor pe meridianele Terrei, a numărului mare de specii ce le cuprinde(peste 250.000), cel mai mare din clasa Insecta, care grupează peste un million de specii şi a numeroaselor specii care produc pagube agriculturii mondiale. Colectarea materialului s-a făcut cu ajutorul capcanelor de sol tip Barber, dintr-o cultura de grâu pentru consum din localitatea Deleşti, judeţul Vaslui.Observaţiile au fost efectuate în anul 2017, colectarea materialului s-a făcut din luna mai până în luna octombrie. Recoltarea materialului s-a făcut la intervale cuprinse între 8 şi 17 zile, în total efectuându-se un număr de 5 recoltări.Speciile cel mai frecvent colectate, au fost: Opatrum sabulosum L.,Otiorrhynchus raucus F., Carabus cupreus L., Pseudophonus rufipes, Harpalus aeneus F.şi Amara aenea Payk*
Cuvinte cheie: diversitate, coleoptere, grâu, faună utilă, faună dăunătoare.

INTRODUCTION

Of the total number of species of animals inhabiting the land, insects are responsible for about 70%. Every year specialists entomologists discover and describe hundreds of thousands of new species, and according to recent data from the literature, are known worldwide about 2 million species of insects.

Among insects, Coleoptera is the largest and most diverse order, which meets over 350,000 global fauna species.

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Coleopterans are insects of different sizes, ranging from 0.25mm (Ptilliidae) to the most giant (Titanus giganteus, Cerambycidae) reaching up to 25 cm.

With great ecological plasticity, the beetles are found in all ecosystems - from the polar regions to the equatorial forests. They are common in almost all types of habitats, they feed on any kind of food. Numerically, the coleopteran insects are superior to other groups, constituting the majority of more than 80% of the total ecosystem insect species exist.

Coleopters perform various useful functions for humans, are good indicators, can serve as one of the main objects in solving the problems of cadastre and integrated ecological monitoring (Baban, 2006)

This paper presents the species of beetles found in a wheat crop in eastern Romania, Vaslui beetle fauna of this area remains poorly studied so far.

MATERIAL AND METHOD

The data presented in the paper were obtained following the observations made in 2017 in a wheat crop located in the Delesti-Vaslui area.

Observations have been made since May, after planting until the beginning of August. Coleopters were captured with Barber soil traps.

A total of 18 traps were installed in 3 variants, 6 each for each variant:

- wheat after wheat, V1
- wheat after sunflower, V2
- wheat after maize, V3

Samples were harvested at 15-day intervals when the material was trapped in gauze, and each sample was recorded as follows:

- date of collection,
- the number of traps (from 1 to 6);
- Experimental variant.

The material thus labeled was brought to the laboratory, was then cleaned of all vegetal remains, and then from the collected material were selected only coleopteran species.

As a methodological and theoretical-scientific support for the investigations carried out, they served the fundamental works and research of the authors: E. Csiki, S. Panin and N. Săvulescu , Z. Neculiseanu and A. Matalin, M.Talmaciu *et al*. , M.Varvara .

The data from the methodological works of E. Miller and N. Zubovschi , Ienistea M. , S. Panin , N. Săvulescu , Reitter E. , Paul Gîdei, Ionuț Ştefan Iorgu and Elena Iulia Pisică , were used by us for the collection, determination, inventory and classification of existing coleopteras.

For studies refer to the structure, dynamics and other aspects of the species of beetles were used M.Varvara work of authors, Ionuț Ştefan Iorgu and Elena Iulia Pisică, M.Tălmaciu *et all.*

RESULTS AND DISCUSSIONS

They were collected in total 3052 samples from 97 species belonging to the three experimental variants.

The situation is the following:

- variant V1, a number of 1185 copies
- variant V2, a number of 987 copies
- variant V3, a number of 880 copies

The largest number of specimens collected were: *Gryllus campestris* Gyll with 654 specimens, representing 21.4% of the total species collected, *Formicomus pedestris* R. with 408 specimens, representing 13.4% of the total species harvested *Dermestes laniarius* L. with 393 specimens, representing 12.9% of the total species collected, *Opatrum sabulosum* L. with 314 specimens, representing 10.3% of the total collected species, *Otiorrhynchus pinastri* L.with 235 specimens, representing 7.7% of the total collected species.

In terms of coleoptera species (tab. 1), 1944 specimens were collected in total, the highest number of specimens collected were:

Table 1

The structure and abundance of species of beetles in wheat existing in the Delesti Vaslui

No.	Scientific name	Variant			Total
		1	2	3	
1.	Formicomus pedestris Rossi	116	210	82	408
2.	Dermestes laniarius L.	165	168	60	393
3.	Opatrum sabulosum L.	123	75	116	314
4.	Otiorrhynchus pinastri Latreille	60	80	95	235
5.	Idiochroma dorsalis Pontopp.	11	13	61	85
6.	Anthicus floralis L.	20	14	13	47
7.	Pteryngium crenatum Fabricius	15	10	22	47
8.	Anthicus humilis Germ.	26	10	8	44
9.	Conosoma bipunctatum Gravenhorst	7	17	19	43
10.	Coccinella 7 punctata L.	14	7	16	37
11.	Pentodon idiota Hbst	6	12	8	26
12.	Otiorrhynchus orbicularis	5	5	10	20
13.	Pterostichus cupreus L.	6	3	9	18
14.	Agriotes lineatus L.	4	3	6	13
15.	Epicometis hirta Poda	7	3	1	11
16.	Harpalus distinguendus Duft	4	4	3	11
17.	Cypticus quisquilius L.	2	8		10
18.	Eurygaster spp. Laporte	1	6	3	10
19.	Micraspis 12 punctata Linnnaeus	5	3	2	10
20.	Tanymecus dilaticollis Gyll.		2	8	10
21.	Aelia spp.	9			9
22.	Ophonus obscurus Fabricius	9			9
23.	Harpalus aeneus Panzer	4	1	3	8
24.	Metabletus truncatelus L. L.	1	3	4	8
25.	Agriotes ustulatus Schaller	1	3	3	7
26.	Hister stercorarius	1	1	4	6
27.	Letrus apterus	3	1	2	6
28.	Zabrus blapoides		2	3	5
29.	Anthicus quadriguttatus Haldeman		4		4
30.	Carabus coriaceus Linnaeus	3	1		4
31.	Amara eurynota Panz.		2	1	3
32.	Anisodactylus binotatus F.			3	3

33.	Cetonia aurata L.	1	1	1	3
34.	Harpalus tardus Panzer	1	1	1	3
35.	Pleurophorus caesus Panz.		3		3
36.	Pseudophonus griseus Panzer	2		1	3
37.	Podonta nigrita		1	2	3
38.	Tachyusa constricta Erichson	1	2		3
39.	Anisodactilus signatus	2			2
40.	Atomaria linearis Stephens			2	2
41.	Calathus fuscipes Goeze			2	2
42.	Cantharis fusca L.	1		1	2
43.	Carabus cupreus		2		2
44.	Cartodere ruficollis Marsh		1	1	2
45.	Cymindis axillaris Fabricius			2	2
46.	Dorcadion fulvum		1	1	2
47.	Exosoma lusitanicum Linnaeus		2		2
48.	Ophonus azureus F.		1	1	2
49.	Otiorrhynchus laevigatus Fabricius	1		1	2
50.	Otho spondiloides	1		1	2
51.	Phyllotreta vittula Redtenbacher	2			2
52.	Pterosthichus nigrita Paykull	2			2
53.	Silpha obscura L.	1		1	2
54.	Zabrus tenebrioides Goeze.		2		2
55.	Abax ovalis Duftschmid	1			1
56.	Amara aenea Dejean	1			1
57.	Apion tenue Herbst.	1			1
58.	Apion virens Herbst			1	1
59.	Apion urticarium Herbst.			1	1
60.	Aphthona euphorbia Schrank	1			1
61.	Carabus crenatus Duftschmid		1		1
62.	Ceutorrynchus scapularis Germar			1	1
63.	Cicindela campestris Linnaeus		1		1
64.	Combocerus glaber Schaller			1	1
65.	Cryptophagus subdepressus Gyllenhal		1		1
66.	Cynegetis punctata Linnaeus		1		1
67.	Dolicaon biguttatus			1	1
68.	Dorcadion pedestre Poda		1		1
69.	Dolichosoma lineare Rossi			1	1
70.	Harpalus calceatus Duftschmid			1	1
71.	Hister bimaculatus		1		1
72.	Malachius marginellus Fabricius			1	1
73.	Medon obsoletus	1			1
74.	Otiorrhynchus fuscipes Stierlin & W.G.	1			1
75.	Otiorrhynchus raucus	1			1
76.	Phyllotreta atra Fabricius	1			1
77.	Platynaspis luteorubra Goeze			1	1
78.	Poecilus dimidiatus G.A.Olivier	1			1
79.	Pseudophonus rufipes De Geer	1			1
80.	Selatosomus bipustulatus			1	1
81.	Quedius cruentus Olivier			1	1
82.	Quedius molochinus	1			1

83.	Staphylinus caesareus Cederhjelm			1	1
84.	Tachinus subterraneus Linnaeus	1			1
TOTAL		**655**	**694**	**595**	**1944**

Depending on the food they consume, the coleopteran species have been grouped into 3 categories:

- useful species that are predatory, feeding on insects or other invertebrates;
- Species cited in the literature as harmful to some cultivated plants;
- species of coleoptera which do not cause damage to cultivated plants but which have a phytophagous feed regime.From the analysis of the collected material in relation to the food spectrum, the situation is as follows:
- a total of 25 species totaling 1031 specimens of coleoptera are quoted in the literature as not harmful

Of these, the most numerous were: *Formicomus pedestris Rossi* with 408 specimens, *Dermestes laniarius L* with 393 specimens, *Anthicus floralis L.* with 47 specimens, *Pteryngium crenatum Fabricius* with 47 specimens and *Anthicus humilis Germ.* with 44 copies (tab. 2)

- 41 species of 858 specimens of coleoptera are cited in the literature as harmful.

The most common were: *Opatrum sabulosum L.* with 314 specimens, *Otiorrhynchus pinastri Latreille* with 235 specimens, *Idiochroma dorsalis Pontopp.* with 85 specimens, *Conosoma bipunctatum Gravenhorst* with 43 specimens, *Otiorrhynchus orbicularis* with 20 copies (tab. 3).

- useful coleopteran species belonging to a number of 13, with a total of 55 specimens.

Table 2

Coleoptera species collected that does not cause damage to crop plants

No.	Scientific name	Variant			Total
		1	**2**	**3**	
1.	Formicomus pedestris Rossi	116	210	82	408
2.	Dermestes laniarius L.	165	168	60	393
3.	Anthicus floralis L.	20	14	13	47
4.	Pteryngium crenatum Fabricius	15	10	22	47
5.	Anthicus humilis Germ.	26	10	8	44
6.	Harpalus distinguendus Duft	4	4	3	11
7.	Hypnoidus pulchellus Linnaeus	4	5	1	**10**
8.	Cypticus quisquilius L.	2	8		10
9.	Oxyporus rufus Linnaeus	9	-	-	**9**
10.	Ophonus obscurus Fabricius	9			9
11.	Harpalus aeneus Panzer	4	1	3	8
12.	Amara aenea Dejean	1	4	2	**7**
13.	Anthicus quadriguttatus Haldeman		4		4
14.	Pleurophorus caesus Panz.		3		3
15.	Cetonia aurata L.	1	1	1	3
16.	Harpalus tardus Panzer	1	1	1	3
17.	Amara eurynota Panz.		2	1	3
18.	Silpha obscura L.	1		1	2

19.	Ophonus azureus F.		1	1	2
20.	Cantharis fusca L.	1		1	2
21.	Atomaria linearis Stephens			2	2
22.	Cryptophagus subdepressus Gyllenhal		1		1
23.	Harpalus calceatus Duftschmid			1	1
24.	Cynegetis punctata Linnaeus		1		1
25.	Amara aenea Dejean	1			1
TOTAL		380	448	203	1031

Tabel 3

Species of harmful coleopterans identified in wheat crops

No.	Scientific name	Variant			Total
		1	2	3	
1.	Opatrum sabulosum L.	123	75	116	314
2.	Otiorrhynchus pinastri Latreille	60	80	95	235
3.	Idiochroma dorsalis Pontopp.	11	13	61	85
4.	Conosoma bipunctatum Gravenhorst	7	17	19	43
5.	Otiorrhynchus orbicularis	5	5	10	20
6.	Pterostichus cupreus L.	6	3	9	18
7.	Tanymecus dilaticollis Gyll.		2	8	10
8.	Pentodon idiota Hbst	6	12	8	26
9.	Agriotes lineatus L.	4	3	6	13
10.	Metabletus truncatelus L. L.	1	3	4	8
11.	Hister stercorarius	1	1	4	6
12.	Eurygaster spp. Laporte	1	6	3	10
13.	Agriotes ustulatus Schaller	1	3	3	7
14.	Zabrus blapoides		2	3	5
15.	Anisodactylus binotatus F.			3	3
16.	Letrus apterus	3	1	2	6
17.	Calathus fuscipes Goeze			2	2
18.	Cymindis axillaris Fabricius			2	2
19.	Epicometis hirta Poda	7	3	1	11
20.	Staphylinus caesareus Cederhjelm			1	1
21.	Malachius marginellus Fabricius			1	1
22.	Apion virens Herbst			1	1
23.	Apion urticarium Herbst.			1	1
24.	Ceutorrynchus scapularis Germar			1	1
25.	Pseudophonus griseus Panzer	2		1	3
26.	Cartodere ruficollis Marsh		1	1	2
27.	Dorcadion fulvum		1	1	2
28.	Otiorrhynchus laevigatus Fabricius	1		1	2
29.	Otho spondiloides	1		1	2
30.	Tachyusa constricta Erichson	1	2		3
31.	Pterosthichus nigrita Paykull	2			2
32.	Anisodactilus signatus	2			2
33.	Tachinus subterraneus Linnaeus	1			1
34.	Hister bimaculatus		1		1
35.	Medon obsoletus	1			1
36.	Apion tenue Herbst.	1			1
37.	Aphthona euphorbia Schrank	1			1

38.	Otiorrhynchus fuscipes Stierlin & W.G.	1			1
39.	Otiorrhynchus raucus	1			1
40.	Exosoma lusitanicum Linnaeus		2		2
41.	Phyllotreta vittula Redtenbacher	2			2
TOTAL		253	236	369	858

CONCLUSIONS

1. In total, the three variants were collected from coleoptera wheat cultures belonging to a number of 97 species, amounting to 3052 specimens; the situation is the following:

- wheat version of wheat V1, 1185 specimens
- in wheat version after sunflower V2, a number of 987 copies
- wheat version of corn V3, 880 specimens

2. The largest number of specimens had the following species: Formicomus pedestris Rossi, 408 specimens, Dermestes laniarius L., 393 specimens, Opatrum sabulosum L., with 314 specimens, Otiorrhynchus pinastri Latreille, 235 specimens, Idiochroma dorsalis Pontopp., with 85 copies.

3. In connection with the spectrum of the food, the situation is as follows

- a total of 25 species totaling 1031 specimens of coleoptera are quoted in the literature as not harmful

Among these, the most numerous were: Formicomus pedestris Rossi with 408 specimens, Dermestes laniarius L with 393 specimens, Anthicus floralis L. with 47 specimens, Pteryngium crenatum Fabricius with 47 specimens and Anthicus humilis Germ. with 44 copies.

- 41 species of 858 specimens of coleoptera are cited in the literature as harmful.
- useful coleopteran species belonging to a number of 13, with a total of 55 specimens.
- Coccinella 7 punctata L. is part of the group of shock predators, in cereal crops, the Coccinella 7 punctata determines the mean, equal or lower levels of aphids than those caused by insecticides by chemical treatments.
- Harpalus aeneus Panzer Feeds eggs and corn poppy larvae with eggs and cracked bugs and other insects.
- Pterosthichus nigrita has adult and predatory larvae of larvae and bowel hoofs of wheat flowers
- Anthicus floralis has omnivorous adults, knowing that they consume small arthropods, pollen, mushrooms, and anything else they can find. Some species are of interest as biological control agents because they can consume eggs or pests of pests.

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OBSERVATIONS ON THE EPIGENOUS FAUNA OF WHEAT CROP IN THE CONDITIONS OF 2017

OBSERVAȚII CU PRIVIRE LA FAUNA EPIGEE DIN CULTURILE DE GRÂU ÎN CONDIȚIILE ANULUI 2017

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Abstract. *The observations were made in 2017, in a wheat crop located in the eastern area of Romania, in the county of Vaslui. The material was harvested using the soil traps type Barber and entomological mesh, during which several harvests of the material were made at intervals of 8 to 15 days. From the collected biological material, were retained all the species belonging to the epigee fauna, which were then determined by means of the determiners (Reitter, Panin, etc.). Following the records was established the specific structure from wheat crop, their dynamics and their abundance.The most frequently collected species were: Heteroptera, Hymenoptera, Diptera, Aracnidae, Orthoptera, and of course those belonging to the order of Coleoptera (Pseudophonus rufipes Mull., Dermestes laniarius Illig., Harpalus aeneus F., Harpalus distinendus Duft., Ophonus azureus F., Opatrum sabulosum L., Otiorrhynchus raucus F., Carabus violaceus L., Pseudophonus rufipes, Harpalus aeneus F.şi Amara crenata Payk) etc..*
Key words: wheat, epigenous fauna, species, pests

Rezumat. *Observațiile au fost făcute în anul 2017, într-o cultură de grâu amplasată în zona de Est a României, din județul Vaslui. Colectarea materialului s-a făcut cu ajutorul capcanelor de sol tip Barber şi a fileului entomologic, perioada în care s-au făcut mai multe recoltări ale materialului, la intervale de 8 -15 zile. Din materialul biologic colectat, au fost reținute toate speciile ce aparțin faunei epigee, care au fost apoi determinate cu ajutorul determinatoarelor (Reitter, Panin etc.). În urma înregistrărilor a fost stabilită structura specifică culturii de grâu, dinamica şi abundența acestora.Speciile cel mai frecvent colectate au fost: Heteroptera, Hymenoptera, Diptera, Aracnidae, Orthoptera, si bineinteles cele ce apartin ordinului Coleoptera (Pseudophonus rufipes Mull., Dermestes laniarius Illig., Harpalus aeneus F., Harpalus distinendus Duft., Ophonus azureus F., Opatrum sabulosum L., Otiorrhynchus raucus F., Carabus violaceus L., Pseudophonus rufipes, Harpalus aeneus F.și Amara crenata Payk) etc..*
Cuvinte cheie: grâu, fauna epigee , specii, dăunători.

INTRODUCTION

Different species of pests can cause damage both in terms of quantity and quality, the wheat was in any phase of vegetation. There are species of pests

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whose development cycle takes place entirely in cereal crops, such as cockroaches humpbacked flies cereals, some aphid species, the red worm straw, grain trips, wheat wasps, carabus cereals.

Wheat is the default host and favorite food for most species of pests specific cereal grains. Evolution wheat pests is influenced by ecological conditions in the wheat fields.

Data on specific diversity of entomofauna in the various crops in Romania were published by: Manolache and Boguleanu, 1967; Lăcătuşu *et al*., 1981; Voicu et al., 1983; Boguleanu, 1994; Perju and Ghizdavu, 2001; Manole et al., 2009; Bucur and Roşca, 2011; Tălmaciu & Tălmaciu, 2011; Buşmachiu and Bacal, 2012 etc. Cultures of wheat in Romania are attacked by a number of pests, causing major damages.

MATERIAL AND METHOD

For the collection of the traps were used Barber ground. They were located in the wheat crops in Vaslui county, with 6 traps per variant, namely:

- Wheat by wheat;
- wheat after sunflower;
- wheat per maize.

The traps were placed in two rows, each 3 row at spaced between 6 and 8 m and between two rows at the distance of about 10 m. For capturing and killing species collected using a solution of formalin in a concentration of 4 -5 %. The traps were operated from May to late July.

Fig.1 Field placement of soil traps type Barber

Harvesting the collected material was done at intervals between 10 and 20 days, the year 2017. At each harvest collected from each variant species and trap were placed in gauze, prior to removing the plant debris, dirt particles or other impurities, and then labeled, on the label specifying:

- date of collection;
- variant;
- trap number.

The material was then brought to the laboratory and after washing under a stream of water, each species was identified, or counted the specimens collected for each trap, on variants and species.

Fig.2 Selecting and identifying the species

Determination was done using the German determinant, Reitter, 1908, Rogojanu, Panin Sergiu, with the help of other determiners and the Internet, for comparison of the different species with the images on the internet.

RESULTS AND DISCUSSIONS

In total, 3052 specimens belonging to 97 species (taxons) were collected in the three variants. On variants, the situation is as follows (tab. 1, fig. 3):
- wheat after wheat 1185 specimens belonging to a number of 58 species;
- in the case of wheat after sunflower, 987 specimens were collected in total, belonging to a number of 56 species (taxa);
- wheat after maize , 880 specimens were collected belonging to a number of 62 species (taxa).

Table 1

The structure and abundance of species existing in wheat crops, in the Deleşti-Vaslui area

No.	Scientific name	Variant			Total
		1	2	3	
1.	Gryllus campestris Gyll	438	136	80	654
2.	Formicomus pedestris Rossi	116	210	82	408
3.	Dermestes laniarius L.	165	168	60	393
4.	Opatrum sabulosum L.	123	75	116	314
5.	Otiorrhynchus pinastri Latreille	60	80	95	235
6.	Furnici	20	83	126	229
7.	Diptere	40	30	41	111
8.	Idiochroma dorsalis Pontopp.	11	13	61	85
9.	Anthicus floralis L.	20	14	13	47
10.	Pteryngium crenatum Fabricius	15	10	22	47
11.	Anthicus humilis Germ.	26	10	8	44
12.	Conosoma bipunctatum Gravenhorst	7	17	19	43
13.	Coccinella 7 punctata L.	14	7	16	37
14.	Hymenoptere	10	18	8	36
15.	Afide	6	11	14	31
16.	Pentodon idiota Hbst	6	12	8	26
17.	Heteroptere	7	10	8	25

18.	Otiorrhynchus orbicularis	5	5	10	20
19.	Pterostichus cupreus L.	6	3	9	18
20.	Cicade	8	2	5	15
21.	Agriotes lineatus L.	4	3	6	13
22.	Epicometis hirta Poda	7	3	1	11
23.	Harpalus distinguendus Duft	4	4	3	11
24.	Cypticus quisquilius L.	2	8		10
25.	Eurygaster spp. Laporte	1	6	3	10
26.	Micraspis 12 punctata Linnnaeus	5	3	2	10
27.	Tanymecus dilaticollis Gyll.		2	8	10
28.	Aelia spp.	9			9
29.	Ophonus obscurus Fabricius	9			9
30.	Harpalus aeneus Panzer	4	1	3	8
31.	Metabletus truncatelus L. L.	1	3	4	8
32.	Agriotes ustulatus Schaller	1	3	3	7
33.	Hister stercorarius	1	1	4	6
34.	Letrus apterus	3	1	2	6
35.	Zabrus blapoides		2	3	5
36.	Anthicus quadriguttatus Haldeman		4		4
37.	Carabus coriaceus Linnaeus	3	1		4
38.	Amara eurynota Panz.		2	1	3
39.	Anisodactylus binotatus F.			3	3
40.	Cetonia aurata L.	1	1	1	3
41.	Harpalus tardus Panzer	1	1	1	3
42.	Pleurophorus caesus Panz.		3		3
43.	Pseudophonus griseus Panzer	2		1	3
44.	Podonta nigrita		1	2	3
45.	Tachyusa constricta Erichson	1	2		3
46.	Anisodactilus signatus	2			2
47.	Atomaria linearis Stephens			2	2
48.	Calathus fuscipes Goeze			2	2
49.	Cantharis fusca L.	1		1	2
50.	Carabus cupreus		2		2
51.	Cartodere ruficollis Marsh		1	1	2
52.	Cymindis axillaris Fabricius			2	2
53.	Dorcadion fulvum		1	1	2
54.	Exosoma lusitanicum Linnaeus		2		2
55.	Gryllotalpa gryllotalpa Linnaeus			2	2
56.	Ophonus azureus F.		1	1	2
57.	Otiorrhynchus laevigatus Fabricius	1		1	2
58.	Otho spondiloides	1		1	2
59.	Phyllotreta vittula Redtenbacher	2			2
60.	Pterosthichus nigrita Paykull	2			2
61.	Silpha obscura L.	1		1	2
62.	Zabrus tenebrioides Goeze.		2		2
63.	Abax ovalis Duftschmid	1			1
64.	Amara aenea Dejean	1			1
65.	Apion tenue Herbst.	1			1
66.	Apion virens Herbst			1	1
67.	Apion urticarium Herbst.			1	1

68.	Aphthona euphorbia Schrank	1			1
69.	Carabus crenatus Duftschmid		1		1
70.	Ceutorrynchus scapularis Germar			1	1
71.	Cicindela campestris Linnaeus		1		1
72.	Combocerus glaber Schaller			1	1
73.	Cryptophagus subdepressus Gyllenhal		1		1
74.	Cynegetis punctata Linnaeus		1		1
75.	Dolicaon biguttatus			1	1
76.	Dorcadion pedestre Poda		1		1
77.	Dolichosoma lineare Rossi			1	1
78.	Harpalus calceatus Duftschmid			1	1
79.	Hister bimaculatus		1		1
80.	Hydrophorus vittula Clairville		1		1
81.	Malachius marginellus Fabricius			1	1
82.	Medon obsoletus	1			1
83.	Otiorrhynchus fuscipes Stierlin & W.G.	1			1
84.	Otiorrhynchus raucus	1			1
85.	Oxypora annularis	1			1
86.	Philontus speldens Steph.		1		1
87.	Phyllotreta atra Fabricius	1			1
88.	Platynaspis luteorubra Goeze			1	1
89.	Poecilus dimidiatus G.A.Olivier	1			1
90.	Pseudophonus rufipes De Geer	1			1
91.	Selatosomus bipustulatus			1	1
92.	Quedius cruentus Olivier			1	1
93.	Quedius molochinus	1			1
94.	Staphylinus caesareus Cederhjelm			1	1
95.	Stilicus angustatus		1		1
96.	Tachinus subterraneus Linnaeus	1			1
97.	Zyras collaris			1	1
TOTAL		**1185**	**987**	**880**	**3052**

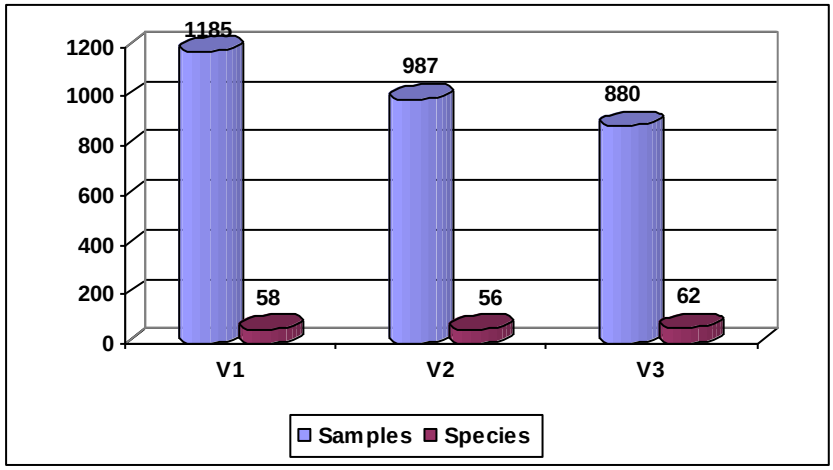

Fig.3 The number of individuals and the 3 species collected

A total of 32 species were collected in the three experimental variants common, these being: *Gryllus campestris* Gyll, *Formicomus pedestris* Rossi, *Dermestes laniarius* L., *Opatrum sabulosum* L., *Otiorrhynchus pinastri* Latreille, *Furnici , Diptere , Idiochroma dorsalis* Pontopp., *Anthicus floralis* L., *Pteryngium crenatum* Fabricius, *Anthicus humilis* Germ., *Conosoma bipunctatum* Gravenhorst, *Coccinella 7 punctata* L., *Hymenoptere , Afide , Pentodon idiota* Hbst, *Heteroptere, Otiorrhynchus orbicularis, Pterostichus cupreus* L., *Cicade ,Agriotes lineatus* L., *Epicometis hirta* Poda, *Harpalus distinguendus* Duft, *Eurygaster* spp. Laporte, *Micraspis 12 punctata* Linnnaeus, *Harpalus aeneus* Panzer, *Metabletus truncatelus* L., *Agriotes ustulatus* Schaller, *Hister stercorarius, Letrus apterus, Cetonia aurata* L., *Harpalus tardus* Panzer.

The largest number of specimens collected in the three variants, over 50 specimens, had a number of 18 species. Of these we mention (tab. 2): *Gryllus campestris* Gyll, with 654 copies representing 21.4% of the total; *Formicomus pedestris* Rossi, with a total of 408 copies, representing 13.4% of the total; *Dermestes laniarius* L., with 393 copies, representing 12.9% of the total; *Opatrum sabulosum* L., with a total of 314 copies, representing 10.3% of the total; *Otiorrhynchus pinastri* Latreille, with 235 copies, representing 7.7% of the total; *Ants*, with 229 copies, representing 7.5% of the total; *Diptere*, with 111 copies, representing 3.6% of the total; *Idiochroma dorsalis* Pontopp., with 85 copies, representing 2.8% of the total; *Anthicus floralis* L., with 47 copies, representing 1.5% of the total.

Tabel 2

The structure of species (taxa) with the highest number of specimens collected

No.	Scientific name	Total	%
1.	Gryllus campestris Gyll	654	21.4
2.	Formicomus pedestris Rossi	408	13.4
3.	Dermestes laniarius L.	393	12.9
4.	Opatrum sabulosum L.	314	10.3
5.	Otiorrhynchus pinastri Latreille	235	7.7
6.	Furnici	229	7.5
7.	Diptere	111	3.6
8.	Idiochroma dorsalis Pontopp.	85	2.8
9.	Anthicus floralis L.	47	1.5
10.	Pteryngium crenatum Fabricius	47	1.5
11.	Anthicus humilis Germ.	44	1.4
12.	Conosoma bipunctatum Gravenhorst	43	1.4
13.	Coccinella 7 punctata L.	37	1.2
14.	Hymenoptere	36	1.1
15.	Afide	31	1.0
16.	Pentodon idiota Hbst	26	0.9
17.	Plosnita	25	0.8
18.	Otiorrhynchus orbicularis	20	0.7
TOTAL	**3052**	2131	100

CONCLUSIONS

1. In the three variants, 3052 specimens were collected from a number of 97 invertebrate species from wheat cultures. On variants, the situation is as follows:
- At V1, wheat per wheat 1185 specimens belonging to a number of 58 species;
- at V2, wheat after sunflower was collected 987 specimens in total, belonging to a number of 56 species (taxons);
- at V3, wheat after maize was collected 880 specimens in total, belonging to a number of 62 species (taxons);
2. During the observation period, a total of 32 species were common to the three experimental variants.
3. A number of 18 species had 2131 copies. The species with the largest number of specimens were: *Gryllus campestris* Gyll, with 654 specimens; *Formicomus pedestris* Rossi, with a total of 408 copies; *Dermestes laniarius* L., with a number of 393 specimens; *Opatrum sabulosum* L., with a total of 314 specimens; *Otiorrhynchus pinastri* Latreille., With a number of 235 specimens; Ants, with 229 copies, representing 7.5% of the total; *Idiochroma dorsalis Pontopp*., With a total of 85 specimens; *Anthicus floralis* L., with a total of 47 specimens.

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DIVERSITY OF SMALL MAMMALS AND INTERSPECIFIC RELATIONSHIPS IN APPLE ORCHARD

DIVERSITATEA MAMIFERELOR MICI ŞI RELAŢIILE INTERSPECIFICE STABILITE ÎN CADRUL UNEI LIVEZI DE MĂR

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Abstract. *This study was realized from April 2017 to August 2018 in a conventional apple orchard from Delesti (Vaslui, Romania). The goal of this research was relations and species diversity of small mammals from this agroecosystem. A total of 8 small mammals species were identified during the research time. Out of small mammals identified, the species Mus spicilegus and Apodemus sylvaticus are cohabitant species, while dominant species is Microtus arvalis. The results reveal that the structure of small mammals communities is correlate with condition of habitat and also, with intensity of agrotechnical procedures carried out during the vegetative season.*

Key words: apple orchard, diversity, rodents, insectivores

Rezumat. *Studiul realizat în perioada aprilie 2017 – august 2018, urmăreşte biodiversitatea mamiferelor mici dintr-o livadă convenţională de meri din localitatea Deleşti, Vaslui (România). 8 specii de mamifere mici au fost identificate în timpul cercetării. Dintre mamiferele mici, speciile Mus spicilegus şi Apodemus sylvaticus au fost specii coabitante în toată perioada de studiu, în timp ce specia dominantă în eşantioanele noastre a fost Microtus arvalis. Rezultatele obţinute au scos de asemenea în evidenţă, faptul că structura comunităţilor de mamifere mici şi diversitatea specifică sunt corelate pozitiv cu oferta de hrană şi habitat, precum şi cu intensitatea lucrărilor agrotehnice desfăşurate pe perioada sezonului vegetativ.*

Cuvinte cheie: livadă de meri, diversitate, rozătoare, insectivore

INTRODUCTION

Knowing the structure of a biocenosis by tracking it over time leads to an understanding of the mechanisms of self-regulation of these biological systems. This is currently the main objective of global environmental research, thus allowing the development of rational exploitation of natural resources and disease and pest control. In this context, the goal of this research is relations and species diversity of small mammals from the apple orhard agroecosystem.

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MATERIAL AND METHOD

The research was carried out between May-November 2017 and April-August 2018, in apple orchard in Delesti, Vaslui (N46.705864, E27.5797611). Monthly, samples were collected using live traps (30 live-trips). The distance between two successive traps was 15 m, respecting the rule that the distance between two successive traps is not greater than the radius of a circle with an area equal to the surface area of the target species (Jones *et al.*, 1996).

The time of a fieldwork session was 48 h/ month, during which traps were activated during the night to capture small mammals. Specimens were identified to species level. They were released after application of the individual marking (Ionescu et al., 2013).

The traps covered 7 types of vegetal carpet between rows of trees: type 1 – land covered with grassland; type 2 - land covered with *Lotus corniculatus*; type 3 - land covered with *Trifolium repens*; type 4 – land covered with *Trifolium pratense*; type 5 - land covered with *Medicago sativa*; type 6 - land covered with the mixture of the four leguminous species; type 7- untilled field.

Trap index for each studied period was computed by following formula (Jackson,1952):

Trap index (TI) =[Total no. of small mammals/ No. of trapping days xNo. of traps]*100

The differences between habitats were estimated by using some indices of Alpha and Beta diversity (Gomoiu and Skolka, 2001).

The correlation between species and types of vegetal carpet is evaluated using Correspondence Analysis.

RESULTS AND DISCUSSIONS

In total 63 rodents and insectivores were collected from the studied area during 2017 - 2018, of which 35 specimens were captured in 2017 and 28 specimens in 2018 (fig. 1). The trap index indicate no significant diferences between captures for the two period (One Way ANOVA: F = 0.36; p = 0.57), beeing in according with vegetative season and agrotechnical activities.

A total of 8 small mammal species were indentified during the collecting time: 5 species of rodents and 3 species of insectivores.

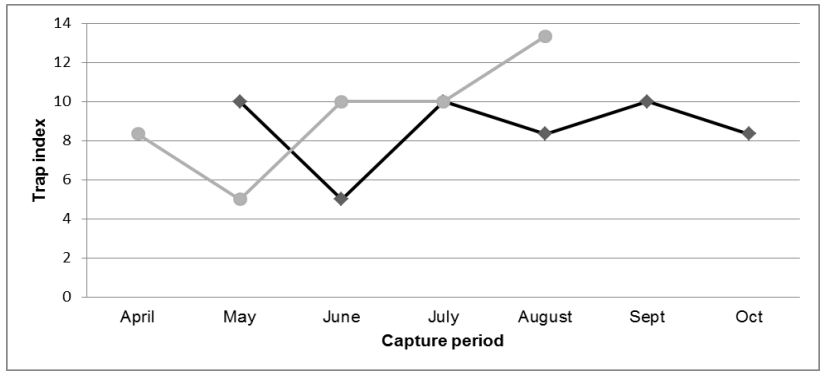

Fig. 1 Variation of Trap index of small mammals for collecting period (2017, 2018)

The most abundant species were *Microtus arvalis* (23.73% of total identified species) and *Mus musculus* (22.03%), followed by *Mus spicilegus* (13.56%) and *Sorex araneus* (11.86%).

Insectivores were poorly represented in the monthly samples in both collection periods (only 11.86% of total identifies). There were identified individuals of 3 species: *Sorex araneus*, *Crocidura suaveolens* and *Talpa europaea*.

In 2017 constant and coabitant species in studied area are *Mus spicilegus* and *Apodemus sylvaticus*, and in 2018 *Mus spicilegus* and *Sorex araneus*.

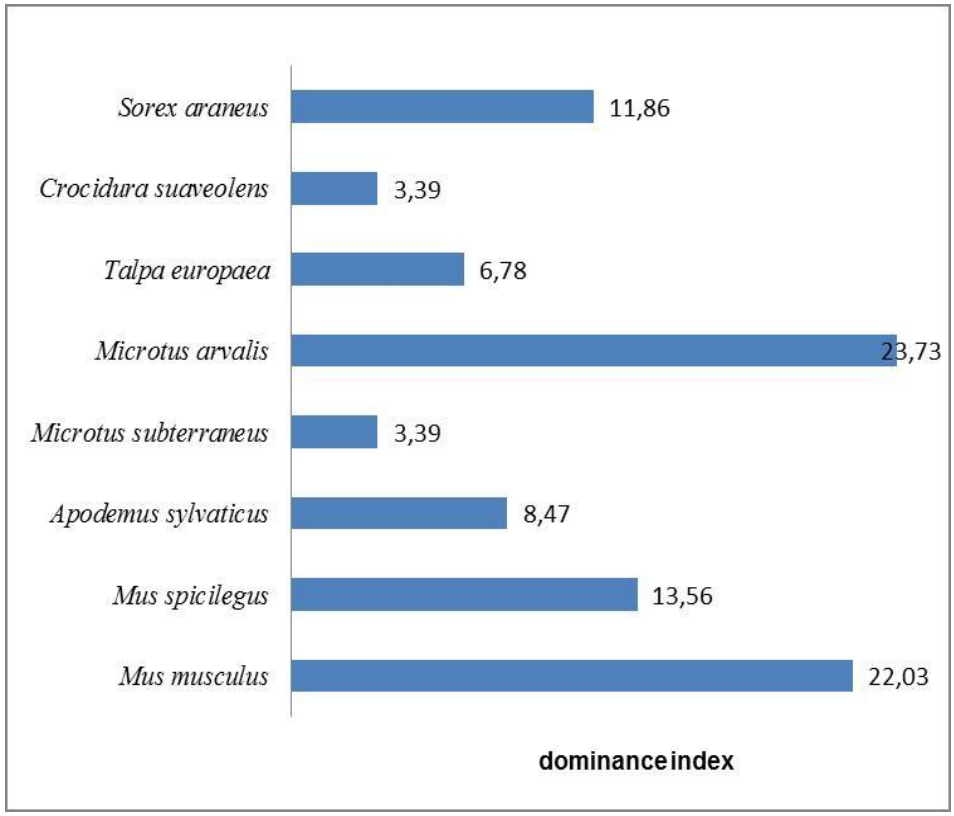

Fig. 2 Composition of small mammals in our samples

The values of diversity indices for every type of vegetal carpet are presented in table 1. Because there were no significant differences between the captures by type of vegetal cover (MANOVA: $F = 0.25$; $p = 0.6$), it cannot discuss about specific or intraspecific small mammals diversity between the types of vegetal carpets. Distance between these types is small and the mobility of the small mammals is much larger. An adult of *Mus spicilegus*

may have between 400 and 800 sqm and one of *Apodemus sylvaticus* may have an individual territory of up to 1200 sqm (Simionescu 1965, 1970; Popovici 2005, 2006).

Table 1

Diversity indices

INDEX	T1	T2	T3	T4	T5	T6	T7
Taxa	4	5	4	1	3	2	3
Simpson_1-D	0.72	0.8	0.7222	0	0.625	0.4444	0.625
Shannon_H	1.332	1.609	1.33	0	1.04	0.6365	1.04
Evenness_e^H/S	0.9473	1	0.9449	1	0.9428	0.9449	0.9428
Menhinick	1.789	2.236	1.633	0.7071	1.5	1.155	1.5
Margalef	1.864	2.485	1.674	0	1.443	0.9102	1.443
Equitability_J	0.961	1	0.9591	0	0.9464	0.9183	0.9464

The multivariate analysis applied gives us an overview of the similarity or difference between the types of vegetal carpets according to the captures of small mammals made and not according to the specific diversity characteristic of vegetal carpets.

T1, T2 and T3 types have a successive positioning and have as common characteristics the species *Apodemus sylvaticus*, *Mus musculus* and *Microtus arvalis*. The putting on the dimensional graph of the T4 and T6 is explained by the lack of common captured species. In T4 the species *Mus spicilegus*, *Apodemus sylvaticus* and *Crocidura suaveolens* were identified while in T6 *Microtus subterraneus*, *Microtus arvalis* and *Talpa europaea* were identified. A positive correlation between *Apodemus syvaticus* and *Sorex araneus* in the T2 could be explained by the lack of competition between these two species as they have different requirements regarding the trophic spectrum.

The small number of recaptured individuals (24% of captured species) it was not possible to study the population renewal degree.

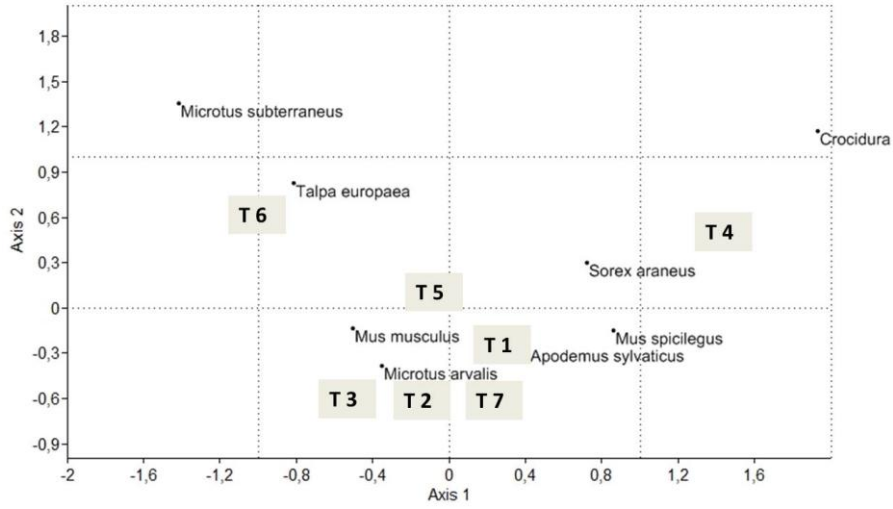

Fig.3 The graph of Correspondence Analysis (T1-7: types of vegetal carpet)

CONCLUSIONS

1. Of the total, 5 species of rodents and 3 species of insectivores were indentified during the research time.

2. The common and constant species in our samples were *Microtus arvalis* and *Mus musculus*.

3. Corespondence analysis show that is no significant correlation between species and type of vegetal carpet.

4. The structure of small mammals communities is correlate with condition of habitat and also, with intensity of agrotechnical procedures carried out during the vegetative season.

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RESEARCHES REGARDING THE ENTOMOFAUNA OF COLEOPTERAS (*COLEOPTERA*) FROM SOME CROPS OF N-E MOLDAVIA

CERCETĂRI PRIVIND ENTOMOFAUNA DE COLEOPTERE (COLEOPTERA) DIN UNELE CULTURI AGRICOLE DIN N-E MOLDOVEI

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Abstract. *The purpose of these research is to identify the useful entomofauna from the agricultural crops which have been taken for the study: maize and cabbage. The researches were carried out in the Adamachi station which belongs to "Ion Ionescu de la Brad" University of Iasi, Romania. The biological material was sampled by means of the Barber soil traps from 3rd of June until 13th of September 2016. In total, 15 samples were made for every crop. The traps were placed every five in a row. To prevent the maceration of insects, a conservative liquid was used (water+ washing powder) in proportion of 16%. After finishing the experiments, the insects were bringing to the laboratory of Entomology in order to be counted and determined. From the Coleoptera order, the most dominant species are:-within the crop of maize: Amara aenea (Carabidae)-5 samples; Coccinella septempunctata (Coccinellidae)-15 samples;-within the crop of cabbage*: *Brachinus crepitans* (*Carabidae*)*-9 samples.*

Key words: *Carabidae, Coccinellidae*, samples

Rezumat. *Scopul acestei lucrări ştiinţifice este acela de a identifica entomofauna utilă din culturile agricole care au fost luate spre studiu: porumb şi varză. Cercetările au fost effectuate în staţionarul Adamachi, care aparţine Universităţii de Ştiinţe Agricole şi Medicină Veterinară ''Ion Ionescu de la Brad'' din Iaşi, România. Matrialul biologic a fost colectat cu ajutorul capcanelor de sol tip Barber din data de 03.06.2016 până la data de 13.09.2016. În total, au fost effectuate 15 recoltări. Au fost amplasate câte 6 capcane pe rând. Pentru a preveni macerația insectelor, a fost folosit un lichid conservant, constând în apă şi detergent, în proporţie de 16%. După finalizarea experimentelor, insectele au fost aduse în laborator, acolo unde au fost inventariate şi determinate. Din ordinul Coleoptera, speciile dominante sunt:în cadrul culturii de porumb: Amara communis (Carabidae); Coccinella septempunctata (Coccinellidae)-15 exemplare; în cadrul culturii de varză: Brachinus crepitans (Carabidae)-9 samples.*

Cuvinte cheie: *Carabidae, Coccinellidae*, exemplare

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INTRODUCTION

One of the orders with the most predators that have a major importance in the reduction of pests is the *Coleoptera* order. This order has about 250000 species, a lot of these being very dangerous for the agricultural crops. The most important predators from this order belong to the following families: *Cicindelidae, Carabidae, Cantharidae and Coccinellidae*.

Coccinellidae family has species of round or oval species, almost hemispherical, with spots on the wings with color spots and contrasting patterns. The most species of *Coccinellidae* are benefical predators which prefer the aphids as main feed.

According to the author (Foltz, 2002), there are more than 5000 species all around the world. The most representative species of the *Coccinellidae* family are: *Coccinella 7-punctata, Adalia variegata, Chilocorus bipustulatus, Adalia bipunctata*.

MATERIAL AND METHOD

In order to carry out the researches, the insects were collected from one station: Adamachi from Iasi county, belonging to "Ion Ionescu de la Brad" University, by using the method of Barber soil traps. The experiments have taken place between June and September of 2016. The traps were placed within three crops: maize, cabbage and apple trees, each five in a row. As a conservative liquid, water and washing powder have been used, in order to prevent the maceration of insects. There were 15 samples in total, the first one took place on 3rd of June, and the last one on 13rd of September.

RESULTS AND DISCUSSIONS

The samples of the biological material were carried out at the following dates: 03.06, 07.06, 13.06, 20.06, 30.06., 05.07., 09.07, 14.07, 20.07, 25.07, 01.08, 07.08, 14.08, 07.09, 13.09 of 2016.

In the crop of maize (tab. 1), the situation is as follows:

03.06: there were 5 samples identified, 1 belonging to *Curculionidae* family: *Magdalis ruficornis* and 8 belonging to *Coccinellidae* family: *Coccinella 7-punctata*.

07.06: there was 1 sample identified, belonging to *Carabidae* family: *Carabus granulatus.*

13.06: there were 6 samples identified, 1 belonging to *Carabidae* family: *Anisodactylus binotatus* and 3 belonging to *Coccinellidae* family: *Coccinella 7-punctata* , *Harmonia axyridis* (two samples);

20.06: no samples were identified;

30.06: no samples were identified;

05.07: no samples were identified;

09.07: there were 7 samples identified, 1 belonging to *Carabidae* family: *Pterostichus melanarius* and 6 belonging to *Coccinellidae* family: *Coccinella septempunctata*.

14.07: there were 3 samples identified, belonging to *Carabidae* family: *Amara communis*.

20.07: there were 4 samples identified, all of them belonging to *Carabidae* family: *Anisodactylus signatus* (two samples), *Anisodactylus poeciloides* (two samples).

25.07: there were 2 samples identified, belonging to *Carabidae* family: *Amara aenea* (one sample), *Carabus nemoralis* (one sample).

01.08: there were 3 samples identified, all of them belonging to *Carabidae* family: *Amara communis* (two samples), *Pterostichus analis* (one sample).

07.08: there were 6 samples identified, all of them belong to *Carabidae* family: *Carabus obsoletus* (two samples), *Carabus nemoralis* (two samples), *Carabus violaceus* (two samples).

14.08: there were 8 samples identified, all of them belonging to *Carabidae* family: *Carabus obovatus* (three samples), *Brachinus crepitans* (two samples); *Amara aenea* (three samples).

07.09: there was 1 sample identified, belonging to *Carabidae* family: *Carabus nemoralis.*

13.09: there were 4 samples identified, all of them belonging to *Carabidae* family: *Brachinus crepitans* (two samples), *Anisodactylus signatus* (two samples).

In the crop of cabbage (*table 2*), the situation is as follows:

03.06: there were 2 samples identified, all of them belonging to *Carabidae* family: *Carabus nemoralis* (one sample), *Amara familiaris* (one sample).

07.06: no samples were identified;

13.06: there were 3 samples identified, 1 belonging to *Elateridae* family (*Agriotes lineatus*), one belonging to *Scarabaeidae* family: *Melolontha melolontha* and, one belonging to *Coccinellidae* family: *Coccinella septempunctata*.

20.06: no samples were identified;

30.06: there were 4 samples identified, 2 belonging to *Scarabaeidae* family: *Melolontha melolontha* and 2 belonging to *Elateridae* family: *Agriotes lineatus*.

05.07: there were 3 samples identified, one belonging to *Coccinellidae* family: *Coccinella septempunctata* and 2 belonging to *Carabidae* family: *Carabus nemoralis* (one sample), *Pterostichus cupreus* (one sample).

09.07: there were 7 samples identified, 2 belonging to *Scarabaeidae* family*: Melolontha melolontha*, 2 belonging to *Elateridaee* family: *Agriotes lineatus* and 3 belonging to *Carabidae* family: *Carabus nemoralis*.

14.07: there were 3 sample identified, all of them belonging to *Carabidae* family: *Carabus coriaceus*.

20.07: there were 4 samples identified, 1 belonging to *Scarabaeidae* family: *Melolontha melolontha* and 3 belonging to *Carabidae* family: *Anisodactylus verticalis* (two samples), *Pterostichus cupreus* (one sample).

25.07: there were 3 samples identified, 2 belonging to *Carabidae* family: *Pterostichus adoxus* and 1 belonging to *Curculionidae* family: *Otiorrhynchus niger*.

Table 1

Entomofauna of Coleopteras (Coleoptera) sampled within the crop of maize by means of the Barber soil traps in the Adamachi station from 3rd of June to 13rd of September of 2016

No.	Family	Species	Number of samples	Total samples
1	*Carabidae*	*Amara communis*	5	34
2		*Amara aenea*	4	
3		*Anisodactylus binotatus*	1	
4		*Anisodactylus signatus*	4	
5		*Anisodactylus poeciloides*	2	
6		*Brachunus crepitans*	4	
7		*Carabus granulatus*	1	
8		*Carabus nemoralis*	4	
9		*Carabus obsoletus*	2	
10		*Carabus violaceus*	2	
11		*Carabus obovatus*	3	
12		*Pterostichus melanarius*	1	
13		*Pterostichus analis*	1	
14	*Coccinellidae*	*Coccinella 7-punctata*	15	17
15		*Harmonia axyridis*	2	
16	*Curculionidae*	*Magdalis ruficornis*	1	1
Total Entomofauna of Coleopteras				**52**

01.08: there were 2 samples identified, all of them belonging to *Carabidae* family: *Brachinus crepitans.*

07.08: there were 6 samples identified, all of them belong to *Carabidae* family: *Carabus violaceus* (two samples), *Brachinus crepitans* (three samples), *Amara aenea* (one sample).

14.08: there were 2 samples identified, all of them belonging to *Carabidae* family: *Brachinus crepitans*.

07.09: there were 2 samples identified, all of them belonging to *Carabidae* family*: Pterostichus cupreus*.

13.09: there were 3 samples identified, all of them belonging to *Carabidae* family*: Brachinus crepitans* (two samples), *Carabus nemoralis* (one sample).

Table 2

Entomofauna of Coleopteras (Coleoptera) sampled within the crop of cabbage by means of Barber soil traps in the Adamachi station from 3rd of June to 13rd of September of 2016

No.	Family	Species	Number of samples	Total samples
1	*Carabidae*	*Amara aenea*	1	**30**
2		*Amara familiaris*	1	
3		*Anisodactylus verticalis*	2	
4		*Brachinus crepitans*	9	
5		*Carabus nemoralis*	6	
6		*Carabus coriaceus*	3	
7		*Carabus violaceus*	2	
8		*Pterostichus cupreus*	4	
9		*Pterostichus adoxus*	2	
10	*Scarabaeidae*	*Melolontha melolontha*	6	6
11	*Elateridae*	*Agriotes lineatus*	5	5
12	*Coccinellidae*	*Coccinella 7-punctata*	2	2
13	*Curculionidae*	*Otiorhynchus niger*	1	1
Total entomofauna of coleopteras				**44**

CONCLUSIONS

1. It can be concluded that, during the year of research 2016, within the crop of maize, from the total of 52 samples, the most significant number of samples belongs to *Carabidae* family (34), followed by *Coccinellidae* family (17) and *Curculionidae* (only 1 sample).
2. The most dominant species of *Carabidae* family is: *Amara communis* (5 samples) and the leastest are: *Anisodactylus binotatus*, *Carabus granulatus*, *Pterostichus melanarius* and *Pterostichus analis* (each 1 sample). The most dominant species of *Coccinellidae* family is: *Coccinella 7-punctata* (15 samples collected).
3. Within the crop of cabbage, from the total of 44 samples, the most significant number of samples belongs to *Carabidae* family (30), followed by *Scarabaeidae* family (6), *Elateridae* (5), *Coccinellidae* (2) and *Curculionidae* (only one sample).

4. The most dominant species of *Carabidae* family is: *Brachinus crepitans* (9 samples) and the leastest are: *Amara aenea* and *Amara familiaris* (each 1 sample). *Coccinellidae* family has 2 samples collected.

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THE RELATIONSHIP BETWEEN SOME MORPHOLOGICAL TRAITS AND YIELD ON ORGANIC CLIMBING BEANS

RELAȚIA DINTRE ANUMITE CARACTERISTICI MORFOLOGICE ŞI PRODUCȚIE LA FASOLEA URCĂTOARE ECOLOGICĂ

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Abstract. *The "components of yield" approach has been used widely to explain variations in the yield of grain legumes. The study has been conducted at Vegetable Research and Development Station (VRDS Buzau), under the normal testing conditions of 2018. The biological material was represented by 12 genotypes from the climbing beans* (*Phaseolus vulgaris* L.) *collectionof the Physiology, Agro-chemistry and Organic Crops Laboratory. A significant genetic variability has been found between climbing bean genotypes, for all indicators which have been analyzed. Some elements which define the pod architecture, the thickness and width have had a significant positive influence on yield indexes for climbing bean genotypes. Two lines of the climbing beans collection (L49M şi L6U) at VRDS Buzau have been identified with a very good performance in yield index on climatic conditions of 2018. These varieties could be used in the breeding program in agro-ecological system for obtaining new cultivars with a good performance in yield.*

Key words: collection, climbing bean, yield, morpho-agronomical traits

Rezumat. *Abordarea "componentelorrecoltei" a fostutilizată pe scară largă pentru a explica variațiile de producție la legumele pentru păstăi/boabe. Studiul a fostrealizat la Stațiunea de Cercetare-Dezvoltare pentru Legumicultură Buzău (SCDL Buzău), încondițiile de testare ale anului2018. Materialul biologic a fost reprezentat de 12 genotipuri din colecția de fasole (Phaseolus vulgaris L.) a Laboratorului de Fiziologie, Agrochimie şi Culturi Ecologice. O variabilitate genetică semnificativă a fost observată între genotipurile de fasole urcătoare, pentru toți indicatorii analizați. Unele elemente care definesc arhitectura păstăilor, grosimea şi lățimea acestora, au avut o influență pozitivă semnificativă asupra indicatorilor de producție, pentru genotipurile de fasole urcătoare. La SCDL Buzău au fost identificate două linii din colecția de fasole (L49M şi L6U), cu o foarte bună performanță în ceea ce priveşte indicele producție, în condițiile climatice din 2018. Aceste soiuri ar putea fi utilizate în programul de ameliorare în sistem agro-ecologic, pentru obținerea de noi soiuri, cu bune performanțe productive.*

Cuvinte cheie: colecție, fasole urcătoare, producție, caracteristici morfo-agronomice

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INTRODUCTION

One of the most important objectives in the germplasm management of any crop is to measure and quantify genetic variability available in the species. In this way breeders can estimate the crop's potential and limitations (Von Schoohoven, 1991). Common bean is one of the most legume crop in the world. It has a special role for rich and poor countries (Onderand Babaoglu, 2001).

In plant breeding, seed / yield index of a cultivar is usually the most important attribute for crop production (Dawo *et al.,* 2007). Seed yield in common bean is expressed as the product of 3 traits: pods/plant, seeds/pod and seed weight (Dawo *et al.,* 2007). According to Ayazet al. 2004 and Dawo et al., 2007, the highest seed yieldis obtained when all these characters are maximized. Researches focused on common bean have shown that differences in plant architectural traits affect yield (Nelson *et al.,* 1997). Genotype × environment interaction was significant for fresh pod traits such as curvature, length/width and width/thickness ratios, and texture, and for dry seed traits such as length/width and width/thickness ratios, volume, hardness and water absorption. There were high correlations of pod texture with seed length/width and width-thickness ratios, seed coat percentage, seed water absorption, crude fat, total sugars, starch content and crude fiber (Escribano *et al*., 1997).

This study was conducted to characterize relationships between some morpho agronomical traitsand yield index of several genotypes in climbing bean.

MATERIAL AND METHOD

The biological material was represented by 12 climbing bean lines collected from Romania and other countries for the germplasm collection of the Physiology, Agro-chemistry and Organic Crops Laboratory. The biological material has been grown in opened field on the ecological polygon, according to the crop technology in the agro-ecological system which was recommended by the scientific papers. Biometrical and morphological determinations of the pods and beans have been performed according to the C.P.V.O. protocol, being prepared the standard papers for measurements. This study presents the variability of pod and bean traits of the selected genotypes. 10 plants were used for the measurements. Pod and bean determinations have been made using the calipers, electronic balance (Kern) and analytical balance (Partner WAS220/X). The data have been analyzed using ANOVA statistical analysis Excel. The paper presents the results obtained for the characterization of the collection in terms of the fruit biometrical indicators. The coefficients correlation has been established that it has allowed the comparison of the variation for the dataset and regression coefficients. The database has been established into electronic system, also a digital images database has been taken using a Nikon 5100 digital camera with DSLR.

RESULTS AND DISCUSSIONS

The data have been analyzed by statistical program Data Analysis from Microsoft Office – Excel. For the pods length (tab. 1), width (tab. 2), thickness (tab. 3), the beans weight (tab. 4), the pod weight (tab. 5) index, ANOVA test has shown the significant effect of climbing bean genotypes and that is why, therefore, these differences between genotypes were analyzed.

Table 1

ANOVA for pods length index;

ANOVA					
	DF	MS	F	P-value	F crit.
Genotypes	9	205,81	**133,1**	3,24E-09	3,02
Errors	10	1,54			
Total	19				

F values (bold) are significant at P≤0,05

Table 2

ANOVA for pods width index

ANOVA					
	DF	MS	F	P-value	F crit.
Genotypes	9	0,21	**61,29**	1,45E-07	3,020
Errors	10	0,004			
Total	19				

F values (bold) are significant at P≤0,05

Table 3

ANOVA for pods thickness index

ANOVA					
	DF	MS	F	P-value	F crit.
Genotypes	9	0,082042	**20,41**	2,69E-05	3,02
Errors	10	0,00402			
Total	19				

F values (bold) are significant at P≤0,05

Table 4

ANOVA for beans weight index

ANOVA					
	DF	MS	F	P-value	F crit.
Genotypes	9	1,23	**61,21**	1,46E-07	3,02
Errors	10	0,02			
Total	19				

F values (bold) are significant at P≤0,05

Table 5

ANOVA for pods weight index

ANOVA					
	DF	MS	F	P-value	F crit.
Genotypes	9	3,059007361	**15,01**	0,000108	3,02
Errors	10	0,20386595			
Total	19				

F values (bold) are significant at P≤0,05

Relationship between indicators analyzed in biometrical determinations for fructifications on climbing beans

Correlation analysis describes the mutual relationship between different pairs of characters without providing the nature of cause and effect relationship of each character. Hence, the path analysis was also performed to determine the direct and indirect contribution of each character to seed yield (Berhe *et al*., 1998). Factor analysis is a multivariate statistical method which can reduce a large number of correlated variables in small number of uncorrelated factors. Any component of yield may affect yield directly and/or it may act indirectly by influencing components which will be produced later in the developmental sequence (Doust *et al*., 1983) (tab. 6).

Table 6.

Relationship between indicators analyzed on climbing bean collection

	Pods length	Pods width	Pods thickness	Pods weight
Pods thickness	-0,55*	0,55*		
Pods weight	-0,01	0,63*	0,73**	
Beans weight	-0,07	0,55*	0,78**	0,98***

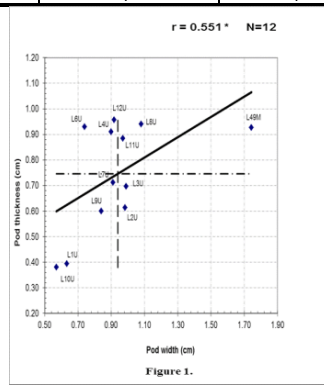

Fig. 1 Relationship between pod width and pod thickness indicators for fructifications on climbing beans;

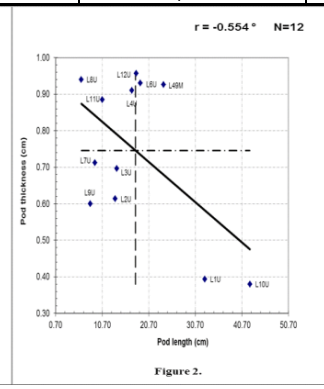

Fig. 2 Relationship between pod length and pod thickness indicators on climbing beans.

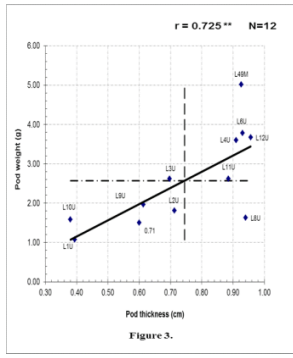

Fig. 3 Relationship between pod thickness and pod weight indicators on climbing bean plants

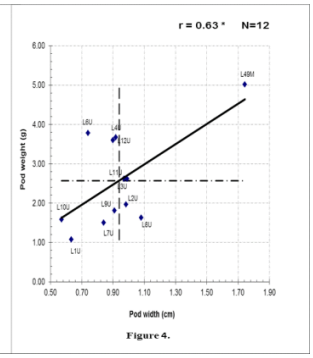

Fig. 4 Relationship between pod width and pod weightindicatorson climbing bean plants

Pods length and thickness indicators have had a negative significant correlation (r = -0.55*) (fig. 2). Climbing bean genotypes which have had high values of the pods length index, have had lower values of the pods thickness index and vice versa. The pod thickness indicator was significantly positively correlated with both yield indicators, respectively pods weight indicator (r = 0.725 **) (fig. 3) and beans weight indicator (r =0.782 **) (fig. 6). This correlation between indicators mentioned in regression analysis, has indicated that the fructification architecture of the climbing beans has had a positive influence for obtaining high yields in climbing bean genotypes.

Thus, the lines L49M and L6U are characterized by a great thickness and pod length (fig. 2), hovering above the regression line on the chart.L9U has had the lowest values for these indicators. The averages for these indicators have been found at L7U and L3U. Another very important indicator for yield index is pod width, which is correlated positively significantly (r = 0.55 *) (fig. 1) with another indicator related to fructifications architecture of the climbing beans, the pod thickness. Bean genotypes which had the best values for these indicators have been L49M and L6U. The genotypes which had the lowest values for these indicators have been L1U, L10U and L9U. These indicators having a significant positive correlation with other two indicators analyzed, respectively, the relationship between pod width and weight (r = 0.63 *) (fig. 4), the best values have been found for the same genotypes. The lines L1U, L9U and L7U bean have had the lowest values for these indicators, hovering below the regression line.

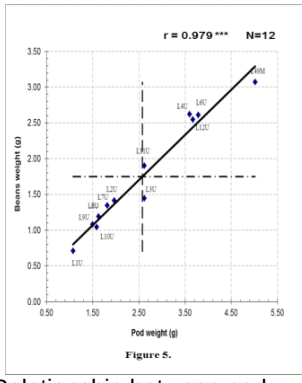

Fig. 5 Relationship between pod weight and bean weight indicators on climbing bean plants;

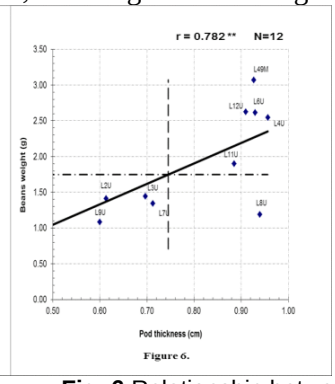

Fig. 6 Relationship between pod thickness and bean weight indicators on climbing bean plants.

Yield indicators, respectively pod weight and beans weight indexes, have been very significant positively correlated (r=0.979*) (fig. 5). Thus, for the breeding program in agro-ecological system, under normal testing conditions of 2018, romanianclimbing bean genotypes have had the good yield index, the highest yield has been found at two lines: L49M and L6U. L1U has been the genotype which had the lowest performance for both yield indicators.

CONCLUSIONS

1. Significant differences among genotypes have been found for all indicators analyzed.

2. Some indexes, as the pods width and thickness, have been correlated with a positive significance for yield indexes analyzed in agro-ecological system.

3. Some traits connected to the pod architecture, the thickness and width have had a significant positive influence on yield indexes for climbing bean genotypes.

4. Climbing bean genotypes collected for the germplasm collection at VRDS Buzau (Vegetable Research and Development Station) have been identified with a very good performance in yield index on climatic conditions of 2018, as climbing bean L49M and L6U and therefore, these varieties could be used in the breeding program in agro-ecological system for obtaining new cultivars with a good performance in yield.

5. For this study, the Romanian climbing bean lines have generally had the good values for yield index.

6. The climbing bean genotype L49M was registered for DUS testing at the State Institute for Variety Testing and Registration, Bucharest, Romania, in 2016.

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THE STUDY OF KALE CULTIVARS BY SOWING AND SEEDLING IN AUTUMN CROP

STUDIUL UNOR CULTIVARURI DE VARZĂ KALE PRIN SEMĂNAT DIRECT ŞI RĂSAD ÎN CULTURĂ DE TOAMNĂ

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Abstract. *The Nero di Toscana variety had very good suitability for sowing under drip irrigation conditions, followed by the varieties Dwarf Green Curled S, Larkezungen and Westlander Halbhoher. Under sprinkling irrigation conditions, the emergence of plants was reduced at Larkezungen variety at 50%, Westlander Halbhoher at 12.5% The feature leaf/plant production varied as follows: Larkezungen - 542 g, Westlander Halbhoher - 347 g, Reflex F1 - 336 g, Black magic - 332 g, Dwarf Green Curled S - 322 g and Dwarf Green Curled - 312 g. Total yield (leaves + strains) was 825 g - Larkezungen, 434 g - Westlander Halbhoher, 422 g - Reflex F1, 380 g - Black magic, 372 g - Dwarf Green Curled S, - Fizz, 332 g - Nero di Toscana, 321 g - Pentland Brigg. Other varieties had a yield of less than 300 g / plant.*
Key words: thrips, attack, pepper, biological control, *Amblyseius swirskiii*

Rezumat. *Soiul Nero di Toscana a avut o foarte bună pretabilitate la semănatul direct în condiţii de irigare prin picurare, fiind urmat de soiurile: Dwarf Green Curled S, Larkezungen şi Westlander Halbhoher. În condiţii de irigare prin aspersie răsărirea a fost redusă la Larkezungen 50%, Westlander Halbhoher 12,5%. Producţie de frunze/plantă a variat astfel: Larkezungen – 542 g, Westlander Halbhoher - 347 g, Reflex F1 - 336 g, Black magic - 332 g, Dwarf Green Curled S – 322 g şi Dwarf Green Curled - 312 g. Producţia totală (frunze + tulpini) a fost de 825 g – Larkezungen, 434 g - Westlander Halbhoher, 422 g – Reflex F1, 380 g - Black magic, 372 g - Dwarf Green Curled S, 361 g - Dwarf Green Curled, 342 g - Fizz, 332 g - Nero di Toscana, 321 g - Pentland Brigg. Restul soiurilor au avut o producţie mai mică de 300 g /plantă.*
Cuvinte cheie: trips, atac, ardei, combatere biologică, *Amblyseius swieskii*

INTRODUCTION

Kale or leaf cabbage (Brassica oleracea convar acephala (D.C.) Alef.), is cultivated for leaves and it is related to wild cabbage (Chrysopoulos, 2015).

The name comes from "kāle" in Danish, Swedish and Norwegian, "Khal" in German and "khal" or "kall" in Scottish-Welsh (Douglas, 2016).

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The colors of kale cabbage leaves alternate between bright and dark green to green purple or green brown. Kale cabbage has a sweet and slightly pungent flavor, with an astringent flavor due to its high iron content. In countries with a tradition for kale cabbage consumption, the red varieties are used for salads because of their fine taste. The curly kale has a pungent taste, and palm kale has a sweet taste. Smaller leaves are generally finer and sweeter than large ones (Tomar, 2018: Perry, 2018).

The kale cabbage, although almost unknown in Romania, is a high-quality vegetable with the composition: dietary fiber, vitamins: K, C, B1, B2, B3, B5, B6, B9, lutein; mineral elements: iron (more than beef), calcium, magnesium, phosphorus, potassium, manganese, sodium, zinc and glucosinolates with anti-carcinogenic effect. It has a low calories content and can also be used in diets. Consumption of kale kale, strengthens the immune system, protects the body against cancer, lowers cholesterol and blood sugar, slows the aging process of the brain and the whole body, protects against cancerous tumors and sclerosis.

MATERIAL AND METHOD

During 2017 – 2018 period, Kale autumn crop experiments were performed in Vegetable Research-Development Station Bacau - Romania, in order to characterization and evaluate the suitability of kale cultivars by direct sowing and seedling with 11 varieties and hybrids: V1 - Larkezungen, V2 - Westlander Halbhoher, V3 – Scarlet, V4 - Nero di Toscana, V5 - Dwarf Green Curled, V6 - Curly Scarlet, V7 - Fizz, V8 - Dwarf Green Curled S, V9 – Reflex – F1; V10 - Black magic, V11 - Pentland Brigg. Determinations regarding: height of plant, plant diameter, no. leaves on the plant, production leaves / plant and total production (leaves and stem) /plant were made.

During the seedling period the tolerance of the varieties and hybrids for the soil pathogens was studied. The observations were accomplished every 10 days in May and June. The attack estimation was determined using the following indicators:

- Frequency of attack (F%),
- Intensity of attack (I%),
- Degree of attack (DA%).

The obtained results will be used in integrated pest management control in sustainable agriculture in order to increase the biological pest control practices in vegetables.

RESULTS AND DISCUSSIONS

Characterization of kale cultivars

1 – Larkezungen. Variety is from northern Germany, with an average height of 42 cm, with finely curved leaves. The leaves are very resistant to frost and have a very good taste. It can be sown for the autumn culture of the decade of May to the third decade of July. In Bacau climatic condition has very good vegetation and the biggest production (tab. 1).

Table 1

The behavoiur of kale cultivars in autumn culture

No. Var.	Cultivar	Height of plant (cm)	Plant diameter (cm)	No. leaves/ plant	Production of leaves / plant (g)	Total production (g)
1	Larkezungen	42	46	51	542	825
2	Westlander Halbhoher	24	51	30	347	434
3	Scarlet	13	12	6	7	8
4	Nero di Toscana	51	37	49	186	332
5	Dwarf Green Curled	28	54	36	312	361
6	Curly Scarlet	27	37	24	76	95
7	Fizz	44	80	35	269	342
8	Dwarf Green Curled S	30	50	20	322	375
9	Reflex F1	38	61	35	336	422
10	Black magic	34	40	28	332	380
11	Pentland Brigg	28	90	24	260	321

2 - Westlander Halbhoher. Variety of German origin, with a lower height, can reach up to 24 cm. The leaves of this variety are very corrugated, their taste improving after the first frost. They can be sown early spring, continuing sowing until the end of July, to have fresh leaves until late in the winter. Height of plant, plant diameter, no. leaves on the plant, production leaf / plant and total production (leaves and stem) /plant are presented in table 1.

3 – Scarlet. The Scarlet variety is not suitable for autumn crops in the Bacău area, having a slow growth, the height being 13 cm, at 100 days after planting (table 1). It has good weather resistance in the field. It produces very decorative, greyish leaves, the color intensifying as the cold weather approaches.

4 - Nero di Toscana. It is a vigorous variety with rich, tasty, succulent, dark green leaves, even in cold days up to minus 6^{o}C. It is harvested when young and tender. It is a very popular vegetable in Italian cuisine and is also known as "Palm Cabbage". It had a medium production – 186 g leaves / plant (tab. 1).

5 - Dwarf Green Curled. It is a compact variety with a height of 28 cm. It has an excellent low temperature tolerance and is one of the best varieties of kale cabbage with free pollination. This variety, due to wintering resistance, can also be used as a winter animal feed.

In our climatic condition the variety had a good growth and medium production– 312 g leaves/plant (tab. 1).

6 - Curly Scarlet. It is a late-mature sort, reaching up to 27 cm tall. The leaves are violet and very creamy. Freezing temperatures intensify the color in a very decorative blue-violet. It can also be used as an ornamental plant. It is a selection of decorative varieties in the French gardens of King Sun, and today it is

more and more common in park design. The production of leaves was low – 76 g leaves/ plant (tab. 1).

7 – Fizz. Leaves grow upright, reaching up to 44 cm high. The variety is ideal for salad, if cultivated at greater distances, will be more productive, larger leaves can be used for cooking. Mature plants are very resistant to low temperatures. The production was medium – 269 g leaves/plant.

8 - Dwarf Green Curled S. The variety has dark green, strongly curved leaves. The plants are compact, with a height of 30 cm. The leaves are very nourishing, their nutritional value being reconsidered in recent years. This has led to a strong expansion in culture lately, due to very high nutritional values. The variety is easy to cultivate, very productive, with a multitude of leaf shapes and colors. In our experimental condition has a medium production – 322 g leaves/plant (tab. 1).

9 - Reflex - F1. The hybrid obtained lately, Reflex F1 has intense, juicy and nutritious green leaves, which maintain their color for a long time, without yellowing. It reaches the height of 38 cm. Can be used for food preparation or as a salad ingredient. Resistance to wintering causes the plant to recover its vegetation in the spring. In our climatic condition the production of Reflex F1 was 336 g/plant (tab. 1).

10 - Black magic There is a selection of "Nero di Toscana" kale cabbage. The leaves are dark green, narrow, well textured. Both the very young, light leaves, but also the long leaves, deeply blanched, dark green, with a rich flavor can be used. Very nourishing, Black Magic Kale (also known as Dinosaur Kale, Tuscan Kale and even Black Flat Cabbage is a particularly valuable gastronomic choice, especially during the winter period. The leaves can be harvested both small (only 6 centimeters or less) or larger, for chips and other dishes. Their flavor is strong and full of vitamins and nutrients. Black magic had a good vegetation with 34 cm height of plant, 40 cm plant diameter, 28 leaves/plant, 332 g leaves/plant, 380 g total production (tab. 1).

11 - Pentland Brigy The leaves are less curly and lighter than the rest of Kale cabbage varieties. The taste is sweet and aromatic, the variety being specially created for texture and aroma, Pentland Brigy produces leaves until November and shoots like broccoli in spring. Variety is a selection resulting from the crosses between Scotch and Thousand Headed being much finer, sweeter and more succulent. It also produces shoots that can be harvested staggered throughout the growing season. Leaves can be harvested in a young phase, when the plant is only 5 cm high. The new leaves will form continuously. In October, the leaves from the top of the plant can be removed in order to form shoots that will be harvested from February to May, when shoots of 10-15 cm long and tender can be chosen. The mature plants survive at -12°C, green shoots can be found under the snow.

The vegetation of plants was good, with height of plant of 28 cm, plant diameter 90 cm, 24 leaves on the plant, 260 g production leaves / plant and 321 g total production.

Study of the suitability of kale cultivars to direct sowing in the field

The results (fig 1) show that only the Nero di Toscana variety had a very good suitability for sowing directly under drip irrigation (100% emergence), followed by the Dwarf Green Curled S, Larkezungen and Westlander Halbhoher varieties with 69.2% of emergence in the condition of direct sowing in field and drip irigation. Under sprinkle irrigation conditions the germination was reduced: Larkezungen 50%, Westlander Halbhoher 12.5%, or nonexistent, to all the other cultivars.

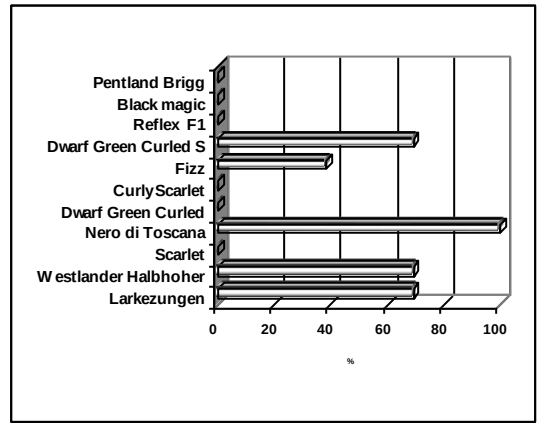

Fig 1 The suitability of kale cultivars to direct sowing in field – drip irigation

Study of the cultivar tolerance at the attack of soil-borne diseases

The tolerance of cabbage cultivars to the attack of soil-borne pathogens is shown in fig. 1. It is noticed that: Nero di Toscana, Reflex F1, Black magic did not show pathogen attack in the seedling phase, the percentage of healthy plants being 100%. The varieties: Dwarf Green Curled, Curly Scarlet, Fizz, and Dwarf Green Curled S had over 90% of healthy plants, followed by: Larkezungen and Westlander Halbhoher with over 89% of non-pathogen-free plants. Scarlet varieties 50.2% and Pentland Brigg 75% were susceptible in the seedling phase to pathogen attack.

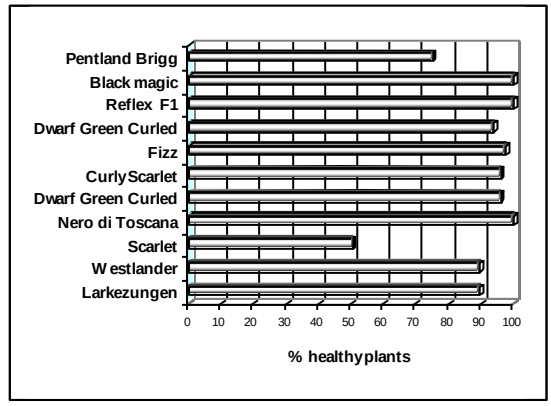

Fig. 2 % of healthy plants

CONCLUSIONS

The tested kale cultivars had different results. Height of the kale plants ranged between 13 cm (Scarlet) and 51 cm (Nero di Toscana). The diameter of the rosette ranged between 12 cm (Scarlet) and 90 cm (Pentland Brigg). The largest leaf / plant production was recorded in the Larkezungen variety - 542 g, followed by Westlander Halbhoher 347 g, Reflex F1 336 g, Black magic - 332 g, Dwarf Green Curled S - 322 g and Dwarf Green Curled - 312 g. The other varieties had a yield of less than 300 g of leaf / plant. The total production was: 825 g - Larkezungen, 434 g - Westlander Halbhoher, 422 g - Reflex F1. The other of the varieties had a total production of less than 400 g / plant.

The suitability of kale cultivars to direct sowing in the field was different. Only the Nero di Toscana variety has a very good suitability for sowing directly under drip irrigation (100% emergence), followed by the Dwarf Green Curled S, Larkezungen and Westlander Halbhoher varieties with 69.2% of emergence in the condition of direct sowing in field and drip irigation. Under sprinkle irrigation conditions the emergence of plant was reduced: Larkezungen 50%, Westlander Halbhoher 12.5%, or nonexistent, to the other cultivars.

The tolerance at the attack of soil-borne diseases varied in large limits. Nero di Toscana, Reflex F1, Black magic did not show pathogen attack in the seedling phase, the percentage of healthy plants being 100%. The varieties: Dwarf Green Curled, Curly Scarlet, Fizz, and Dwarf Green Curled S had over 90% of healthy plants, followed by: Larkezungen and Westlander Halbhoher with over 89% of non-pathogen-free plants. Scarlet varieties 50.2% and Pentland Brigg 75% were susceptible in the seedling phase to pathogen attack.

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PRELIMINARY RESULTS ON GERMINATION AND VELOCITY OF KELVEDON WONDER PEA SEEDS VARIETY

REZULTATE PRELIMINARII PRIVIND GERMINAȚIA ŞI VELOCITATEA SEMINȚELOR DE MAZĂRE LA SOIUL KELVEDON WONDER

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Abstract. *The seed is an important factor of production that ensures the biological material necessary for the establishment of agricultural and horticultural crops. The seed of a cultivation will faithfully pass the characteristics determined by the genome if it has a higher cultural value, a primordial value determined by germination, purity and state of health. In the case of seed produced in the year 2016, the germination index varied from 84.0% determined to five days, up to 93.5% (on the ninth day). Germination speed is maximum at first determination (21.0%) and decreases to 8.5% when seed germination has reached the highest value during the 12 days. The velocity coefficient of germination has descended values, the lowest value of 8% registering on day 12, which can be genetically influenced, but also by storage conditions.*

Key words: pea seed, germintion rate, velocity germination.

Rezumat. *Sămânța este un factor important de producție care asigură materialul biologic necesar înființării culturilor agricole şi horticole. Sămânța unui cultivar va transmite în mod fidel caracteristicile determinate de genom dacă aceasta are o valoare culturală cât mai ridicată, valoare determinată în mod primordial de germinație, puritate şi starea de sănătate. În cazul seminței produsă în anul 2016, indicele de germinare a variat de la 84,0% determinat la cinci zile, până la 93,5% (in a noua zi). Viteza de germinare este maximă la prima determinare (21,0%) şi scade până la valoarea de 8,5% când germinația seminței a atins cea mai ridicată valoare, pe parcursul celor 12 zile. Coeficientul velocității de germinare a avut valori descendente, cea mai scazuta valoare de 8 % înregistrându-se în ziua 12, valoare care poate fi influențată genetic dar şi de condțiile de păstrare.*

Cuvinte cheie: semințe de mazăre, germinație, viteza de germinare.

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INTRODUCTION

Seed is a morpho-anatomic and functional structure proper to superior flower plants, resulting from the fertilization process of the ovule and plays a role in the reproduction and multiplication of plants.

For agriculture, seed is an important factor of production that provides the biological material necessary for the establishment of agricultural and horticultural crops (Stan *et al.,* 2003). Its importance as a factor of production is also reinforced by the fact that it is the carrier of the characteristics that will give agronomic value and the use of the new cultivation, characteristics that are determined by the specific genome of the biological population from which it was formed, population called cultivar or variety (Munteanu and Falticeanu, 2008).

The seed of a variety will faithfully convey the characteristics of the genome if it has a higher cultural value, a value primarily determined by germination, purity and health, that is to say, the most important quality indicators of a seed (Chaux and Foury, 1996).

The high values of these quality indicators represent the ultimate goal of any seed producer (Atanasiu and Atanasiu, 2000; Bârcă *et al.,* 2012).

The germination velocity, as a major indicator for the evaluation of seed germination vigor, varies considerably depending on the cultivar (Voicu *et al.,* 2017; Voicu, 2017) and the experimental conditions (Chugh and Sawhney, 1996; Campbell *et al.,* 2011; Butnariu and Butu, 2014; Ipătioaie *et al*., 2016; Ipătioaie, 2017).

The purpose of the paper was to evaluate the germination rate, the velocity and the pea seed speed index after two years of storage.

MATERIALS AND METHODS

From total mass of pure seeds well-homogenized, 400 seeds are randomly counted – 8 repetitions of 50 seeds each, placed at a sufficient distance in order to ensure the necessary space needed for the germs' growth and nutrition, as well as for the protection of the seeds that are not contaminated by diseases. In the case in which the seeds are strongly infected, it is necessary for the paper substrate to be changed, at an intermediate count. As a method of germination, the germination between-paper (BP) was used, in controlled temperature (20 ^{o}C), humidity (80 %) and lack of light.

The seeds are placed to germinate between strips of paper, rolled and uniformly distributed (fig. 1). The placement of the seeds on the paper is done manually because the pea seeds are big enough to allow the proper development of the germs. The repetitions of placing the seeds in between stripes of paper are rolled and put into plastic bags, in order to maintain a constant level of moisture, and then they are placed in the germinator (Sanyo MLR), in a horizontal position.

Taking into account that the germination analysis is applied to a great number of species, in order to render uniform the methods used, the standard SR 1634/1999 establishes the requirements of each specie.

Fig. 1 Germination pea seeds stage

After determining the physical purity, which was between 99,6 and 99,9%, the seeds were prepared in order to determine the germination, for the seeds obtained in 2016. According to standard SR 1634/1999, the minimal germination for the pea seeds must be of 80%

RESULTS AND DISCUSSIONS

Regarding the Kelvedon Wonder cultivar, the germination index ranged from 84.0%, determined at five days, to 93.5%, determined on the ninth day and kept within the same limit until the last determination (fig. 2). The highest daily growth rate was between fifth and seventh, when the value increased to 90.0%.

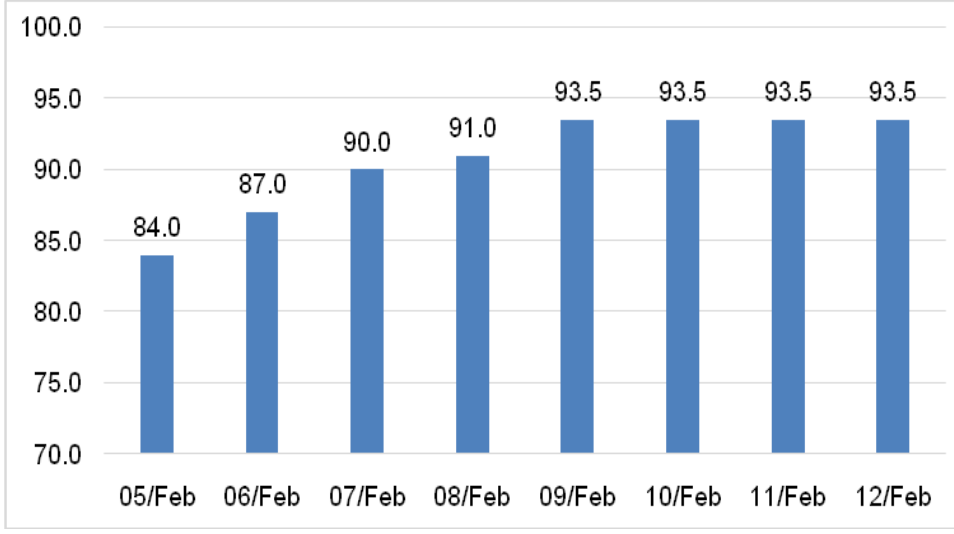

Fig. 2 Germination rate in dynamics for the Kelvedon Wonder variety (%)

The germination velocity on the Kelvedon Wonder cultivar is maximal at first determination (21.0%) and decreases to 8.5% when germination of seed has reached the highest value over the 12 days. Daily, the greatest difference in germination rate was between fifth and sixth day, with a difference of 2.6%, demonstrating a good germination capacity of the Kelvedon Wonder cultivar (fig. 3).

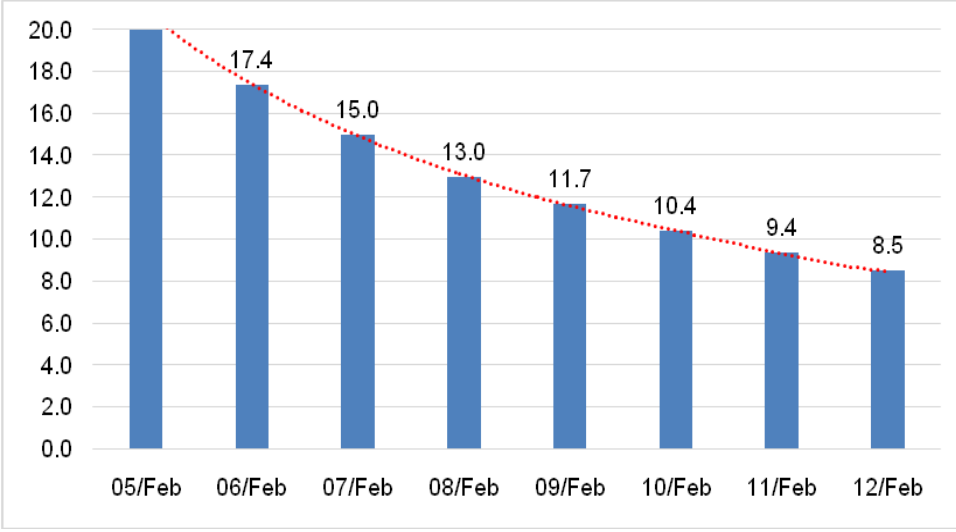

Fig. 3 Germination velocity for Kelvedon Wonder variety (%)

Kelvedon Wonder sprouting rate coefficient ranged from 8.0% to 17.1%. The highest percentage was recorded on the first day of determining the number of normal germs when the highest germination rate was recorded (fig. 4). The lowest germination rate was recorded at the last determination when the highest germination index for the Kelvedon Wonder cultivar was recorded.

Voicu's 2017 results highlighted that the 2012 seed (after four years of storage) begins with a germination index of 60.3% and ends after 5-6 days with a germination index of 70, 1%, which qualitatively disqualifies it from being marketed.

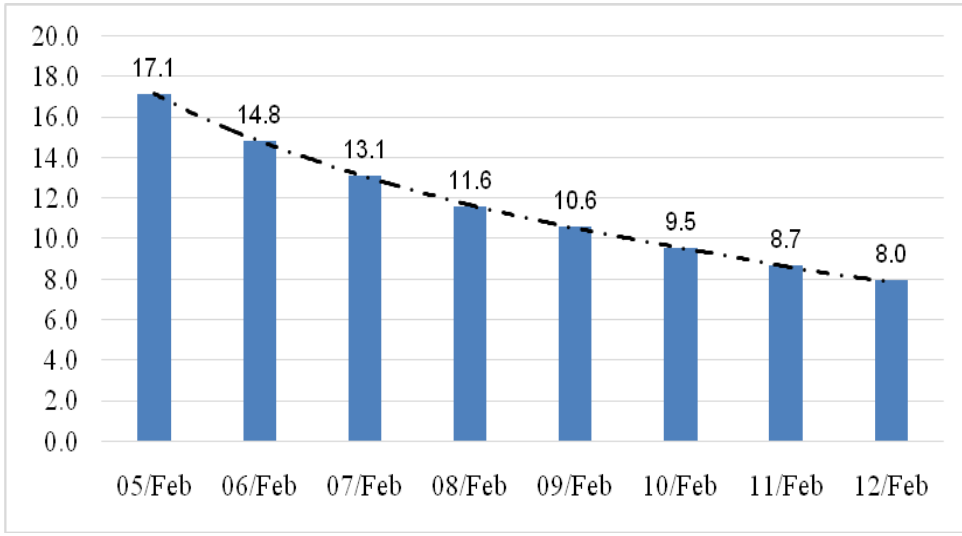

Fig. 4 Velocity germination coefficient and emergence for the Kelvedon Wonder cultivar (%)

CONCLUSIONS

1. After two years of storage, seeds from cultivar Kelvedon Wonder retained quality indices, so they can be used to set up crops.

2. The highest germination rate is recorded on the fifth day when germinating most seeds, but it decreases to the 12th day of determination.

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RESEARCH ON THE INFLUENCE OF FERTILIZATION AND IRRIGATION METHOD OF TOMATOES OVER THE PRODUCTION

CERCETĂRI PRIVIND INFLUENŢA METODEI DE FERTILIZARE ŞI IRIGARE A CULTURII DE TOMATE ASUPRA PRODUCŢIEI

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Abstract. *The research of this study was carried out at the University of Agricultural Sciences and Veterinary Medicine "Ion Ionescu de la Brad" in Iasi. The experience was set up in a semicircular solar cell where the fertilization regime was pursued: fertilization by irrigation water, fertilization with classical fertilizers, fertilization with microorganisms and non-fertilized. The irrigation was dripped. The tomato production showed a difference from the control of 52.43 t/ha, in the fertilized variant, being considered positively very significant. In the case of tomatoes it was found that the fertilization is clearly superior to the other methods used.*

Key words: fertilization, irrigation, tomatoes, production

Rezumat *Cercetările acestui studiu s-au efectuat în cadrul Universităţii de Ştiinţe Agricole şi Medicină Veterinară "Ion Ionescu de la Brad" din Iaşi. Experienţa s-a înfiinţat într-un solar de tip semicircular unde s-a urmărit regimul de fertilizare: fertilizare prin apa de irigare, fertilizare cu îngrăşăminte clasice, fertilizare cu microorganisme şi nefertilizat. Irigarea s-a făcut prin picurare. Producţia de tomate a înregistrat o diferenţă faţă de martor de 52,43 t/ha, la varianta fertirigată, fiind considerată pozitiv foarte semnificativă. În cazul tomatelor s-a constatat că fertirigaţia este net superioară celorlalte metode utilizate.*

Cuvinte cheie: fertilizare, irigare, tomate, producţie.

INTRODUCTION

Modern farming technologies are based on the long-term soil fertility, resilience and regeneration capacity. Forming, maintaining and preserving soil fertility is the greatest challenge for today's agriculture. From modern and sustainable agricultural technologies, drip irrigation has the highest efficacy, of 90%, compared to conventional irrigation methods; the main benefits of water being absorbed by the soil, creating immediate availability for plants, leakage or evaporation (Drăgănescu, 1986). Being a localized method, water is only given to those areas of the field that require irrigation (plant roots). This paper aims to deal

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with some aspects of research on the influence of the fertilization and irrigation method of tomato culture in protected space on production.

MATERIAL AND METHOD

The experimental researches on the influence of the fertilization method of a tomato crop were carried out in the year 2017 at the "Ion Ionescu de la Brad" University of Agricultural Sciences and Veterinary Medicine in Iasi, Department of Agricultural Mechanization and Vegetable Sector of Horticultural Farm No.3 "Vasile Adamachi"of the Didactic Resort in Iasi. The experiments were carried out in a semi-circular solar tunnel, 25 m long and 5.4 m wide. In order to investigate the influence of the watering method, a drip irrigation and fertilization plant was designed and realized within the department of the Mechanization of Agriculture. The installation was made up of fertilizer tank, automatic watering programming system and water distribution system (Corduneanu *et al.,* 2015) (fig.1).

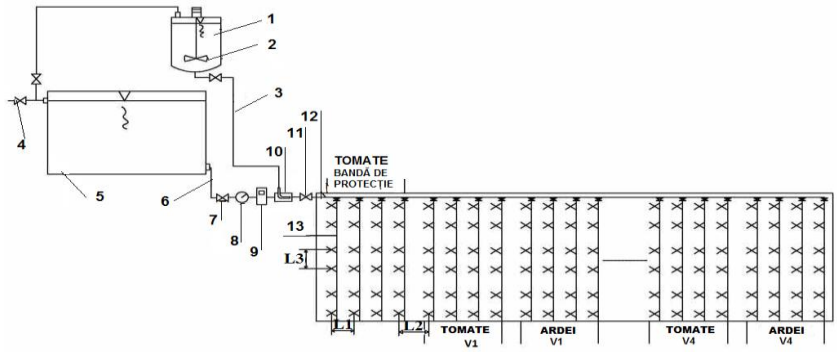

Fig. 1 Scheme of drip irrigation and fertilization:
1- water buffer tank; 2- tank for the preparation of the watering fertilizer solution; 3- agitator; 4 - connection for the buffer tank water supply; 5 - connection for supplying the fertilizer solution; 6 - supply pipe for irrigation facility; 7:11 - valves; 8 - watermeter; 9 - programmer; 10 - ejector for mixing the water-fertilizer solution; 12 - main pipe; 13 - dropping pipeline; L1 - spacing between rows on tape; L2 - distance between tapes; L3 - distance between plants in a row.

The tank used in the experimental fertilization plant had a capacity of 300 L, made of metal, resistant both to mechanical and chemical shocks. On the outside, the tank was graduated from 10 to 10 L, the reading was done using a side-mounted transparent hose, operating on the principle of capillarity. At the top, the reservoir is provided with a feeding mouth through which water is added to mix the water with fertilizers.

Solution mixing was carried out by an electric motor propeller shaker. At the bottom is the outlet of the solution, provided with an opening valve and an outlet hose. The fertilizer solution passes through a 1/2 "hose into the waterline line. The water distribution system was made up of main pipelines, secondary water distribution pipelines and watering equipment. the water made of polyethylene, 1" and 55 m in length, had the link with a secondary water distribution pipeline located in the solar waterworks component. The main pipeline has been connected by a fitting assembly and accessory to a water tank feeding the system.

The secondary water distribution pipeline was placed perpendicular to the rows of plants and had the role of feeding the watering strips representing the active part of the drip irrigation system. Watering equipment (watering line) is the end of the plant, consisting of transport and watering pipes provided with plant water distribution devices. The connection between the water pipe and the drip tap was made by means of valves that can also be used as start connectors. The distance between the orifices on the watering band used in the experiment was 10 cm, their diameter 16 mm and the wall thickness of 0.15 mm (6 mil). The automatic watering programming system included a programmer for irrigation and a water meter for measuring the flow rate.

The system was placed at the entrance to the solar system, being connected to the secondary water supply pipe and fertilizer solution. The FLORABEST programmer was used in the installation. The flow measurement was done using a water meter located before the programmer, which made the amount of water that was administered through the buses recorded.

The biological material used for the experience of the protected area within the vegetable sector of the "Vasile Adamachi" Farm consisted of a tomato crop (*Lycopersicon esculentum Mill*.), The *F1 Minaret* hybrid, for which the specific crop technology was respected. The setting up of the crops was carried out in a tunnel type solar, with a width of 5.4 m and a length of 25 m, with a plant density of 31.740 plants /ha. *Minaret F1* (fig. 2) is a fast-growing, semi-finished and uniform fruit early tomato hybrid, being recommended for cultivation in greenhouses and solariums or in the open field. Hybrid has high resistance to drying and vascular wasting. The fruit has a uniform, intense red color with a mass of between 180 and 200 g. The plant exhibits rapid growth, stable vegetative-generative balance and nematode tolerance.

The vegetable plants under study were grouped into four experimental variants (tab. 1):

Table 1

Variantele experimentale pentru tomate – 2017

Experimental variants	Method of fertilization	Irrigation method
V_1	Through the irrigation water	Dripping
V_2	Dispersal	
V_3	Microorganisms	
V_4	Unfertilizedt	

Fig. 2 Hybrid *Minaret F1*

Tomatoes were planted in strips with a distance of 80 cm between them. The distance between the rows in the band was 60 cm and the distance between the plants in turn, 45 cm, resulting in a density of 31,740 plants/ha. For protection, a plant tape was created from the same hybrids (Corduneanu *et al.,* 2015).

V_1 plants were fertilized simultaneously with drip irrigation, twice a week, fertilizing after sunrise.

In the first stage of vegetation, Nutrispore - NPK (MgO) 30-10-10 water borne fertilizer was used, Bor (B), Iron (Fe), Manganese (Mn), Zinc (Zn) promoting rhizobacteria). In the second application, Nutrispore® NPK (MgO) 15-10-30 was administered with Bor (B), Iron (Fe), Manganese (Mn), Zinc (Zn) and Nutrispore® NPK 12-48- 8, Boron (B), Iron (Fe), Manganese (Mn), Zinc (Zn) for the same V1 plants. Weighing the fertilizer was performed with an accurate electronic weighing scale (precision of 0.01 g). For the best fertirigation, plant nutrition was performed periodically, twice a week, between two consecutive waterings, thus preventing clogging of the plant (Corduneanu *et al*., 2015; 2016). The fertigation was carried out in the first step by opening the drip irrigation line, fed from a constant water level basin for 10 minutes to fill the drip tapes. During this time, the fertilizer tank was fed with 30 l of water. The fertilizer solution obtained separately by mixing the water-soluble fertilizer with water was introduced into the fertilizer tank where the final mixture was made by means of a stirrer. In order to introduce the fertilizer solution into the watering system, the fertilizer tank valve and the automatic watering system were opened, so that the fertilizer was introduced into the irrigation water that came to the plant via the bus and then the secondary pipe by means of a drip irrigation tap (Corduneanu *et al.,* 2015; 2016). The water supply to the solar system was achieved by opening the tap. The amount of water is recorded by a water meter. Once the tap is opened, the fertilizer solution in the fertilizer tank goes into the irrigation water via the hose connected to an automatic programmer. From the moment the mixture is made, the nutrient water feeds the water distribution pipe to which the drip irrigation tapes adjacent to each plant are connected. After completion of the fertilization, dripping was also carried out for 10 minutes to ensure complete elimination of the fertilizer solution in the system.

Plants of variant V_2, subject to classical nutrition (fertilizer spreading around the plant) were fertilized with Cristaland® NPK 20-20-20 fertilizer applied to basic fertilization, Cristaland® NP 15-50 + 2MgO, applied in the floral button phase (the first inflorescence), and Cristaland® NPK 9-18-27 + 2 MgO, applied in the formation of first fruits phenophase.

The V_3 plants were fertilized with Micoseed® MB microorganisms fertilizer spread around each plant applied to the field preparation 2-3 days before planting. According to the literature, Micoseed MB is a fertilizer based on Glomus sp., Beauveria sp., Metarhizium sp. and Trichoderma sp. (Stoleru *et al.,* 2014). Also in this variant, during the vegetation period two fertilizations with Nutryaction® were applied, in order to increase the biological activity of the plants. In V4 variant, the plants were not fertilized, constituting the control sample, to which drip irrigation (Corduneanu *et al.*, 2015; 2016; 2017).

Drip irrigation was performed every two days, two hours per day, respectively 8.00 ... 10.00 or 7.00 ... 9.00, depending on the temperature. A watering cycle consisted initially from the opening of the main water tap, at the same time as the tap was opened at the entrance to the solar system. By opening the first tap, the main water supply pipe was fed, and with the opening of the second tap, the supply of the secondary distribution pipe could be provided. Once the latter was filled, it was possible to fill the watering strips, parallel to the rows of plants, so that the watering itself can be done by means of the drippers on each strip. Gut irrigation was done so that the furrows were filled with water, irrigation lasting an average of 30 minutes.

Biometric measurements were made weekly (fig.3), whereby the growth

dynamics of the plants were determined, depending on the variant, by following the number of flowers/ fruits on a plant and the mass of the fruit. Biometric measurements were made by the study of five tomato plants of each variant (Corduneanu *et al.,* 2015; 2016; 2017). Determination of the fruit mass was performed by weighing five fruits of the current crop of each variant.

Fig.3 Fruits taken into study

Harvesting (fig. 4) was made in staggered manner, by variants, recording the quantity of fruit obtained in each variant. The resulting vegetables were weighed with an electronic precision weighing scale.

Fig.4 Tomato yield

RESULTS AND DISCUSSIONS

Influence of fertilizer and watering method on the number of fruits of tomato plants

The number of fruit per plant varied considerably from 12.26 fruit to unfertilized and drip irrigation, up to 17.69 fruit in drip irrigation and microorganism-based fertilizer application. Approximate values were recorded for the fertilized variants by the drip irrigation system and the fertilized ones, with 15, 83 fruit at V1 and 14,51 at V2 variant (tab. 2).

Table 2

Number of fruits per plant

Experimental variant	Date of harvest (2017)							Average
	17.05	27.05	3.06	10.06	29.06	7.07	17.07	
V_1	0	0	0.60	4.60	28.00	36.40	41.20	**15.83**
V_2	0	0	0.80	4.00	25.00	31.40	40.40	**14.51**
V_3	0	0	1.60	5.20	28.80	41.80	46.40	**17.69**
V_4(Mt)	0	0	1.00	4.00	22.00	24.00	35.00	**12.26**

The difference of 5.40 fruit per plant, compared to the control, obtained in variant three, fertilized with microorganism-based fertilizers, is considered distinctly significant. A distinctly significant difference of 3.54 fruits per plant was also obtained in the V_1 fertilized variant (tab. 3). The classic fertilized variant, V_2, made a difference from the control of 2.22 fruit per plant, and was considered poorly.

Table 3

Results on the number of fruits per plant (2017)

Experimental variant	Nr. of fruit per plant	The relative value %	The difference from the witness	The significance of the difference
V_1	15.83	128.80	3.54	**
V_2	14.51	118.06	2.22	*
V_3	17.69	143.94	5.40	**
V_4 (Mt)	12.29	100.00	0.00	ns

DL 0.1% = 5.90; DL1% = 3.47; DL = 5%

Influence of fertilizer and watering method on tomato fruit mass

The mass of tomato fruit was influenced by the watering and fertilization method, so that a value of 248.47g / fruit was obtained in the drip irrigated and non-fertilized variant. In variants fertilized by the classical method and by microorganisms (both by spreading around the plant), the obtained values were somewhat close, of 254, 41 g / fruit for V3 and 251.73 g / fruit. The highest value was recorded by the plants of fertilized variant, V1, where the average mass of a fruit was 270.66 g / fruit (tab. 4).

This value demonstrates the importance of localized application of water and fertilizer in terms of fruit mass, and implicitly influences final production.

Table 4

Table of tomato fruits (g)

Experimental variant	Date of harvest (2017)					Average
	11.07	19.07	25.07	2.08	17.08	
V_1	235.78	279.72	220.62	335.10	282.08	**270.66**
V_2	198.36	232.94	258.30	308.24	274.20	**254.41**
V_3	158.64	224.98	281.38	307.06	286.58	**251.73**
V_4(Mt)	234.98	234.02	247.38	267.56	258.40	**248.47**

The statistical analysis shows that the fertilization mode did not

significantly influence the fruit mass (tab. 5).

Table 5

Rezultatele privind masa fructelor de tomate (2017)

Experimental variant	Nr. of fruit per plant	The relative value %	The difference from the witness	The significance of the difference
V_1	270.66	108.93	22.19	ns
V_2	254.41	102.39	5.94	ns
V_3	251.73	101.31	3.26	ns
V_4 (Mt)	248.47	100.00	0.00	ns

DL 0.1% =85.88; DL1% = 50.45; DL =32.18%

Influence of the method of fertilization and watering on the production of tomatoes

In the crop year 2017, the production ranged from 113.19 t/ha for variant V_4, drip irrigation, unfertilized to 165.62 t/ha for the fertilized variant (Table 6).

The difference from the control, of 52.43 t/ha, is considered positively very significant. Therefore, in the case of tomatoes, it is found that the experimental variant to which fertilization has been applied is clearly superior to the other variants in fruit production per hectare. In 2017, the establishment of tomato culture was carried out after a large bean culture *"Phaseolus coccineus L."* and there is the possibility of resilience of mineral elements.

Table 6

Tomato production (t/ha) **– 2017**

Experimental variant	Total production (t/ha)	Relative production (%)	The difference from the control (t/ha)	The significance of the difference
V_1	165.62	146.32	52.43	***
V_2	125.23	110.64	12.04	*
V_3	138.67	122.51	25.48	**
V_4 (Mt)	113.19	100.00	0.00	ns

DL 0.1% =31.56; DL1% = 18.54; DL =11.82%

CONCLUSIONS

Experimental research in protected space was carried out in Horticultural Farm No.3 "Vasile Adamachi" in Iasi, in a semicircular solar tunnel with a surface of 135 m^2.

To achieve the experiences of the vegetable sector, was chosen a tomato culture (*Lycopersicon esculentum Mill.*), *Minaret F1* hybrid.

The experiments were carried out with a drip irrigation system consisting of a fertilizer tank, automatic watering programming system and water distribution system.

There were four experimental variants. Experience has been influenced by the fertilization method (fertilization, classic and microorganisms) for a protected tomato crop.

Biometric measurements determined the number of flowers/fruit, fruit mass and production.

The average values of the number of fruit per plant in the crop year 2017 recorded values ranging from 12.26 fruit to the unfertilized variant and 15.83 fruit per plant in the variant where drip fertilization was used.

The mass of tomato fruits varied, depending on the fertilization method used, from 246.71 g in the control variant to 270.66 g in the fertilized variety.

Tomato production showed a difference of 52.43 t/ha compared to the witness, being considered very significant.

In the case of tomatoes, it was found that the experimental variant to which fertilization was applied is clearly superior to the other variants in fruit production per hectare.

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THE STUDY OF THE CLIMBING POD BEANS REGARDING THE INFLUENCE OF THE CULTIVAR AND PLANT DENSITY ON SEED PRODUCTION / HECTARE UNDER THE ENVIRONMENTAL CONDITIONS OF ZONE IERNUT

STUDIUL INFLUENȚEI CULTIVARULUI ŞI A DENSITĂȚII PLANTELOR/HA ASUPRA PRODUCȚIEI DE SEMINȚE/HA LA FASOLEA DE PĂSTĂI URCĂTOARE, ÎN CONDIȚIILE DE MEDIU ALE S.C.D.L. IERNUT

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Abstract. *The paper presents the research results from a bifactorial experiment carried out at Vegetable Research and Development Station Iernut. Experimental factors were four cultivars (Mădărăşeni cultivar and three perspective lines – Alina, Ghiboleasca and Viola-2) and three crop density determined by the number of plants in a hole (2 ,3 and 4 plants / hole). The goal of the experiment was to evaluate the influence of the two factors on the seed production. The best result was obtained for all the cultivars and a density of two plants/hole.*
Keywords: climbed, bean pods, cultivar, density, production

Rezumat. *Lucrarea prezintă rezultatele de cercetare obținute într-o experiență de tip bifactorial organizată în condițiile de la Stațiunea de Cercetare Dezvoltare pentru Legumicultura Iernut. Factorii experimentali luați în studiu au fost reprezentați de patru cultivare (Mădărăşeni şi trei linii de perspectivă - Alina, Ghiboleasca şi Viola-2) şi trei densități de cultură determinate de numărul de plante dintr-un cuib (2, 3 şi 4 plante / cuib). Scopul acestei cercetări a fost evaluarea influenței celor doi factori asupra producției de semințe. Cel mai bun rezultat a fost obținut pentru toate cultivarele la o densitate de două plante / cuib.*
Cuvinte cheie: urcătoare, fasole păstăi, cultivare, densitate, producție

INTRODUCTION

The bean is an important vegetable species for both pods and grains (Avasilcăi *et al.*, 2017; Hamburdă *et al.*, 2016; Teliban *et al.*, 2014, 2015). This paper refers to the production of seeds per unit area. Local populations were studied and were created through the ameliorative selection, under the conditions from Transilvania area, valuable lines of climbing beans for pods.

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MATERIAL AND METHODS

The biological material used, is part of the Măldăreşeni cultivar and of grains ameliorative lines which are valuable for Transylvania's conditions (L-Alina, L-Grasa of Iernut (Ghiboleasca) and a4-L-Viola-2. The experiment has been organized in a split plot design with four replicates for the two factors: cultivar and density.

- the A-factor (the cultivar), with four graduations: A_1 - Măldărăşeni, A_2 - L-Alina, A_3 - L-Grasa of Iernut (Ghiboleasca) and A_4 - L-Viola-2;

- the B-factor, the number of plants per planting hole, with three graduations: b1 - two plants on the planting hole, b2 - three plants on the planting hole and b3 - four plants on the planting hole. The distance between rows was of 80 cm and the distance between the planting holes was of 25 cm (Ruşti and Munteanu, 2008; Stan *et al.*, 2003; Teodorescu *et al.*, 2012, 2014).

The influens of experimental factors was evaluated by the seed yield of each graduation of factors (Ceapoiu, 1968).

RESULTS AND DISCUSSION

The biological material used was characterized by specific features of the cultivar (tab. 1, tab. 2).

Table 1

Cultivars' description

The cultivar	Precocity	Vegetation period	Moment of crop establishment	
			For pods	For seed
Mădărăşeni	Early	77	1 – 10.05	20.04
L – Alina	Belated	115	30.04 – 05.05	25.04
L – Ghibolească	Semi-early	78	05.05 – 10.05	30.04
L – Viola-2	Semi-belated	85	03.05 – 10.05	20.04

Fig. 1 Măldărăşeni Variety - plants, pods and flowers

From the analysis of the influence of factor "A", it was found that compared to witness "A_1" cultivar was a difference: very significantly negatively for "A_2" cultivar and significantly positively for "A_3" cultivar (tab. 2).

Fig. 2 L-Alina - plant, pods and flowers

Table 2

The influence of factor "A"

The factor	Production		Diff. t/ha	Meaning
	t/ha	%		
A_1	3.4	100	Mt	Mt
A_2	2.76	81.17	- 0.64	000
A_3	3.9	114.7	0.5	***
A_4	3.66	107.6	0.26	*

LSD 5% = 0.104 x 2.26 = 0.235 t/ha
LSD 1% = 0.104 x 3.25 = 0.338 t/ha
LSD 0.1% = 0.104 x 4.78 = 0.497 t/ha

Table 3

Multiple comparisons of factor B

Clasification	Production (t/ha)	The difference between the variant from the ...place		
		III – B_3	**II – B_2**	**I – B_1**
I – B_1	4.6	2.35**	1.15	-
II – B_2	3.45	1.2	-	
III - B_3	2.25	-		

LSD 5% = 0.761 x 2.06 = 1.567 t/ha
LSD 1% = 0.761 x 2.8 = 2.13 t/ha
LSD 0.1% = 0.761 x 3.75 = 2.85 t/ha

The analysis of the multiple comparisons of factor "B" at the same graduation of "A" showed the significant positively differences between "B_1" and "B_3" from all cultivars, distinctly significant from the other comparisons especially for L-Ghimbolesca cultivars, L-Viola-2 or significant in the case of Mădărăşeni and L - Alina (tab. 4) cultivars.

Table 4

Multiple comparisons of factor "B" at the same graduation of "A" regarding production of seed /he

Clasification		Production (t/ha)	The difference between the variant from the place		
			III	**II**	**I**
A_1	**I**	4.5	2.2***	1.1*	-
	II	3.4	1.1*	-	
	III	2.3	-		
			III	II	I
A_2	**I**	3.7	1.9***	0.9*	-
	II	2.8	1.0*	-	
	III	1.8	-		
			III	II	I
A_3	**I**	5.2	2.6***	1.3**	-
	II	3.9	1.3**	-	
	III	2.6	-		
			III	II	I
A_4	**I**	5.0	2.7***	1.3**	-
	II	3.7	1.4**	-	
	III	2.3	-		

LSD 5% = 0.416 x 2.06 = 0.857 t/ha;
LSD 1% = 0.416 x 2.8 = 1.165 t/ha
LSD 0.1% = 0.416 x 3.75 = 1.56 t/ha

The meanings of the differences between the variants (seed production per hectare) have shown very clearly and also through the analysis of comparing two "A's" average at the same graduation of B or at different graduations of B (tab. 5).

Table 5

Comparison of two "A's" average at the same graduation of "B" or "B's" different graduations (the production of seed per hectare)

The factor	t/ha	The difference between the variant from the place										
		XII	XI	X	IX	VIII	VII	VI	V	IV	III	II
I– A_3B_1	5.2	3.4***	2.9***	2.9***	2.6***	2.4***	1.8***	1.5***	1.5***	1.3***	0.7**	0.2
II– A_4B_1	5.0	3.2***	2.7***	2.7***	2.4***	2.2***	1.6***	1.3***	1.3***	1.1***	0.5*	-
III– A_1B_1	4.5	2.7***	2.2***	2.2***	1.9***	1.7***	1.1***	0.8***	0.8***	0.6**	-	
IV– A_3B_2	3.9	2.1***	1.6***	1.6***	1.3***	1.1***	0.5*	0.2	0.2	-		
V– A_2B_1	3.7	1.9***	1.4***	1.4***	1.1***	0.9***	0.3	0	-			
VI- A_4B_2	3.7	1.9***	1.4***	1.4***	1.1***	0.9***	0.3	-				
VII– A_1B_2	3.4	1.6***	1.1***	1.1***	0.8***	0.6**	-					
VIII– A_2B_2	2.8	1.0***	0.5*	0.5*	0.2	-						
IX– A_3B_3	2.6	0.8***	0.3	0.3	-							
X– A_1B_3	2.3	0.5*	0	-								
XI- A_4B_3	2.3	0.5*	-									
XII- A_2B_3	1.8	-										

CONCLUSIONS

1. The four cultivars are highly valued by consumers, although they are differentiated by different quantitative and qualitative features.

2. As result of the capacity of seed production, the cultivars can be classified in the following order: L-Ghimboleasca, L-Viola 2, Mădărăşeni, L-Alina.

3. In all cultivars, we obtained the highest seed production for B_1 (two seed / the hole) the establishment saving biological material culture.

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YIELDING CAPACITY OF SOME *PLEUROTUS ERYNGII* MUSHROOM STRAINS

CAPACITATEA DE PRODUCȚIE A UNOR TULPINI DE CIUPERCI DIN SPECIA *PLEUROTUS ERYNGII*

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Abstract. *Pleurotus eryngii mushrooms are widely produced for their excellent nutritional and medicinal qualities. This experiment was conducted to investigate the yielding capacity of three P.eryngii strains (Pery-G, Pery-K and Pery-26) cultivated on three variants of lignocellulosic substrate, four replicates/variant. The trail was performed in the mushroom house and the spawned bags (2 kg substrate) were randomized on racks with two levels. Pery-G strain showed the biggest production in the V2 variant (75% straws + 20% sawdust + 5% wheat bran and corn flour 1/1) with 544 g/bag (27.20%) and in the V1(95% straws + 5% wheat bran and corn flour), with 534 g/bag (26.70%). Pery-26 strain yielded the best result of the experiment in the V2 with 548 g/bag (27.40%). All three experimental strains yielded the smallest harvests in the V3 variant (50% straws + 30% sawdust + 15% corn cobs + 5% wheat bran and corn flour 1/1).*
Key words: *Pleurotus eryngii*, lignocellulosic substrate, yield

Rezumat. *Ciupercile Pleurotus eryngii sunt produse pe larg datorită excelentelor calități nutritive și medicinale. Acest experiment s-a desfăşurat cu scopul de a evalua capacitatea de producție la trei tulpini de P.eryngii (Pery-G, Pery-K şi Pery-26) cultivate pe trei variante de substrat lignocelulozic, patru repetiții/variantă. Trialul s-a desfăşurat în ciupercărie, cu sacii însămânțați (2 kg substrat) dispuşi randomizat pe stelaje cu 2 nivele. Tulpina Pery-G a dat producția cea mai mare pe variantele de substrat V2 (75% paie + 20% rumeguş + 5% tărâțe de grâu şi mălai 1/1) cu 544 g/sac (27,20%) şi, respectiv V1 (95% paie + 5% tărâțe de grâu şi mălai), cu 534 g/sac (26,70%). Tulpina Pery-26 a realizat cea mai mare producție a experimentului pe varianta V2, cu 548 g/sac (27,40%). Toate tulpinile experimentale au realizat recoltele cele mai slabe pe varianta V3 (50% paie + 30% rumeguş + 15% ciocălăi + 5% tărâțe de grâu şi mălai 1/1).*
Cuvinte cheie: *Pleurotus eryngii*, substrat lignocelulozic, recoltă

INTRODUCTION

The *Pleurotus eryngii* (King oyster) mushrooms present excellent nutritional and culinary qualities, being considered among the most tasteful mushrooms of *Pleurotus spp*. group. They posess clear therapeutic valences too, the basidiocarps and the mycelium constituting sources of bioactive compounds

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that are capable of reducing disease risk and treating some diseases (Chang 2010; Zhiming *et al*., 2016; Sanchez, 2017). The culture substrate can be prepared from different renewable lignocellulosic materials, most of them being agroforestry subproducts/wastes (Akyuz and Yildiz, 2007; Kirbag and Akyuz, 2008; Phillipoussis, 2009; Kazemi Jeznabadi *et al*., 2016). The *P.eryngii* mushroom culture extends more and more in the world, being realized in different technological variants: outdoor /indoor culture, with the substrate being filled into plastic bags/bottles made of PP, with/without soil or peat casing layer (Kirbag and Akyuz, 2008; Rodriguez Estrada *et al*., 2009; Yamanaka, 2011). In Romania, *Pleurotus eryngii* mushrooms are very little known, some cultivation attempts being recorded, but only for testing the market.

In this work the pilot-mushroom farm level research results are presented having as objective the production potential checking of some *P.eryngii* strains on subtrates obtained from lignocellulosic subproducts/wastes, available in big quantities in our country.

MATERIAL AND METHOD

The biologic material was represented by three strains of *Pleurotus eryngii* of different origins, all from the *RDIVFG Vidra* collection: Pery-G, Pery-26, Pery-K. Pure cultures of mycelium grown on MEA/PDA culture media were inoculated in flasks containing 650 g granular support (wheat grains) prepared and sterilized according to the usual method used in our lab. (Mateescu, N., Zăgrean, A.V., 2003). The flasks were incubated at dark, for 21-23 days at 24-26°C and then, used for spawning.

The culture substrate was made in three different variants: V1 = straws (wheat, barley) 95% + nutritional supplement 5% [Str 95% + Supp 5%]; V2 = straws 75% (wheat, barley) + poplar and beech sawdust, shavings (1/1) 20% + nutritional supplement 5% [Str 75% + Ssh 20% + Supp 5%]; V3 = straws (wheat, barley) 50% + poplar and beech sawdust, shavings (1/1) 30% + corn cobs 15% + nutritional supplement 5% [Str 50% + Ssh 30% + Cc 15% + Supp 5%]. *Supp = wheat bran and corn flour, mixed 1/1 (w/w). The shredded and humidified material was homogenized and mixed with plaster (4%), then filled into autoclavable PP bags (2 kg/bag) and sterilized for 90 minutes at 121°C. After cooling, the bags were each inoculated with 60 g of spawn (3%) and placed for incubation at 22-24°C, 70-80% RH, CO_2 concentration above 3000 ppm, at dark. Finally, 36 bags were prepared: 4 bags for each substrate variant and strain, resulting a total of 72 kg of substrate. The bags were randomly placed on racks in the pilot mushroom farm for 2-3 days at 12-14°C, RH 85-90%, CO_2 concentration below 800-900 ppm. The light was provided by fluorescent lamps, for 8-10 hours/day. The foil from the top of the bags was cut afterwards. The next 3-4 days, the temperature was kept at 15-16°C, RH at 80-85%, CO_2 concentration below 900 ppm. After primordia formation, the parameters were set to the specific microclimate conditions of the fructification stage: 14-18°C, RH 80-85%, CO_2 concentration below 1000-1500 ppm, light at 500-1000 lux 8-10 hours/ day.

The parameters of the microclimate were measured using a Wohler KM410 multitester, with sensors for CO_2 concentration, temperature and RH. Production was measured in grams of mushroom/bag, and the harvest yield in percentages, respectively grams of fresh mushroom/100 grams of substrate. The statistical interpretation of the results was done through the variation analysis method.

RESULTS AND DISCUSSIONS

The first flush of Pery-G mushrooms occured 7 days after the fruiting induction by thermal shock. The other strains formed primordia after 9 days (Pery-26) and 12 days respectively (Pery-K). The mushrooms of the first flush occured 35-40 days after spawning and they developed in 8-10 days, depending on strain and substrate variant. The second flush came after a pause of 18-19 days, it lasted 12 days and it was more quantitatively reduced than the first one.

The growing cycle ended 75-80 days (2.5 months) after spawning, a period quite close to that signalled by others (Sonnenberg *et al*., 2006; Rodriguez Estrada *et al*., 2009).

The Pery-G strain has obtained very good harvests on two of the three substrate variants, recording 544 g/bag (27.20 %) in 2 flushes on the V2 variant and, respectively 534 g/bag (26.70 %) on the V1. It was surpassed only by the strain Pery-26 on the V2 variant, with 548 g/bag (27.40 %), this being also the maximum value of the experiment. Poorer results achieved the strain Pery-K, being situated on the third place on all of the substrate variants.

The Pery-G strain colonized the substrate faster the other strains, prooving a notable vigor, being manifested as such and at the reproductively stage level - fructification. The results synthesis concerning the influence of the strain on the mushroom harvest obtained on three culture substrates is presented in table 1.

Table 1

The strain influence on the yield of *P. eryngii*

No.	Strain	Yield (average value for three substrates)		Difference (±d)	Significance of difference
		(g)	(%)	(g)	
1	Pery-G	523.33	133.96	+132.67	***
2	Pery-26	482.66	123.55	+92.00	***
3	Pery-K (ctrl)	390.66	100.00	0	-
DL 5%			=	3.23 g	
DL 1%			=	4.39 g	
DL 0,1%			=	5.88 g	

The results analysis shows that, indifferently of the used substrate, Pery-G and Pery-26 strains have yielded larger crops than Pery-K, both very significant statistically assured. Thus, on the three substrates, Pery-G achieved an average of 523.33 g/bag, exceeding the control with 132.67 g/bag. Pery-26 gave 482.66 g/bag, with an increase of 92 g/bag over Pery-K (control), recorded with 390.66 g/bag.

The synthesis of the experimental results concerning the influence of the culture substrate on the mushrooms harvest (2 flushes) at all the three *P.eryngii* strains verified is presented on Table 2.

Of all the three substrate variants, V2 and V1 have ensured - in this order - superior results over V3, at all the three verified strains. The averages of the

recorded productions by all the three strains on V2 (490 g/bag) and on V1 (474. 66 g mushrooms/bag) exceeded very significant the obtained average on V3 variant (control), with 58.00 g/bag (V2) and 42.66 g/bag respectively (V1).

Table 2

The substrate influence on the yield capacity of three strains of *P. eryngii*

No.	Substrate	Yield (average value for three strains)		Difference (±d)	Significance of difference
		(g)	(%)	(g)	
1	V1	474.66	109.87	+42.66	***
2	V2	490.00	113.42	+58.00	***
3	V3 (ctrl)	432.00	100.00	0	-
	DL 5 %	=		3.23 g	
	DL 1 %	=		4.39 g	
	DL 0,1%	=		5.88 g	

The C/N values are lower for the wheat straws (48.8-59.6) than for the corn cobs (64.2-71.6) and much lower than for the sawdust (150-450) (Philipoussis, 2009). In our research, the V3 substrate [Str 50% + Ssh 30% + Cc 15% + Supp 5%], with the highest sawdust percentage and, subsequently, the highest C/N ratio, yielded the lowest harvest during the two production flushes, respectively 432 g/bag – the average yield of the three used strains.

It was observed that, by adding organic nitrogen supplements (soy flour, wheat/barley bran), the C/N value of the growing substrate is decreasing, thus obtaining increases in production. Therefore, there have been reported higher production values, respectively 25-35 kg mushroom/100 kg substrate (yielding capacity 25-35%), for the *Pleurotus eryngii* strains cultivated on substrates having 1.4-1.5% nitrogen, compared to 20 kg mushroom/100 kg damp substrate, obtained on 0.8% nitrogen substrates (Sonnenberg *et al*, 2006). In high quantities, the sawdust influences negatively the physical and granulometric (particle sized) structure of the substrate. When humidified, the substrate is highly compacted, becoming hardly accessible for mycelium to penetrate; the mycelium demands aerobic conditions in order to obtain a fast and healthy colonization. Improper conditions may lead to the formation of a mycelium with very thin hyphae and a poorly developed network, with a low growing speed, slow colonization of the substrate and low harvest yield – in case of high sawdust and shredded straws percentage (Kazemi Jeznabadi *et al*, 2016). This brings, by similarity, a confirmation for our results, considering the higher production obtained for the V1 and V2 substrates, with more straws, having, in plus, higher values of the cellulose/lignin ratio than in the V3 substrate with less straws and more sawdust: 2.2-5.3 is the value of cellulose/lignin ratio in straws and 1.7-2.0 in sawdust, according to Philippoussis (2009).

The first flush of fructification was quantitatively and qualitatively superior to the second one for all the strains and substrates. Flush 2 represented less than

30% of the total yield for the Pery-G and Pery-26 strains, on all three substrate variants. Only the Pery-K strain has fructified in the second flush more than 30% of the summed yield of the two flushes 32.2% (V1), 30.9 (V2) and 34.65% (V3).

The analysis of the combined influence of both strain and substrate, over the mushroom production, highlights the fact that the Pery-G strain, when cultivated on the three substrate variants, assures very significant yield differences, compared to the Pery-K control, grown on the V3 substrate (Table 3). Therefore, the Pery-G strain has exceeded the control by 134 g mushrooms/bag, on the V1 substrate, by 144 g mushrooms/bag on the V2 substrate (second result of the experiment, after Pery-26/V2), and by 92 g mushrooms/bag on V3. Similarly, if compared to the control, Pery-26 has given very significantly higher yield on V1 (96 g/bag) and V2 (148 g/bag – best result of the experiment), but insignificant results on V3 (4 g/bag). The Pery-K strain had a lower production on all the substrates, than the other two strains. With Pery-K strain, the V2 and V1 variants of substrate assured insignificantly lower yields compared to the V3 control.

Table 3

Combined influence of strain and substrate on yield capacity of *P. eryngii*

Strain	Substrate	Yield		Difference (±d)	Significance of difference
		(g)	(%)	(g)	
Pery-G	V1 [Str 95% + Supp 5%]	534	133.3	+134	***
	V2 [Str 75% + Ssh 20% + Supp 5%]	544	136.0	+144	***
	V3 [Str 50% + Ssh 30% + Cc 15% + Supp 5%]	492	123.0	+92	***
Pery-26	V1 [Str 95% + Supp 5%]	496	124..0	+96	***
	V2 [Str 75% + Ssh 20% + Supp 5%]	548	137.0	+148	***
	V3 [Str 50% + Ssh 30% + Cc 15% + Supp 5%]	404	101.0	+4	-
Pery-K	V1 [Str 95% + Supp 5%]	394	98.5	-6	-
	V2 [Str 75% + Ssh 20% + Supp 5%]	378	94.5	-22	-
	V3 [Str 50% + Ssh 30% + Cc 15% + Supp 5%]	400	100.0	0	-

DL 5% = 30.46 g
DL 1% = 41.41 g
DL 0,1% = 55.31 g

CONCLUSIONS

1. The Pery-G and Pery-26 strains had high yields, producing on the three substrate variants an average of 523.33 g mushrooms/bag with 2 kg substrate, (26.17% yield), respectively 482.66 g/bag (24.13% yield) - high, statistically very significant values, superior to the Pery-K strain, recorded with an average harvest yield of 390.66 g/bag (19.53%). This recommends them for further research, for approval and introduction into production

2. The first flush of fructification was highly superior, in both quality and quantity, to the second one, for all the strains and substrates.

3. The V2 substrate (75% straws + 20% sawdust and shavings + 5% nutritional supplement) and V1 substrate (95% straws + 5% nutritional supplement), in this order, have favorized superior harvest yields, compared to the V3 substrate (50% straws + 30% sawdust and shavings + 15% corn cobs + 5% supplement). The average yield of the three strains, on the V2 substrate (490 g/bag) and the V1 substrate (474.66 g/bag), have very significantly exceeded the average yield obtained on the V3 substrate. (432 g/bag). The results recommend the V1 and V2 substrates for the potential growers of *Pleurotus eryngii* mushrooms.

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ASSESSMENT OF BITTER CHERRY CULTIVARS OBTAINED AT RSFG IASI

EVALUAREA UNOR SOIURI DE CIREŞ AMAR OBȚINUTE LA S.C.D.P. IAŞI

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Abstract. *The aim of the paper is to present the valuable features of bitter cherry cultivars obtained at RSFG Iasi, that improve the cultivars' assortment with different maturation ages of the fruits sequenced all over the cherries' maturation season. In terms of fruit's weight (g) and equatorial diameter (mm), the cultivars Amaris (5.1 g and 21.1 mm) and Amar Galata (4.1 g and 18.0 mm) got remarked statistically during the five years. They recorded very significant differences and distinct positive significant differences in comparison with the witness cultivar Silva (3.0 g and 15.8 mm). For the stone's size, the cultivars recorded a weight between 0.25-0.33 g, recording very negatively significant differences (Amar Maxut with 0.25 g) and negatively distinct significant differences (Amaris with 0.26 g) in comparison with the cultivar Silva as control (0.33 g). Regarding the fruits' resistance to cracking, Amar Maxut (0.3%), Amaris (0.3%) and Amar Galata (3.3%) present a resistance superior to the control cultivar Silva (4.1%).*

Key words: bitter cherry, cultivars, fruit, quality, assortment

Rezumat. *Scopul lucrării este de a prezenta caracterele valoroase a unor soiuri de cireş amar create la SCDP Iaşi, care îmbunătățesc sortimentul cu soiuri cu diferite epoci de maturare a fructelor eşalonate pe tot parcursul sezonului de maturare a cireşelor. Sub aspectul greutății fructului (g) şi a diametrului ecuatorial (mm) s-au remarcat în cei cinci ani soiurile Amaris (5,1 g şi 21,1 mm) şi Amar Galata (4,1 g şi 18,0 mm), din punct de vedere statistic înregistrând diferențe foarte semnificative şi distinct semnificative pozitiv față de soiul martor Silva (3,0 g şi 15,8 mm). Ca mărime a sâmburelui, soiurile au înregistrat o greutate cuprinsă între 0,25-0,33 g, înregistrând diferențe foarte semnificative negativ (Amar Maxut cu 0,25g) şi distinct semnificative negativ (Amaris cu 0,26 g) față de soiul martor Silva (0,33 g). Referitor la rezistența fructelor la crăpare, Amar Maxut (0,3%), Amaris (0,3%) şi Amar Galata (3,3%) prezintă o rezistență superioară soiului martor Silva (4,1%).*

Cuvinte cheie: cireş amar, soiuri, fruct, calitate, sortiment.

INTRODUCTION

In the North- Eastern area of Romania, the cherry tree, both the one with sweet fruits and the one with bitter fruits was grown since the ancient times

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(Dumitrescu *et. al.*, 1981). The bitter cherries are consumed less in their fresh phase, however they represent a valuable raw material for industrialization as jam, liqueurs, syrups (Petre *et. al*., 2007, Beceanu, 2009; Budan, 2014). Internationally, the syrups and liqueurs made of bitter cherries represent the subject of numerous research studies (Hui, 2006; Webster and Looney, 1998; Nikolic *et. al*, 1998), the jams being less investigated (Jamba and Carabulea, 2002).

The bitter cherry assortment grown in our country was quite poor till 1994, composed of three cultivars (Roz amar Mărculeşti, Amara, Silva) and local populations with many gaps in assuring fruits for industrialization, as a consequence of the lack of valuable cultivars, with batched maturation epochs.

To improve the bitter cherry assortment with new cultivars that are productive, resistant to diseases, with quality fruits, resistant to cracking and with different maturation epochs that could assure an uninterrupted supply of raw material, on a long period of time, for the food industry as well as for the people's needs, positive selection of some local bitter cherry biotypes, that have been planted along cultivars and genotypes from around the country, has been performed at SCDP Iaşi (Petre *et al.,* 1997).

The aim of the paper is to present the valuable features of bitter cherry cultivars obtained at SCDP Iaşi, that improve the cultivars' assortment with different maturation ages for the fruits sequenced all over the cherries' maturation season.

MATERIAL AND METHOD

To harness the biological background with genotypes that exist in the spontaneous flora and the flora grown in the Iaşi area, positive selection of valuable bitter cherry biotypes has been performed. The selected genotypes have been planted in the national collection and in competition micro crops within RSFG Iaşi.

The studies have been conducted during 2012 – 2016, having three bitter cherry cultivars (Amar Galata, Amar Maxut, Amaris) as research material and the comparison has been performed against the Silva cultivar used as control.

The trees can be found in experimental plots, grafted on mahaleb and planted at a distance of 5 x 4 m, with the shape of flattened free palmette crown on the direction of the trees' row, without any sustaining system and without irrigation system. On the row with trees, the soil was prepared with the lateral disk with feeler and between the rows of trees, the soil was grassed. The control of diseases and pests was performed as soon as warnings have been received, phytosanitary treatments being applied.

In the experimental plantation, it was looked for the trees' vigour, resistance to frost and anthracnosis, the main growing and fructification phenophases (Fleckinger J., 1960), the physical traits (fruit's and stone's weight, equatorial diameter of the fruit (D), the colour and the shape of the fruit), the chemical traits and the quality traits of the fruits (soluble dry substance, pulp firmness, stone's adherence to pulp, the fruit/stone ratio, the percentage of the stone from the fruit, fruits' resistance to cracking). The resistance of the fruits to cracking was determined by soaking 100 fruits from each cultivar in distilled water, checking the number of fruits cracked after 6 hours and determining the percentage of cracking per cultivar.

The productivity was determined depending on the fertility index, that represents the percentage of fruits resulted 25-30 days after the petals' fall and they are considered cultivars of big productivity with values above 30-35% (Cociu & Oprea, 1989). The experimental data was statistically interpreted by analysing the variance and the variation coefficient (s%) was calculated, the following values being admitted arbitrarily: 0-10% - small variation coefficient; 10-20% - average variation coefficient; 20-30% - big variation coefficient.

RESULTS AND DISCUSSIONS

As a result of subsequent selections performed during 1981-2011, three bitter cherry biotypes have been chosen, two of which got homologated as new cultivars in 1994 under the name of Amar Maxut and Amar Galata, the third biotype being homologated in 2016 under the name of Amaris.

Regarding the growing vigour of the trees, the Amar Maxut and Amar Galata cultivars have middle vigour, Amaris has weak vigour and Silva has big vigour. All the cultivars, excepting Silva can be recommended for crops with increased density per hectare (tab. 1).

Regarding the resistance to diseases, 2013 and 2016 were rainy years (with precipitations surplus) favourable for the evolution of pathogens (monilia and anthracnosis), the cultivars manifested an easy sensitivity to anthracnosis, the frequency of the attack being between 3.0-3.9% (tab. 1).

Under the conditions of the winter from 2012 (when the minimum temperature, recorded on the 12th of February 2012 was -24.3°C) and under the conditions of March 2013 when the cherry tree was out of the vegetative rest, there were recorded minimum temperatures of -10.8°C (on the 24th of March), the degree of affecting of the flower buds varied in relatively small limits, recording 1% for Amar Galata, 2% for Amar Maxut, 9% for Amaris and 8% for Silva.

Table 1

The features of the tree for the bitter cherry cultivars (average 2012-2016)

Cultivar	Tree's vigour	Resistance to:			
		Frost	Anthracnosis (*Coccomyces hiemalis* Higg.)		
		Affected flower buds (%)	Attack frequency (%)	Attack intensity (%)*	Attack degree (%)
Amar Galata	middle	1	3.8	10	0.38
Amar Maxut	middle	2	3.1	13	0.40
Amaris	weak	9	3.0	14	0.42
Silva (mt)	strong	8	3.9	15	0.59

*- the attack intensity mark on the scale 1-6: 1=1-3% attacked surface; 2=4-10%; 3=11-25%; 4=26- 50%; 5=51-75%; 6=76-100% (Cociu & Oprea, 1989).

The triggering and the flowering have been influenced by the environment conditions, among which, the evolution of temperatures recorded after disbudding had an important role, the speeding up or delaying of the phenophase being dependent on them. Regarding the behaviour of the bitter cherry cultivars, it can

be noticed that during the studied period, the flowering sequencing was produced between the 3rd and the 30th of April, period that overlaps the flowering of the other cultivars, allowing interpollination (tab. 2).

The coefficient of fertility through free pollination represents a main element in the estimation of the pollinators' value. The values recorded for the natural fertility of the three cultivars were extremely high (36.4-61.1%) in comparison with the witness cultivar (30.0%), recording a high variation coefficient (32.7%) and they are classified as cultivars of high productivity, due to the fertility index that recorded values above 30% (tab. 2).

The harvesting maturity was recorded in the 3rd decade of May (Amaris), 2nd decade (Silva, Amar Maxut) and 3rd decade of June (Amar Galata) and the number of days from the end of flowering to maturation was between 34-68 days, recording a high to average variation coefficient (22.3 – 13.7%).

The phenological periods for the same cherry genotypes are variable according to the climatic conditions of each year (Darbyshire *et al.,* 2012). The order in which the cherry cultivars get to maturity is always the same, the only difference being the time range between two subsequent cultivars that could be longer or shorter.

Table 2

Phenological stages and natural feritility for the bitter cherry cultivars (2012-2016)

Cultivar	Flowering start (phase E)	Flowering end (phase G)	Natural fertility (%)	Fruits' maturation date	Number of days between end of flowering and maturation
	Limit dates (earliest - latest):				
Amar Galata	05-25.04	14-30.04	61.1	20-24.06	56-68
Amar Maxut	05-25.04	13-26.04	36.4	10-22.06	58-59
Amaris	03-19.04	09-27.04	38.5	27-30.05	34-49
Silva (control)	04-21.04	14-26.04	30.0	16-20.06	56-64
Average	4.2-22.5	12.5-27.2	41.5	18.2-24.0	51-60
Standard deviation	1.0-3.0	2.4-1.9	13.5	7.1-4.3	11.4-8.2
Variability coefficient (%)	**22.5-13.3**	**19.0-6.9**	**32.7**	**39.1-18.0**	**22.3-13.7**

The physical, chemical and quality features of the fruit are highlighted in tables 3 and 4. In terms of fruits' weight (g) and equatorial diameter (mm), in 5 years, the cultivars Amaris (5.1 g and 21.1 mm) and Amar Galata (4.1 g and 18.0 mm) got remarked, recording, statistically, very significant and distinct positive significant differences in comparison with the witness cultivar Silva (3.0 g and 15.8 mm) (tab. 3).

For the stone's size, the cultivars recorded a weight between 0.25-0.33 g, recording very negative significant differences (Amar Maxut with 0.25 g) and distinct negative significant (Amaris with 0.26 g) in comparison with the control cultivar Silva (0.33 g). The ratio fruit/stone was between 12.8 (Amar Galata and

Amar Maxut) and 19.6 (Amaris) recording, statistically, very positive significant differences in comparison with the control cultivar Silva (9.1).

The percentage of the stone from the fruit's weight recorded values between 5.09% (Amaris) and 7.80% (Amar Galata and Amar Maxut). Statistically, the three cultivars recorded very negative significant differences in comparison with the control cultivar Silva (11.00%).

The content in dry substance is extremely important in cherries, the taste of the fruits being highly dependent on it. The values of this parameter were between 17.7% (Amar Galata) and 19.4% (Amar Maxut), the differences being statistically non-significant in comparison with the control cultivar (tab. 3).

Table 3

The physical and chemical features for the bitter cherry cultivars (average 2012-2016)

Cultivar	Average weight of the fruit (g)	Average weight of the stone (g)	The ratio fruit/stone	Stone from the fruit's weight (%)	The fruit's equatorial diameter (mm)	Soluble dry substance (%)
Amaris	5.1***	0.26^{00}	19.6***	5.09^{000}	21.1***	18.3
Amar Galata	4.1**	0.32	12.8***	7.80^{000}	18.0*	17.7
Amar Maxut	3.2	0.25^{000}	12.8***	7.80^{000}	17.2	19.4
Silva (Mt)	3.0	0.33	9.1	11.00	15.8	17.5
LSD 5%	0.7	0.04	1.37	0.43	2.2	2.4
LSD 1%	1.0	0.06	1.92	0.61	3.1	3.4
LSD 01%	1.5	0.08	2.72	0.86	4.3	4.8

The epidermis' colour is variable as following: bicolour (Amar Galata), dark red (Amaris), black (Amar Maxut and Silva) (fig. 1). For each studied cultivar, the pulp firmness is average and in terms of pulp adherence to stone, only the early cultivar Amaris is non-adherent, all the others being semi-adherent.

Table 4

Physical and quality features of fruits for the bitter cherry genotypes

Cultivar	Epidermis' colour	Pulp firmness	Fruit's shape	Stone adherence to pulp	Fruit's resistance to cracking (%)
Amar Galata	Bicolour	average	Heart-shaped	Semi-adherent	3.3
Amar Maxut	Black	average	Kidney-shaped	Semi-adherent	0.3
Amaris	Dark red	average	Heart-shaped	Non-adherent	0.3
Silva (Mt)	Black	average	Circular	Semi-adherent	4.1

The fruit's shape is heart-shaped for Amar Galata and Amaris, kidney-shaped for Amar Maxut and circular for Silva. Regarding the fruits' resistance to cracking, Amar Maxut (0.3%), Amaris (0.3%) and Amar Galata (3.3%) have a resistance that is superior to the control cultivar Silva (4.1%) (tab. 4).

Fig. 1 – The studied bitter cherry cultivars (original)

CONCLUSIONS

1. From the rich existing genetic background in the North-Eastern area of Romania, numerous bitter cherry biotypes have been identified, from which, following verifications in competition comparative crops, two bitter cherry cultivars were homologated in 1994 (Amar Galata and Amar Maxut) and one, the Amaris cultivar, was homologated in 2016.

2. The Amaris cherry cultivar presents early maturation, Amar Maxut presents average maturation and Amar Galata presents semi-late maturation, assuring a harness period of 26-32 days.

3. In comparison with the control cultivar Silva, the cherry cultivars Amaris, Amar Maxut and Amar Galata have superior qualities concerning the tree's vigour, resistance to frost and diseases, fruit's weight and calibre, small stone, increased content in soluble dry substance and extremely good resistance to the phenomenon of fruit cracking.

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EVALUATION OF SOME NEW SWEET CHERRY CULTIVARS ADAPTED TO THE ROMANIAN NORTH-EAST CONDITIONS

EVALUAREA UNOR SOIURI NOI DE CIREŞ, ADAPTATE CONDIŢIILOR DE CULTURĂ DIN NORD-ESTUL ROMÂNIEI

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Abstract. *The North East region, Iasi county, is the most important sweet cherry (Prunus avium L.) production region in Romania. However, in the last two decades, fresh cherry production consisted primarily of few cultivars as 'Stella', 'Bing', Boambe de Cotnari'. In recent years, there has been increased interest in planting new cultivars by North Eastern growers. New cultivars from around the world currently are being tested in high density orchards. Some selections are being evaluated for harvest timing, fruit size, productivity, firmness, resistance to rain-induced cracking and flavor. The most promising cultivars/selections include 'Kordia', 'Karina', 'Regina', 'Ferrovia' and 'Sweetheart'.*

Key words: *Prunus avium*, fruit quality, fruit size, productivity

Rezumat. *Regiunea de Nord Est,respectiv judeţul Iaşi, este cea mai importantă regiune de producţie pentru cireş (Prunus avium L.) din România Cu toate acestea, în ultimele două decenii, producţia de cireş s-a bazat pe un sortiment restrâns, în principal 'Stella', 'Bing', Boambe de Cotnari'. În ultimii ani, s-a observatt un interes sporit pentru plantarea de soiuri noi, de către cultivatori, fapt pentru care noi soiuri din întreaga lume sunt în prezent testate în livezi cu densitate ridicată. Unele selecţii sunt evaluate pentru calendarul recoltării, mărimea fructelor, productivitatea, fermitatea, rezistenţa la crapare. Cele mai promiţătoare soiuri sunt 'Kordia", 'Karina', 'Regina', 'Ferrovia' şi 'Sweetheart'.*

Cuvinte cheie: *Prunus avium*, calitatea fructelor, mărimea fructelor, productivitate

INTRODUCTION

Present paper aims to study the behavior of new cherry varieties for their recommendation and extension into production. The recommendation of the most important varieties and hybrids in the horticultural field must be done with great discernment, since the majority of fruit plantations are established upon the recommendation of authorized persons (Budan and Petre, 2006). Production capacity

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depends on the biological potential of the varieties to maximize the environmental conditions and applied technology.

Orchards with vigorous sweet cherry trees are still common in some European Countries and the most of planting material is grafted on *Prunus mahaleb* L. and *Prunus avium* L. seedlings.

Trees on these rootstocks are vigorous and difficult to maintain, especially during harvesting (Gjamovski *et al.,* 2016).

Vigourous and very tall cherry trees have no place in modern cherry production and thus the demand for less vigorous trees that are easier to control

If the conditions of work, fertilization and irrigation are considered to be optimal, it is necessary to have experience with varieties in order to determine which ones are more efficient in terms of productivity and which have a better resistance to limiting factors. These experiences tell us which of the varieties or hybrids studied in a particular area of production give the highest yields, which are the most valuable in qualitative and economic terms. At the same time, these experiences contribute to the study of varieties, coming with a contribution to information on the morphological and physiological characteristics (Iurea *et al.*, 2017; Sîrbu *et al.*, 2017). In this paper we aim to analyze mainly the fruits quality parameters and production of some new cherry varieties in an intensive system in Iasi County, region of North-East of Romania.

MATERIAL AND METHOD

The research was conducted in an comercial orchard, that is part of S.C. HORTIFRUCT S.R.L., located in the village of Şerbeşti, Iasi county.

The studied varieties were: '**Kordia**', '**Karina**', '**Regina**', '**Ferrovia**' and '**Sweetheart**'. To study the behavior of the five sweet cherry varieties of, there was made a comparative study of the 7-year-old plantation. All cultivars were grafted on Gisela 5 rootstock. The orchard was planted in 2010.

The planting distances are 4 meters between rows and 2 meters between trees, resulting a density of 1250 trees/ha. Training system is Central Vogel Lider (V.C.L.), as it can be seen in figure 1.

Spring frost tolerance was noted. Harvesting date and yield were recorded. The weight of the fruits, their size, and their cracking tolerance were measured and led us to classify the cultivars. All the data will contribute to the choice of an update sweet cherry assortment more convenient for modern training methods (Istrate *et al.*, 2016; Gjamovski *et al.*, 2016). Fruits were harvested from at least five trees on all cultivars. There were analyzed fifty fruits from each cultivar for fruit quality analysis and one hundred fruits were examined for cracking resistance. The fruit quality was determined based on weight, diameter (mm) and organoleptic characteristics (Perez-Sanchez *et al.*, 2010**;** Milatović *et al.*, 2013). Fruit flavor was estimated subjectively.

Fig. 1 Aspects from the experimental field in different stages of vegetation and production

RESULTS AND DISCUSSIONS

Most of the promising selections obtained in the last years breeding programs (Trajkovski, 1993) were screened on Gisela 5 rootstock, for their adaptability to new intensive high density orchards and for flowering capacity and precocity, and fruit characteristics.

With regard to the blooming period, 'Regina' and 'Karina' are the most late, the duration of the bloom develops during the first and second decades of April. This is an advantage as it reduces the risk of overlapping blooming with spring frost (Asănică *et al.*, 2012). 'Kordia' and 'Sweetheart'varieties with early flowering, are predisposed to late spring frosts (tab. 1).

Table 1

Phenology and productivity of the analyzed sweet cherry varieties, data for year 2018

Variety	Start of flowering	Fall of petals	Harvesting date	Average fruit diameter (mm)	Productivity (t/ha)
Regina	13.04	25.04	25 - 28.06	26 - 28	22 t/ha
Kordia	10.04	20.04	10 - 15.06	24 - 28	20 t/ha
Karina	13.04	25.04	25 - 28.06	24 - 26	20 t/ha
Ferrovia	13.04	25.04	10 - 15.06	24 - 28	20 t/ha
Sweetheart	10.04	20.04	05 - 08.07	22 - 24	19 t/ha

Fruit aspect is very important since it is the initial sensory attribute that can determine a consumer's choice. It is considered that there are three important characteristics associated with the appearance of fruit: color, size and shape, and surface texture. Fruit size is an important characteristic for commercial value.

Table 2 shows the data for the fruit quality characteristics of evaluated varieties. In terms of fruit size and weight, all analyzed varieties can be classified as large fruit (22 - 24 mm) to very large ones (24 - 28 mm), the following varieties were noted: 'Regina' (10.6 g) and 'Kordia' (10.3 g).

Table 2

Quality characteristics of the analyzed sweet cherry varieties, data for year 2018

Variety	Fruit characteristics				
	Flavor	**Color**	**Shape**	**Weight** (g)	**Cracking resistance**
Regina	Taste is mildly sweet, and pleasant.	Ripe fruits have dark red skin and flesh color.	Rounded shape.	10.6	Very good
Kordia	The flavor is moderately strong with a nice sugar-acid balance.	Shiny red that turns dark red when ripe.	Heart shaped	10.3	Very good
Karina	Taste is sweet with strong flavor.	Dark red shiny color.	Wide heart-shaped.	9.5	Very good
Ferrovia	Very sweet and slightly acid, very good flavor.	Bright red color.	Vaguely heart-shaped	10.1	Good
Sweetheart	Strong flavor with a good balance of sugar and acid.	When ripe, the skin is dark red and flesh is red.	Heart-shaped.	9.2	Poor

The skin color is relatively similar to all 5 varieties, with different shades from bright red to dark red, with high organoleptic characteristics.

Table 3

Evolution of the production (t/ha), between 2016-2018

Variety	2016	2017	2018	% to the control	Difference to the control (t/ha)	Significance of differences
Regina	10.2	13.7	22	155	7.8	***
Kordia	12.1	15.9	20	141	5.8	***
Karina	10.2	14.0	20	141	5.8	***
Ferrovia	10.0	13.5	20	141	5.8	***
Sweetheart	9.9	13.0	19	134	5.8	***
Average	10,48	***14.2****	20,20	142,4	4.8	***

LSD 5% = 0.72 t/ha; LSD 1% = 1.57 t/ha; LSD 0.1% = 3.64 t/ha

***Control** (Average production compared to the previous year)

Fig. 2 Aspects of the fruiting formations, June, 2018 (original)

The results of the varieties productivity are given in Table 3. Analyzing production evolution in the last three years can be observed a very significant increase in 2018 mainly due to the high percentage of flower buds differentiation and thus, the large number of fruits/bunch (fig 2). In 2018 there was used additional pollination, 2 bumble bee colonies per hectare.

Regarding fruit production among the evaluated varieties the most productive is 'Regina' (22.0 t/ha), followed by 'Kordia', 'Karina' and 'Sweetheart'.

CONCLUSIONS

1. The earliest varieties in terms of fruiting phenophases progress are: 'Kordia' and 'Sweetheart' and the lates ones are: 'Regina', 'Karina' and 'Ferrovia'.

2. Varieties phenology emphasized that the beginning and the progress of the fructification phenophases is conditioned by the climatological factor.

3. Regarding fruit production, the most productive is 'Regina' (22.0 t/ha), followed by 'Kordia', 'Karina' and 'Sweetheart'.

4. In terms of fruit size and weight, the following varieties were noted: 'Regina' (10.6 g) and 'Kordia' (10.3 g).

5. Temperatures of -3...-4^{o}C during flowering period do not affect the level of production.

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AROMA PROFILE BASED ON ODOR ACTIVITY VALUES AND AROMATIC SERIES ANALYSIS IN RED WINES SUBJECTED TO DIFFERENT AGEING TYPES BY AMERICAN AND FRENCH OAK CHIPS

PROFILUL AROMATIC BAZAT PE VALORILE ACTIVITĂŢII ODORANTE ŞI PE SERIILOR AROMATICE ÎN VINURILE ROŞII SUPUSE DIFERITELOR TIPURI DE MATURARE CU CHIPS-URI DIN STEJAR AMERICAN ŞI FRANCEZ

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Abstract. *Use of oak wood during the process of wine ageing is an ancient and common practice in most of the world's wine producing regions. In this study, the contribution of a chemical compound to the aroma of a wine was evaluated by determining the odour activity value (OAV). OAV, was calculated as the ratio between the concentration of an individual compound and the perception threshold reported in the literature. The analytical aroma profile was established by using the OAVs of each odorant compounds exhibiting similar odor descriptor grouped in an aroma series. Major aroma contributors in the Fetească neagră wine aged with American and French oak chips were the fruity, chemistry, fatty and floral series followed by the woody series. Red wines analyzed at 1.5 and 3 months present similar behaviour, however wines aged with 5 g/L of French oak chips distinguished from the rest when using PCA.*
Key words: aromatic series, OAVs, American and French oak chips, red wines

Rezumat. *Utilizarea lemnului de stejar în procesul de maturare a vinului este o practică veche şi comună în majoritatea regiunilor producătoare de vin din lume. Contribuția unui compus chimic la aroma unui vin a fost evaluată prin determinarea valorii activității odorante (VAO). Aceasta din urmă, VAO, a fost calculată prin raportul dintre concentrația unui compus individual şi pragul de percepție raportat în literatura de specialitate. Profilul de aromă analitică a fost stabilit prin utilizarea VAO a fiecărui compus odorant care prezintă un descriptor olfactiv similar grupat într-o serie aromatică. Principalele arome care contribuie la vinul de Fetească neagră, maturat cu chips-uri din stejar american şi francez, au fost seriile fructe, chimic, onctuos şi floral, urmată de lemnos. Vinurile roşii analizate la 1,5 şi 3 luni prezintă un comportament similar, dar vinurile maturate cu 5 g/L chips-uri din stejar francez se disting de restul cu ajutorul PCA.*
Cuvinte cheie: serii aromatice, VAOs, chips-uri din stejar american şi francez, vin roşu

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INTRODUCTION

Red wine produced from *Fetească neagră (V. vinifera)* is a popular alcoholic drink consumed in Romania known to have potential health benefits related to its phytochemical composition.

Ageing is a fundamental technological process that bring to a harmonious development of aromatic, gustatory and chromatic attributes of wine (García-Carpintero *et al.,* 2012), thus reflecting the global quality of wine. Therefore, during wine ageing, groups of subtle reaction occur, which tend to improve the taste and flavor of wine over time. The composition of wine is complex and changes continuously during ageing. Volatile compounds related to aroma have a significant impact on the quality of wine and, hence, for consumer acceptance. Various chemical classes of compounds are responsible for the aroma wines, such as, esters and terpenes are well-known to confer to floral or floral characters (Capone *et al.,* 2013), alcohols and aldehydes own green leafy aroma characters (Kaluaa and Boss, 2009); methoxypyrazines are strongly linked to green capsicum descriptors. Meanwhile, C13-norisoprenoids generally contribute too many flavours (Peinado *et al.,* 2004) in fruits and wines, such as berry, tobacco, honey, balsamic and violet aromas. Ageing can modify these compounds and give wines their distinct fragrances.

The use of oak pieces aims to accelerate the chemical reaction rates (esterification, polymerization, condensation and oxidation, spontaneous clarification), which take place within wine (Gómez Gallego *et al.*, 2015). Oak chips uses in ageing have been reported to improve the sensory attributes of young wine (Dumitriu *et al.,* 2016).

Part of the aroma in wines, is acquired from the wood during the ageing process. The role of oak wood is fundamental since it releases important compounds that have great influence on the final wine characteristics, reducing the astringency, and improving important flavor characteristics, taste, color, phenolics and aroma (Rodríguez and Gómez-Plaza, 2011). The number and quantity of components released by the wood during the ageing process will depend on the species of wood, and the individual oak chips (including seasoning, manufacture, toasting, dosage and contact time), very important factors that will be affect the quality of red wines. Volatile compounds from oak wood require a powerful separation technique for their determination, being gas chromatography, preferably coupled to mass spectrometry (GC–MS) the main technique used to obtain chemical information (Lubes and Goodarzi, 2017). The extraction step previous to the chromatographic analysis is the most difficult task of the analytical methodology.

Wine aroma is the result of the volatile compounds that constitute it. Not every volatile contribute with the same intensity to aroma. The concentration-odour threshold ratio, well-known as the "odour activity value" (OAV), must be considered as the only norm to estimate the contribution of each compound to aroma, although interactions (antagonistic and additive effects) among different

aroma components occur in the matrix (Genovese *et al.,* 2013). Because an individual compound generally has several flavours, it is difficult to establish or evaluate global aroma profiles only using the odour activity values (OAVs) of volatiles. The organoleptic profiles of red wines are comprised by arranging the OAVs of the aroma compounds with identical descriptors into aromatic series. This activity reports quantitative information obtained by chemical analysis to sensory perceptions. Thus, simply and effectively examines and compares the aroma characters.

Nonetheless, there is lack of information about the effect of oak chips during ageing on the aromatic profile of wine. Hence, further in-depth researches have to be conducted to understand the mechanisms that impact on the organoleptic features of the aged wine. Therefore, the aim of this study was to assess the impact of oak chips as accelerating ageing techniques on the aromatic profile of a red wine.

MATERIAL AND METHOD

Fetească neagră variety grapes (*V. vinifera*) were grown in North-East Romania winemaking region and harvested in 2013. The maceration–fermentation process was made at 10-12 ºC for 7 days. Afterwards, the grape skins were pressed to extract the remaining juice. The press wine was blended with the free run wine and the mixture was pumped off into stainless steel tanks to complete alcoholic and malolactic fermentations. The wine obtained was divided in 8 batches with 5 L each one and placed in independent glass vessels. The batches were aged with different types of oak wood chips (American and French) and different dosage (3 and 5 g/L) for 1.5 months and 3 months. The dimensions chips in centimetres was 0.5 x 1.5 x 0.2 (width x length x thickness).

The contribution of a chemical compound to the aroma of a wine was evaluated by determining the odour activity value (OAV). OAV is a measure of the importance of a specific compound to the odour of a sample. The odour activity value (OAV) was calculated as the ratio between the concentration of an individual compound and the perception threshold reported in the literature (Francis & Newton, 2005). Furthermore, the analytical aroma profile was established by using the OAVs of each odorant compounds exhibiting similar odour descriptor grouped in an aroma series.

Statistical data analyses were performed using Statgraphics Centurion XVI of StatPoint Technologies Inc. (Warrenton, Virginia). Principal component analysis (PCA) was performed using R package „ggbiplot".

RESULTS AND DISCUSSIONS

Volatile compounds are essential for wine high quality, determining their aroma and varietal properties. Aroma compounds are present in wines, and flavour intensity depends on both concentration and threshold (Wu *et al.,* 2016). Anyway, just a restricted number of volatiles can be found at concentrations high enough to be perceived (OAV $\geq$ 1) and considered as flavour contributors as well as active odorants (Genovese *et al*., 2013).

In order to evaluate the overall aroma of the wine, the aroma compounds were grouped into different aromatic series according to their odour descriptor and each compound was assigned to one or more aromatic series based on their similar odour character. The series used in this work place contain compounds in groups with similar odour descriptors and these represent the main constituents for the aroma of *Fetească neagră* wines, namely chemistry, fruity, fatty, buttery, floral, green, citric fruit, toasty, spice and woody odours. The total intensities for each aromatic series were calculated as the sum of the OAVs for each of the compounds assigned to a given series. The results are represented in Fig. 1. One of the most evident differences between 1.5 and 3 months were the increase in all series, especially in the fruity and chemistry series, due to the high quantity of esters formed in the alcoholic fermentation. Other differences were that in general French oak chips present the highest series in comparison with series of American oak chips.

The red wines aged with American oak chips of Am3-3M (> 400) and French oak chips of Fr5-3M (> 650) showed relatively high levels of aromatic series, which suggested that these lastly oak types provided more powerful aroma than the other type. Meanwhile, the American oak chips of Am3-1.5M (< 180) and the French oak chip of Fr3-1.5M (< 210) displayed weak aroma.

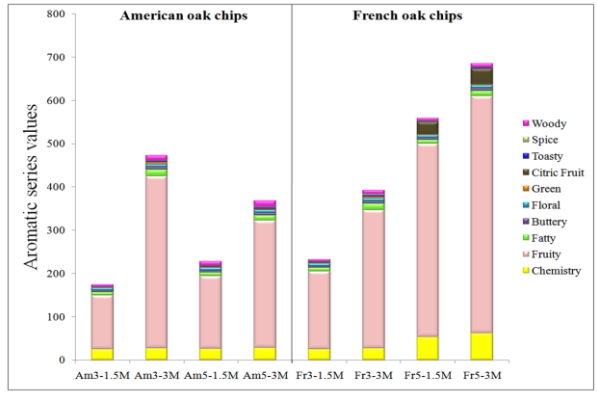

Fig. 1. Aromatic series values for American and French oak chips of aged wines. These results are shown as the mean values.

The chemistry series showed a higher intensity in wines aged with American oak chips (> 27) from Am5-3M and French oak chips (> 60) from Fr5-3M; the fruity series showed a higher level in American oak chips (> 350) from Am3-3M and French oak chips (> 500) from Fr5-3M; fatty aroma was rich (> 15) in American oak chips from Am3-3M and (> 14) in French oak chips from Fr3-3M.

Regarding the buttery series, the maximum value was found in Am3-3M (5.44) and Fr5-3M (5.08). In wines aged with American oak chips (Am5-3M) showed the highest floral flavour (7.33), followed by French oak chips (Fr5-3M) (7.54). The wines aged with French oak chips presented the maximum values for citric fruit series

in Fr5-3M (> 30) and American oak chips showed values much lower (< 0.7), which suggested that these types of flavour cannot be perceived by humans. The other series such as green, toasty and spice presented slight flavour (< 4.4). In addition, the woody series presented a higher intensity in wines aged with American oak chips (> 14) from Am5-3M and French oak chips (> 9) from Fr3-3M.

Principal component analysis (PCA) was used to evaluate the profiles of aromatic series were useful to discriminate and group the different types of wine selected in this research (Fig. 2). The first principal component (PC1) accounted for 53.8% of the total variation, while PC2 explained a further 29.4%. Plots of the PCA revealed that the 10 aromatic series were scattered in quadrants I and IV, showing their positive correlations with PC1.

The wines aged with American oak chips (Am3-3M and Am5-3M) and French oak chips (Fr3-3M) for 3 months were located on the positive side of PC1 and the negative side of PC2. Then, the wines aged with American oak chips (Am3-1.5M and Am5-1.5M) and French oak chips (Fr3-1.5M) for 1.5 months were located on the negative region of PC1 and PC2 (fig.2). The other wines aged with French oak chips (Fr5-1.5M) for 1.5 months were positioned on the positive side of PC2 and negative side of PC1 and the same type of wine aged for 3 months were located on the positive side of PC1 and PC2.

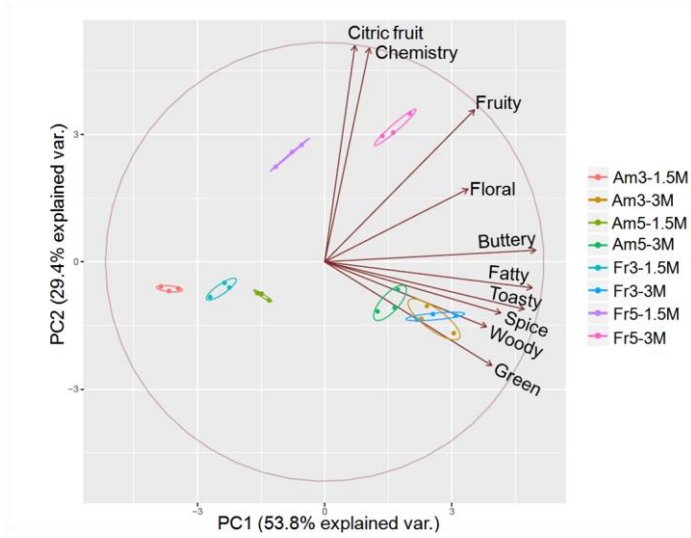

Fig. 2 Principal components analysis using as classifying variables the compounds analyzed in *Fetească neagră* wines

Wines produced with Am3-3M, Am5-3M and Fr3-3M were markedly different from the Fr5-3M samples and were characterized by concentrations of woody, spice, toasty aromatic series. In contrast, a wine aged with Fr5-3M was described with fruity, chemistry and citric fruit aromatic series.

CONCLUSIONS

1. These results confirm the importance of geographical origin of oak wood in the aromatic series of wines during ageing. Each wood transmits some aromatic components to wine in different quantities according to its characteristics and that provokes differences in OAVs and aromatic series of aged wines. Therefore, wines with different characteristics were obtained from the same wine, after 1.5 and 3 months of ageing with oak chips. The application of alternative techniques resulted in an increase in odour activity values at 3 months compared to the 1.5 months of ageing.

2. PC1 differentiated wines aged 1.5 months by other aged 3 months with both type of oak chips. PC2 separated French oak chips with 5g/L by all other sample. Also, French oak chips with 3g/L have a similar profile with American oak chips and cannot be differentiated.

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THE INFLUENCE OF STORAGE CONDITION ON SOME BIOACTIVE COMPOUNDS OF BERRIE FRUITS AND THOSE HUMAN HEALTH PROMOTING

INFLUENŢA CONDIŢIILOR DE PĂSTRARE ASUPRA UNOR COMPUŞI BIOACTIVI DIN FRUCTELE DE PĂDURE ŞI CONTRIBUŢIA ACESTORA ASUPRA SĂNĂTĂŢII UMANE

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Abstract. *The main criteria underlying this research consist in assessing the influence of the principal storage technologies on the content of some bioactive compounds contained by berry fruits. To balance fluctuations in product supply and market demand, fresh berry fruits often require short- or long-term storage in order to extend the supply of the berry fruits beyond the end of the harvest season. Understanding the interaction between the fruits and the environment is crucial for obtaining the most suitable conditions for extending shelf life. Portions of 250 g of strawberries, cranberries, gooseberries, blackberries or raspberries contain considerably more than the minimum daily requirement of vitamin C, while most of the other fruit can provide more than half the daily requirement. In order to freeze the berries fruits, generally no pretreatments are applied and therefore no changes in nutritive values occur during storage if proper packaging is used. During thawing, however, losses may occur. The fruits were monitorized in three fixed time points of refrigerated storage conditions at 2^0C, and also after different freezing condition (-18^0C in laboratory freezing condition and from supermarket freezing condition). The biological material studied was represented by 4 types of berries, as follows: Vaccinum myrtillius, Ribes rubrum, Rubus fructicocus and Rubus idaeus which were asseassed in terms of quality in fresh condition (T0 – moment), and after 3, respectively 7 days of refrigerate storage condition as well as after 6 month of freezing (in bulk and packaged in polyethylene bags). The soluble dry matter substances content was noticed to decrease in refrigerated storage condition between T1 and T2 time points ($p<0.001$). As concerning the differences in vitamin C content between fruits storage in bulk and packaged with polyethylene film were highlight significantly higher values ($p<0.001$) for all analyzed species that were packaged also in freezing storage conditions. When compared to the other fruits tested, the red gooseberries (43.5 mg/ 100 g), followed by raspberries (35.6 mg/ 100 g) were evidenced by their high vitamin C content. By keeping the fruits refrigerated for 7 days, although the sensory characteristics have undergone major changes, a significant decrease in vitamin C content is noted, however its final values at Tf moment are still remarkable: 27.8 mg/ 100 g for currants and 24.3 mg/ 100 g for raspberries.*

Key words: berries, vitamin C, storage condition

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Rezumat. *Principalul criteriu care a stat la baza acestor cercetări a constat în evaluarea influenței principalelor tehnici de păstrare asupra conținutului unor compuşi bioactivi din fructele de pădure. Pentru a echilibra fluctuațiile de aprovizionare cu produse şi cererea de pe piață, ținând cont de faptul că fructele de pădure sunt foarte perisabile, se impune utilizarea unor tehnici de păstrare de lungă durată cu scopul extinderii perioadei de aprovizionare a magazinelor şi după perioada de recoltare. Porțiuni de 250 g de zmeură, agrişe, afine şi mure prezintă un conținut superior în vitamina C comparativ cu cerința zilnică minimă, în timp ce majoritatea celorlalte specii pot asigura doar jumătate din necesarul zilnic. Pentru a congela fructele şi legumele, în general nu se aplică pretratamente şi, prin urmare, nu au loc modificări ale valorii nutritive pe parcursul stocării, dacă ambalarea este corespunzătoare. Totuşi, pe parcursul decongelării pot să apară pierderi. Fructele au fost monitorizate în trei moment prestabilite din timpul refrigerării şi de asemenea după aplicarea unor tehnioci de congelare. Materialul biologic studiat este reprezentat de 4 specii de fructe de pădure: Vaccinum myrtillius, Ribes rubrum, Rubus fructicocus and Rubus idaeus, care au fost evaluate în stare proaspătă (T0) şi după 3,7 zile de refrigerare, precum şi după 6 luni de stocare în condiții de congelare. Conținutul în SUS scade distinct semnificativ ($p<0.001$) în condiții de refrigerare în intervalul dintre T1 şi T2. Conținutul de vitamina C a prezentat diferențe foarte semnificative ($p<0.001$) pentru fructele stocate prin congelare, diferențele fiind influențate de modul de ambalare (vrac/ polietilenă). Coacăzele (43,5 mg/100 g), urmate de zmeură (35,6 mg/100 g) s-au evidențiat prin cel mai ridicat conținut în vitamina C. Prin păstrarea fructelor de pădure în condiții de refrigerare timp de 7 zile,pe lângă modificările majore sub aspect organoleptic s-a evidențiat şi o scădere a conținutului de vitamina C, cu toate că în momentul Tf acesta încă mai este considerabil pentru unele specii: 27,8 mg/ 100 gla coacăze şi 24,3 mg/ 100 g la zmeură.*

Cuvinte cheie: fructe de pădure, vitamina C, condiții de păstrare

INTRODUCTION

To balance fluctuations in product supply and market demand, fresh berry fruits often require short- or long-term storage in order to extend the supply of the berry fruits beyond the end of the harvest season. Understanding the interaction between the fruits and the environment is crucial for obtaining the most suitable conditions for extending shelf life (Murariu *et al.,* 2015).

Berry fruits consumption play an important role in balancing the human diet, mainly because the composition of fruit differs markedly from other food items of plant and animal origin. The contribution of fruit to the protein requirement is slight, and it is not a good source of calcium, thiamine and riboflavin. However, this type of fruit is particularly rich in antioxidants such as ascorbic acid and anthocyans (Agnieszka, 2008; Murariu *et al.*, 2014).

Previous literature in this field have shown that ascorbic acid of natural origin is superior when compared to the synthetic product, due to the presence of certain flavonoid compounds in those fruits which influence the blood circulation, increasing the permeability and the elasticity of the capillary vessels (Bazzano *et al.*,

2003). There are considerable differences of opinion when addressing the minimum daily requirement of ascorbic acid. In some countries, a daily allowance of 20 mg is considered sufficient, but in other countries quantities of up to 70 mg/day are recommended. Portions of 250 g of strawberries, cranberries, gooseberries, blackberries or raspberries contain considerably more than the minimum daily requirement of vitamin C, while most of the other fruit can provide more than half the daily requirement. In order to freeze the berries fruits, generally no pretreatments are applied and therefore no changes in nutritive values occur during storage if proper packaging are used. During thawing, however, losses may occur (Murariu *et al.,* 2014).

The diversity of bioactive compounds found in berries is reflected by the wide spectrum of their biological and medicinal properties. Bioactive compounds found in berries strengthen the walls of blood vessels, improve their elasticity and peripheral blood circulation, and increase the body's resistance to infections (Skrovankova *et al.*, 2015). The most significant health benefits are attributed to phenolic compounds and vitamin C. Due to the rich and varied composition of bioactive compounds and beneficial health benefits resulting largely from their antioxidant activity, berries are widely recognized as natural functional products.

MATERIAL AND METHOD

To characterize the influence of some preservation technologies applied and the potential health benefit of the berries, quality and physico-chemical parameters along with the vitamin C content, were evaluated for three fixed time points of refrigerated storage condition at 2^0C, and also after different freezing condition (-18^0C in laboratory freezing condition and from super market freezing conditions).

The biological material studied was represented by 4 types of berries, as follows: cranberries (*Vaccinium myrtillius*), gooseberry (*Ribes rubrum*), blackberries (*Rubus fructicosus*) and raspberry (*Rubus idaeus*) which were assessed in terms of quality in fresh condition (T0 – moment), after 3 days (T1 – moment), respectively after 7 days (T2 – moment) of refrigerate storage condition as well as after 6 month of freezing (in bulk and packaged in polyethylene bags).

The vitamin C content was determined using the extraction method with oxalic acid and titration with 2,6 – dichlorophenol – indophenols. The pH values were determined by direct potentiometric method using Hanna Instruments. The soluble dry matter was determined with Zeiss refractometer.

RESULTS AND DISCUSSIONS

The rol of vitamin C in berries constitution is represented by the participation in the growth and development precesses associating division and cell expansion (Smirnoff, 2000b), enzyme cofactor (Ariggoni and De Tullio, 2002), antioxidant, against pathogens and in the photosynthesis process (Kazuya, 2017, Velescu *et al.,* 2014). Some nutrients from fruit berries such us the antioxidant and vitamins appear to play a double role in metabolism. These are required for normal growth and development and they appear to provide antioxidant protection

against chronic diseases, including chronic heart disease, arthritis and cancer (Krinsky *et al.,* 2005).

The daily requirement of vitamin C for a healthy adult body is 0 – 90 mg/day, for women during pregnancy 100 mg/day, for breastfeeding women 130 mg/day and for children 1.5 – 2 mg/kg body/ day depending on age.

The soluble dry matter substances content was noticed to decrease in refrigerated storage condition between T_1 and T_2 time points ($p<0.001$) for all analyzed parameters. Instead storage on freezing condition highlights a decrease only for cranberries and raspberries ($p<0.001$), the gooseberries barely decrease and blueberries content highlight a slight increase (0.1–0.2 U.N. $p<0.05$) (tab. 1).

The significant decrease of the soluble dry matters content at the T_1, T_2 analysis moments and after defreezing of the samples revealed low values for the all fruit berries sold in bulk. The bulk raspberry values (6.8% in T_1; 5% in T_2 and 4.9 after defreezing are inferior to those specified in the literature (7 - 12%) (after Beceanu, 2010). Similar results were also obtained for bulk blackberries, but the values decrease below those presented in the literature occurred in T_2 moment. It is also noted that soluble dry matter values of bulk blueberries were inferior to those in the literature at all times of analysis (tab. 1).

Of note is that all analyzed samples in the three moments (T_0, T_1 and T_2) which have been purchased and storage in pre - packeged form presented superior values to those marketed in bulk form, values that fall within the limits specified in the literature.

Table 1

Mean values of soluble dry matters content of berries and statistical differences functional by storage period

Specification	T0	T1 (T0 vs T1)	T2 (T0 vs T2)	Defreezing (T0 vs defreeze)	Reference values
Cranberries	10.2	9.8*	9.4***	9***	8-12
Pre-packaged raspberries	9.8	9.4*	9.3***	9.1***	7-12
Bulk raspberry	8	6.8***	5***	4.9***	7-12
Pre-packaged blueberries	8.2	8***	7.8***	7.9***	7-12
Bulk blueberries	6.2	5.5***	4.9***	6.2I.S.	7-12
Pre-packaged blackberries	10.4	10.02***	9.6***	10.5*	8-12
Bulk blackberries	9	8***	7.5***	9.2I.S.	8-12

i.s. – insignifical statistical differences ($p<0.05$); * - significant statistical differences ($p<0.01$); ** - distinct significant differences ($p<0.001$) and *** - very significant differences ($p<0.001$); To – the first moment of analysis in fresh condition; T1 – result obtain for all analysis after 3 days of refrigerate storage condition; T2 - result obtain for all analysis after 7 days of refrigerate storage condition.

As concerning the differences in vitamin C content between fruits storage in bulk and packaged with polyethylene film were revealed significantly higher values ($p<0.001$) for all analyzed species that were packaged also in refrigerated and freezing storage conditions. When compared to the other fruits tested, the red gooseberries (43.5 mg/100 g), followed by raspberries (35.6 mg/100g) were evidenced by their high vitamin C content.

Cranberries, bulk blue berries and pre-packaged black berries showed lower vitamin C content than the limits specified in the literature (tab. 2), and pre-packaged raspberries, bulk raspberry, pre-packaged blue berries and bulk blackberries were superior to those in literature.

It is revealed very significant differences ($p<0.001$) for vitamin C content of de-freezing fruit berries by comparation with the values obtain in T_0 moment at the cranberries, bulk raspberries and blueberries.

Although independently of the preservation technique applied (refrigeration or freezing) the vitamin C content of the tested fruits was noticed to significantly decrease, it could be evidenced that it's concentrations were measured at still high values: 27.8 mg/100 g for gooseberries and 24.3 mg/100 g for raspberries even after 7 days of storage at 2^0C. Regarding the type of packaging used, it is noted that all products purchased from retail packaged in closed polyethylene recorded higher values of the bioactive compounds analyzed in all time points considered (T_0, T_1, T_2 and after freezing) (tab. 2).

Table 2

Mean values of vitamin C content [mg/100g] of berries and statistical differences functional by storage period

Specification	T0	T1 (T0 vs T1)	T2 (T0 VS T2)	Defreezing (T0 vs defreeze)	Reference values
Cranberries	14.1±0.01	13.3±0.01**	12.1±0.01***	3.6±0.1***	15-20
Pre-packaged raspberries	35.6±0.02	29.4±0.04***	24.43±0.3***	30.1±0.01***	15-25
Bulk raspberry	30.3±0.01	21.4±0.01***	17.8±0.04***	3.7±0.01***	15-25
Pre-packaged blueberries	43.5±0.04	38.9±0.04***	27.8±0.04***	34.26±0.4***	36
Bulk blueberries	30.6±0.04	23.4±0.04***	14.6±0.04***	9.5±0.01***	36
Pre-packaged blackberries	15.6±0.2	9.5±0.02**	13.4±0.07**	10.1±0.04***	17
Bulk blackberries	21.5±0.1	20.8±0.07n.s	13.5±0.04***	12.6±0.04***	17

i.s. – insignifical statistical differences ($p<0.05$); * - significant statistical differences ($p<0.01$); ** - distinct significant differences ($p<0.001$) and *** - very significant differences ($p<0.001$); To – the first moment of analysis in fresh condition; T1 – result obtain for all analysis after 3 days of refrigerate storage condition; T2 - result obtain for all analysis after 7 days of refrigerate storage condition.

The pH values obtained at T_0 moment of the analyzed for fruit berries ranged in the interval inferior delimited by 2.65 value pre-packaged blueberries and superior of 3.58 value for Pre-packaged blackberries (tab. 3).

There is an increase in values in the 7 days of refrigeration evidenced by very significant differences for all analyzed samples.

Frozen fruits revealed very significant increased for all pH values compared to the values obtained at time T0 for all analyzed samples.

Table 3

Mean values of pH values of berries and statistical differences functional by storage period

Specification	T0	T1 (T0 vs T1)	T2 (T0 VS T2)	Defreezing (T0 vs defreeze.)
Cranberries	3.17±0.02	3.16±0.04^{IS}	4.19±0.02***	3.45±0.04***
Pre-packaged raspberries	2.87±0.09	3.2±0.09***	3.64±0.01***	3.13±0.01***
Bulk raspberry	3.11±0.01	3.24±0.01***	3.48±0.01***	3.36±0.04***
Pre-packaged blueberries	2.65±0.01	2.69±0.01*	3.05±0.01***	2.98±0.01***
Bulk blueberries	2.7±0.001	2.8±0.04*	3.02±0.05***	2.94±0.05***
Pre-packaged blackberries	3.58±0.03	3.65±0.01*	3.74±0.01***	3.79±0.02***
Bulk blackberries	3.42±0.05	3.44±0.01*	3.72±0.06***	3.61±0.01***

i.s. – insignifical statistical differences ($p<0.05$); * - significant statistical differences ($p<0.01$); ** - distinct significant differences ($p<0.001$) and *** - very significant differences ($p<0.001$); To – the first moment of analysis in fresh condition; T1 – result obtain for all analysis after 3 days of refrigerate storage condition; T2 - result obtain for all analysis after 7 days of refrigerate storage condition.

CONCLUSIONS

The presented component analyzed of the various berry fruits species point the vast differences related to the storage condition applied. The most significant health benefits are ascribed to the antioxidants like vitamin C. Owing to the rich composition in this bioactive compound and their healh promoting properties , berry fruits are widely recognized as functional products. The results obtained for the chemical components studied from the berries constitution revealed superior values for most samples of pre-packaged fruits. Taking into account that these products have a very high level of perishability, they are recommended to be marketed in small quantities packing (250 - 500 g) made of polyethylene for storage in both refrigeration and freezing conditions to ensure optimum nutritional and antioxidant properties for the consumares.

Lien A. *et al.* (2008) related that free radicals play a toxic role for the human body. The free radicals are produced from normal cell metabolism "in situ" or from external sources pollution, cigarette smoke, radiation or medication. Tose accumulation in high quantities generates the oxidative stress appereance,

process with major part in the development of chronic diseases, aging, cardiovascular and neurodegenerative diseases.

Due to the inability of the human body to conteract oxidative stress by producing antioxidant it is recomanded the externally supplied throw food products and/or supplements that are rich in antioxidants (Murariu *et al.,* 2016) such us most of berrie fruits.

It is also recomanded that the industrialization to be made throw advanced systems of processing and/or storage, so that it can be guaranteed their availability throughout the year, keeping them in a high value the bioactive compounds such us antioxidants.

By conducting this research is considereded opportrune to open another theme, applying other techniques of preserve (in controlled atmosphere or storage refrigerated or freezing in vacuum conditions) in order to ensure a minimal degree of bioactive compounds with hight benefits in human health.

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OBSERVATIONS ON THE USEFUL AND HARMFUL ENTOMOPHAGUS EXISTING IN THE APPLE TREE ORCHARDS

OBSERVAŢII ASUPRA ENTOMOFAUNEI UTILE ŞI DĂUNĂTOARE EXISTENTE ÎN PLANTAŢIILE POMICOLE DE MĂR

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Abstract. *In this paper there are presented the results of observations made on the useful and harmful entomofauna existing in some apple tree orchards. The collection of the material was done using the soil trap type Barber method, permanently located from May to September in 2017 in an intensive apple orchard belonging to the S.C. Loturi Service SRL from Deleşt, Vaslui country. The samples were collected periodically at intervals of 10-14 days. The several variants were used, depending on the composition of the existing or over-planted vegetal carpet with different grass species. At each sample collection, all collected material was stored gauze and labeled, with each sample specifying: date of harvest, trap number and variant. The collected material belongs to several pendants, Arthropoda, Nematoda, clasa, Hexapoda, Crustacea, Arachnida etc., order, Coleoptera, Hymenoptera, Collembolla, Diptera, Orthoptera etc. Among the collected species we mention: Opatrum sabulosum L., Epicometis hirta Poda, Gryllus spp L.., Otiorrhynchus spp.Germar., Pterostichus spp Bonelli , Pseudophonus rufipes De Geer.*
Key words: soil trap, apple tree orchards, entomophauna

Rezumat. *În prezenta lucrare sunt prezentate rezultatele în urma observaţiilor făcute cu privire la entomofauna utilă şi dăunătoare existentă în unele plantaţii pomicole de măr. Colectarea materialului s-a făcut utilizând metoda capcanelor de sol tip Barber, care au fos amplasate în permanenţă , din luna mai până în luna septembrie, în anul 2017. Recoltare probelor s-a făcut periodic, la intervale de 10-14 zile.Au fost utilizate mai multe variante, în funcţie de compoziţia covorului vegetal existent sau supraânsămânţat cu diferte specii de graminee. La fiecare recoltare a probelor, tot materialul colectat a fost pus în tifon şi etichetat, pe fiecare probă specificându-se: data recoltării, numărul capcane şi varianta. Materialul colectat aparţine la mai multe încrengături, Arthropoda, Nematoda etc., clase, Hexapoda, Crustacea, Arachnida etc, ordine, Coleoptera, Hymenoptera, Collembolla, Diptera, Orthoptera etc. Printre speciile colectate amintim: Opatrum sabulosum L., Epicometis hirta Poda, Gryllus spp., Otiorrhynchus spp., Pterostichus spp , Pseudophonus rufipes etc.*
Cuvinte cheie: capcana de sol, plantatie pomicla de măr, entomofauna

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INTRODUCTION

Of all human activities, agriculture is the most complex biological system operating in the natural environment. The way in which agricultural systems take into account natural conditions and how they integrate into them also depends on the environmental status of the environment. Organic fruit growing aims to bring the soil to its natural potential of assuring the needs of plants with nutrients by mineralizing organic matter or by degradation of soil minerals by physical or microbiological factors.

"Fertilization" is not done directly for the plant and for the mobilization of the microbiological complex in the soil, in order to release through biological processes the nutrients that the plants have during the vegetation period. The annual and perennial legumes, the symbiotic fixtures of nitrogen-nitrogen, occupy an important role, the nitrogen fixed by them releasing into the soil slowly, as mineralization of the organic matter resulting from the body of the fixative microorganisms (Miller and Zubovski, 1917; Malcolm and Bell, 1997; Talmaciu *et al.*, 2016).

MATERIAL AND METHOD

Using this method (beeting method) samples were collected by shaking the branches of the trees and shoots with a wooden stick protected with a rubber sleeve in an entomological mesh.

When collecting the useful and damaging species from the tree crown, the frayage method consisted in the sudden shaking of two branches of 10 trees in each variation. The sampling was made of ten trees, five constantly observed and marked at the beginning of the season and five trees chosen at random. The beeting method has been used to collect the biological material from the tree crown (shaking plants) in various vegetation phenophases.

Samples of harvested biological material were taken to the laboratory where they were subjected to inventory and were cleaned, and then the collected insects were determined.

According to the working methodology established at the establishment of the experimental group, it included 7 variants:

V-1, existing vegetal carpet from the spontaneous flora (witness),
V-2, the *Lotus corniculatus*,
V-3 vegetal carpet, (*Tifolium repens*),
V-4, vegetation overgrown with red clover (*Trifolium pratense*),
V-5 vegetal overlay with lucerne (*Medicago sativa*),
V-6, vegetal oat overlay with a mixture of 4 leguminous species,
V-7 black field.

Fig. 1 Beeting method

RESULTS AND DISCUSSIONS

To establish the structure and dynamics of the entomofauna, from the SC Loturi Service SRL Delesti apple orchards in in 2017.

At Variant number 1, Existing vegetal carpet from the spontaneous flora (witness) were collected specimens of entomofauna belonging to a number of 25 species,8 order in total, 212 samples. A number of 107samples belonging to harmful fauna, and 105 samples belonging to useful fauna (tab. 1).

At Variant number 2, Vegetable carpets over-sown with guides, were collected specimens of entomofauna belonging to a number of 25 species,8 order in total, 90 samples. A number of 13 samples belonging to harmful fauna, and 75 samples belonging to useful fauna (tab. 2).

At Variant number 3, Vegetable carpets over-chopped with white clover, sample of entomofauna belonging to a number of 21 species and families were collected in total, 176 samples. A number of 106 samples belonging to harmful fauna, and 70 samples belonging to useful fauna (tab. 3).

At Variant number 4, Vegetable carp topped with red clover, samples of entomofauna belonging to a number of 8 order were collected, in total 106 samples. The most samples species belonging to useful fauna (75), and 31 samples belonging to harmful fauna (tab. 4).

At Variant number 5, Vegetable carpets overgrown with alfalfa, the colected species beloning of 15 families were collected, with a total of 92 samples. The most samples species belonging to useful fauna (54), and 38 samples belonging to harmful fauna (tab. 5).

At Variant number 6, vegetable carp topped with the 4 species of grasses and legumes were collected in total, 97 samples. A number of 42 samples belonging to harmful fauna, and 55 samples belonging to useful fauna (tab. 6).

At Variant number 7, Black field, specimens of entomofauna belonging to a number of 17 species and families were collected, in total, 91 samples. . A number of 51 samples belonging to harmful fauna, and 40 samples belonging to useful fauna (tab. 7).

Table 1

The situation concerning the collection epigenous entomofauna V1 variant

Order	No.	Name of species/Families	06.05	18.05	05.06	25.06	14.07	28.07	18.08	07.09	Total	Type of fauna
Coleoptera	1	*Otiorrynchus ovatus*	2								2	D
	2	*Stethourus punctillum*	3	1			5	1	6	4	20	Pd
	3	*Omias rotundum*		1							1	D
	4	*Cartodere elongata*				1				8	9	Pd
	5	*Coccinella 7 punctata*								1	1	Pd
	6	*Longitarsus jacobae*								5	5	D
Homoptera	1	*Cicadelidae*	1		6			2		3	12	D
	2	*Membracidae*			1					8	9	D
	3	*Aphididae*				30	30	3		7	70	D
Hymeoptera	1	*Ichneumonidae*	1								1	Pz
	2	*Encyrtidae*	1			5			2	6	14	Pz
	3	*Eulophydae*				1					1	Pz
	4	*Platygasteridae*				3					3	Pz
	5	*Scelionidae*				1	1				2	Pz
	6	*Formicidae*				1	18				19	Pd
	7	*Braconidae*						1			1	Pz
	8	*Aphidiidae*	3	3		3					9	Pz
Diptera	1	*Syrphidae*	4			3	1				8	Pd
	2	*Anthomyiidae*		3		2					5	D
	3	*Cecidomyiidae*				2					2	D
Heteroptera	1	*Nabiidae*	1							2	3	Pd
Lepidoptera	1	*Gelechiidae*				1					1	D
Araea	1	*Araneidae*	3	3							6	Pd
Thysanoptera	1	*Aeolothripidae*		3							3	Pd
	2	*Thripidae*						2	11		13	Pd
8 order	25 de families		19	14	7	53	55	9	19	36	212	107 D 105 U

Table 2

The situation concerning the collection epigenous entomofauna V2 variant

Order	No.	Name of species/Families	06.05	18.05	05.06	25.06	14.07	28.07	18.08	07.09	Total	Tupe of fauna
Coleoptera	1	*Psylliodes dulcamarae*	1								1	D
	2	*Cantharis spp*	1								1	D
	3	*Stethourus Punctillum*	1				1	1	1		4	Pd
	4	*Olibrus flavicornis*	1								1	D
	5	*Cartodere elongata/*		1							1	Pd
	6	*Coccinella 7 punctata*					1				1	Pd
	7	*Otiorrynchus obvatus*		7							7	Pd
	8	*Apion apricans*								1	1	D
Homoptera	1	*Aphididae*	1								1	D
	2	*Cicadelidae*				1	6	1			8	D
Hymeoptera	1	*Encyrtidae*	1								1	Pz
	2	*Platygasteridae*	1								1	Pz
	3	*Aphidiidae*		2		7	2			1	12	Pz
	4	*Ichneumonidae*				1					1	Pz
	5	*Pteromalidae*				1			2		3	Pz
	6	*Formicidae*					7				7	Pd
	7	*Braconidae*					1				1	Pz
Diptera	1	*Anthomyiidae*	1	2							3	D
	2	*Syrphidae*	1			2		1			4	Pd
Heteroptera	1	*Pyrrhocoridae*				5					5	Pd
	2	*Miridae*					1			2	3	Pd
Neuroptera	1	*Chrysopa spp*							3		3	Pd
Araea	1	*Araneidae*	5								5	pd
Thysanoptera	1	*Aeolothripidae*	3	2				4			9	Pd
	2	*Thripidae*				3			3		6	Pd
8 order	25 families		17	14	-	20	19	7	9	4	90	16d 74 u

Table 3

The situation concerning the collection epigenous entomofauna V3 variant

Order	No.	Name of species/Families	06.05	18.05	05.06	25.06	14.07	28.07	18.08	07.09	Total	Type of fauna
Coleoptera	1	*Attagenus unicolor*	8								8	Pd
	2	*Cartodere elongata*	17	4					1		22	Pd
	3	*Otiorrynchus obvatus*	4	1							5	D
	4	*Stethourus punctillum*		1			1		1		3	Pd
	5	*Apion nigritarse*		2							2	D
Homoptera	1	*Aphididae*		18	24	6	4	2	2		56	D
	2	*Cicadelidae*	4	1							5	D
Hymeoptera	1	*Encyrtidae*	1			1	1		1	1	5	Pz
	2	*Eulophidae*		3		2					5	Pz
	3	*Aphidiidae*			5		1		3	1	10	Pz
	4	*Chalcididae*					1				1	Pz
Diptera	1	*Anthomyiidae*	4	4	2		2	1		2	15	D
	2	*Syrphidae*			2						2	Pd
	3	*Tachinidae*			2						2	Pd
Heteroptera	1	*Nabidae*	3			1					4	Pd
	2	*Pentatomidae*			3		5			5	13	D
Neuroptera	1	*Chrysopa spp*		1				1		3	5	Pd
Lepidoptera	1	*Pluttelidae*				1					1	D
	2	*Noctuidae*							1		1	D
Araea	1	*Araneidae*					2			1	3	Pd
Thysanoptera	1	*Thripidae*	4	4							8	D
9 order		21 families	45	39	38	11	17	4	9	13	176	106 D 70 U

Table 4

The situation concerning the collection epigenous entomofauna V4 variant

Order	No.	Name of species/Families	06.05	18.05	05.06	25.06	14.07	28.07	18.08	07.09	Total	Type of fauna
Coleoptera	1	*Cartodere elongata*	4		3			1			8	Pd
	2	*Stethourus punctillum*	1	3	17	1			2	3	27	Pd
	3	*Coccinella bipunctata*				1					1	Pd
	4	*Cantharis spp*					2			1	3	D
Homoptera	1	*Aphididae*	2		3	3		1		8	17	D
Hymeoptera	1	*Ichneumonidae*		1			1				2	Pz
	2	*Pteromalidae*				4	1				5	pz
	3	*Braconidae*	1								1	Pz
Diptera	1	*Anthomyidae*	1						1		2	D
	2	*Chloropidae*			2					1	3	D
	3	*Tipulidae*		2							2	Pd
Heteroptera	1	*Miridae*	2	10	2	1	3	3	1		22	Pd
Araea	1	*Araneidae*			2			2	3		7	Pd
Orthoptera	1	*Acrididae*				1	4		1		6	D
7 order		14 de families	11	16	29	11	11	7	8	13	106	31D 75 U

Table 5

The situation concerning the collection epigenous entomofauna V5 variant

Order	No.	Name of species/Families	06.05	18.05	05.06	25.06	14.07	28.07	18.08	07.09	Total	Type of fauna
Coleoptera	1	*Stethourus punctillum*		1						4	5	Pd
	2	*Cartodere elongata*	1						1		2	Pd
Homoptera	1	*Coccidae*	2			2			1		5	D
	2	*Aphididae*	10		8	1	1			4	24	D
Hymeoptera	1	*Braconidae*		3	1		1				5	Pz
	2	*Formicidae*			4		4	9	1		18	Pd
	3	*Aphidiidae*	1	1		3				3	8	Pz
Diptera	1	*Chloropidae*	1		1				1		3	D
	2	*Tipulidae*		1			3			1	5	D
	3	*Cecidomyiidae*				1					1	D
Heteroptera	1	*Lygaeidae*		1							1	Pd
	2	*Miridae*						1		4	5	Pd
	3	*Pyrrhocoridae*										Pd
Neuroptera	1	*Chrysopa spp*	1						1		2	Pd
Araea	1	*Araneidae*	1		2			2		3	8	Pd
7 order	15 families		17	6	16	7	9	12	5	19	92	38 D 54U

Table 6

The situation concerning the collection epigenous entomofauna V6 variant

Order	No.	Name of species/Families	06.05	18.05	05.06	25.06	14.07	28.07	18.08	07.09	Total	Type of fauna
Coleoptera	1	*Stethourus Punctillumi* Coccinelidae				1			6	12	19	d
	2	*Longitarsus apicalis*/Chrysomelidae							1		1	D
Homoptera	1	*Coccidae*	5								5	D
	2	*Aphididae*	17		2		3				22	D
	3	*Cicadelidae*		1		1	2	1	1	1	7	D
Hymeoptera	1	*Braconidae*	1								1	Pz
	2	*Pteromalidae*	1	1						2	4	Pz
	3	*Chalcididae*	1								1	Pz
	4	*Encyrtidae*		1							1	Pz
	5	*Scelionidae*					4				4	Pz
	6	*Formicidae*					1				1	Pd
	7	*Eurytomidae*					1				1	Pz
	8	*Eulophydae*								2	2	Pz
	9	*Aphidiidae*						3			3	Pz
Diptera	1	*Syrphidae*			2						2	Pd
	2	*Anthomyiidae*					2				2	D
	3	*Tachinidae*						1			1	Pd
	4	*Cecidomyiidae*							3		3	D
Heteroptera	1	*Miridae*				1		1			2	Pd
	2	*Nabidae*							2		2	Pd
	3	*Pyrrhocoridae*							3		3	Pd
Neuroptera	1	*Chrysopa spp*			1						1	Pd
Lepidoptera	1	*Gelechiidae*				1					1	D
	2	*Tortricidae*					1				1	D
Araea	1	*Araneidae*				1					1	Pd
Thysanoptera	1	*Thripidae*		1			1			4	6	Pd
9 order		26 families	25	4	5	5	15	6	16	21	97	42 D 55 U

Table 7

The situation concerning the collection epigenous entomofauna V7 variant

Order	No.	Name of species/Families	06.05	18.05	05.06	25.06	14.07	28.07	18.08	07.09	Total	Type of fauna
Coleoptera	1	*Coccinella 7 punctata*	2	2			3			1	8	Pd
	2	*Phyllotreta vittula*								1	1	D
	3	*Stethourus Punctillum*							4		4	D
	4	*Cantharis* spp.			1					1	2	D
Homoptera	1	*Aphididae*	14		4	2		8			28	D
	2	*Cicadelidae*	1	3			3				7	D
Hymeoptera	1	*Ichneumonidae*	1			1					2	Pz
	2	*Pteromalidae*				1		1			2	Pz
	3	*Braconidae*							1		1	Pz
	4	*Apidae*		1		2	1		2		6	U
	5	*Formicidae*	1		2	1		5			9	Pd
Diptera	1	*Tipulidae*		1	1					1	3	D
	2	*Cecidomyidae*							1		1	D
	3	*Chloropidae*			1					4	5	D
	4	*Anthomyidae*					1			1	2	Pd
Heteroptera	1	*Pyrrhocoridae*	2						2		4	Pd
	2	*Miridae*					4				4	Pd
Araea	1	*Araneidae*	1							1	2	Pd
6 order	17 families		22	7	9	7	12	14	10	10	91	51D 40 U

In graphical representation we can observe the percentage obtained by the species belonging to the useful entomofauna recorded in each working variant.

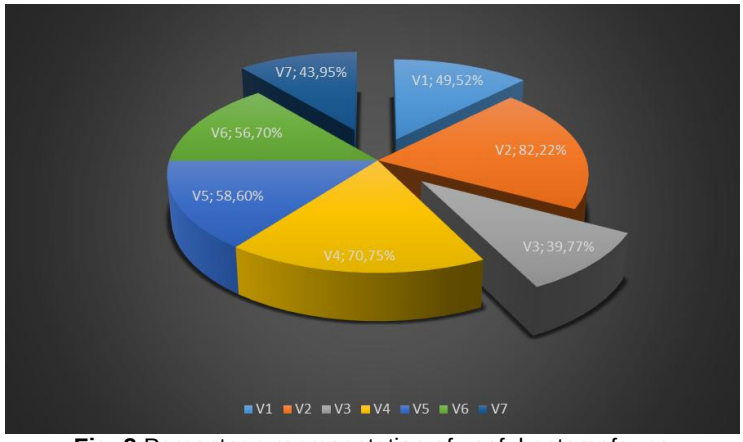

Fig. 2 Percentage representation of useful entomofauna on variants

CONCLUSIONS

1. Following the eight harvests that took place in May 2017, 510 samples, of entomofauna were collected in total.
2. The situation of the collections on variants is as follows:
► V1 were collected 11 species with a total of 14 specimens.
► A total of 11 species with a total of 55 specimens were collected at V2.
► At V3 a total of 14 species were collected with a total of 30 specimens.
► A total of 9 species were collected at V4 with a total of 109 specimens.
► A total of 19 species were collected at V5 with a total of 214 specimens.
► A total of 19 species were collected at V6 with a total of 14 specimens.
► A total of 7 species with a total of 10 specimens were collected at V7.
3. The most common and common species of coleopterans were *Dermestes laniarius* Ill. *Harpalus calceatus, Harpalus distinguendus, Amara eurynota, Phyllotreta nemorum, Opatrum sabulosum* and *Omias rotundus*.

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THE BIOLOGICAL CYCLE OF THE CODLING MOTH - *CYDIA POMONELLA* L., AT WALNUT CULTIVARS UNDER THE CONDITIONS OF THE IAŞI FRUIT TREE ECOSYSTEM

CICLUL BIOLOGIC AL VIERMELUI MERELOR - *CYDIA POMONELLA* L., LA SOIURI DE NUC ÎN CONDIŢIILE ECOSITEMULUI POMICOL IAŞI

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Abstract. *The purpose of this paper is to follow Cydia pomonella's biological cycle with the help of pheromone traps in order to warn the treatments and to know the evolution of the pest in the NE area of Romania in the case walnut tree growing. Another objective pursued is to effectively combat this pest with plant protection substances. The observations were made in 2017, having as research material 14 walnut genotypes, in the 7th year since planting, being grafted on Juglans regia as rootstock. In case of variant 1 phytosanitary treatments with fungicides and insecticides were carried out and in the second variant (V2) no phytosanitary treatments were carried out, pest control being carried out by biotechnical means, using AtraPom synthetic sex pheromones traps. During this period the climatic factors, which influence the occurrence of the pest, were analyzed. Based on the observations made, the flight curve of the species was drawn in the studied area. Following the monitoring of the C. pomonella, we can warn the treatments according to the number of adults captured, as follows: for the first generation in the period 16-20.05.2017 and for the second generation in the period between June 25th to July 1st.*
Key words: pheromone, traps, walnut, *Cydia pomonella* L.

Rezumat. *Scopul acestei lucrări este de a urmări ciclul biologic al dăunătorului Cydia pomonella, cu ajutorul capcanelor cu feromoni în vederea avertizării tratamentelor şi de a cunoaşte evoluţia dăunătorului în zona de NE a României la cultura nucului. Un alt obiectiv urmărit este acela de a combate eficient acest dăunător cu ajutorul substanţelor de protecţie a plantelor. Observaţiile au fost efectuate în anul 2017, având ca material de cercetare 14 genotipuri de nuc, în anul VII de la plantare, fiind altoite pe Juglans regia. În cazul variantei 1 au fost efectuate tratamente fitosanitare cu fungicide şi insecticide, iar în cea de-a doua variantă (V2), nu s-au efectuat tratamente fitosanitare, controlul dăunătorilor fiind realizat cu ajutorul mijloacelor biotehnice, utilizând capcane*

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cu feromoni sexuali sintetici AtraPom. În această perioadă s-au analizat factorii climatici, ce influențează apariția dăunătorului. Pe baza observațiilor făcute s-a întocmit curba de zbor a speciei în zona studiată. În urma monitorizării dăunătorului Cydia pomonella, putem avertiza tratamentele în funcție de numărul de adulți capturați, astfel: pentru prima generație 16-20.05.2017, iar pentru a doua generație 25.06-01.07.
Cuvinte cheie: capcană, nuc, *Cydia pomonella* L.

INTRODUCTION

Walnut is a species of particular economic and social importance, due to the high food value of fruit, wood quality and the use of raw materials for various industries (chemical, pharmaceutical). Unlike other fruits, nuts are a food rich in protein substances, minerals, vitamins (Cociu *et al.*, 2007). Lately both consumption and walnut tree surfaces increased (FAO, 2016). Although walnuts are a species that is attacked by a relatively small number of diseases and pests compared to other cultures, their effective control is not to be neglected because both diseases and pests can compromise culture. The codling moth, *Cydia pomonella* (L.) (*Lepidoptera*: *Tortricidae*), is the most important pests of apples worldwide but also for other fruit tree species and is often studied in the last years (Basheer *et al.*, 2016; Piskorskiand and Dorn, 2011; Jonesand and Wiman, 2008). In our country the walnut tree is attacked by the pest *Cydia pomonella* L. whose larva can attack fruits (Teodorescu *et al*., 2003).

MATERIAL AND METHOD

Cydia pomonella L. species biological cycle research was conducted in 2017, with 14 research genes of walnut genotypes in the 7th year of planting, being grafted on *Juglans regia*. With the help of the biological criteria, we can determine the optimal time to apply the treatments, the biology of the pest being closely related to climatic data.

Table 1

Main climatic elements of 2017 in Iaşi area

Month	Year 2017				
	TEMPERATURE			RAINFALL	HUMIDITY
	mean	low	high	mm	
I	-4.9	-17.1	7.3	323.6	97.26
II	-0.80	-21.9	14.4	13.8	82.10
III	7.89	-1.2	22.7	108	89.75
IV	9.72	-2.5	25.5	140.4	89.16
V	22	3.9	30.3	72	61.51
VI	20.64	9.1	34.5	56	65.9
VII	21.03	10.6	34.2	56.4	69.3
VIII	20.99	6.8	37.7	67	61.76
IX	16.79	0.7	31.5	31.2	68.09
X	10.42	0	26.5	76.8	74.1
XI	15.5	-2.6	15.1	32.2	54.5
XII	16	-5.7	13	69.44	84.03
Total	19.03	-21.9	37.7	1046.84	67.04

The climatic conditions of the analyzed period had a strong influence on the evolution of the pest and implicitly on its occurrence. Analyzing the climatic data from this period we find that since April the maximum temperature exceeded 25.5ºC, the highest peak and record for the Iasi area in 2017 was 37.7ºC in August and the minimum temperature was recorded in February -21.9ºC (tab. 1). In April there was a climatic accident, temperatures of up to -2.5ºC were recorded after high temperature days, the trees are growing in turn, the low temperatures were accompanied by snowfall. The rainfall recorded in 2017 were significant but were unevenly distributed throughout the year.

In the analyzed period, Cydia pomonella's biological cycle was studied with AtraPom-type sex pheromone traps produced by Raluca Ripan Institute for Research in Chemistry. In the case of the two variants, were placed pheromone traps of the AtraPom type, which were placed in each experimental version of three traps, which were read once at every two days between May and July. The pheromone was changed once at every 3 weeks, and when necessary, the glue plates of the traps were also changed, which were damaged due to rain, temperatures, etc. Data collection was made on the same day both at V1 and V2, except in days of rain, when adults do not lay eggs. Phytosanitary treatments were performed in variant 1, as shown in table 2.

Table 2

Treatments performed on walnut trees during March-July 2017(*, 2017)**

Treatment	Pests and diseases	Products and concentrations applied
T1	Hybernating forms of pests	B. Bordelaise 5% - 5 kg/ha Mospilan 20SG 0.03% - 0.3 kg/ha
T2	*Gnomonialeptostyla* (Anthracnose)	Dithane M45 0.2%- 2 kg/ha Decis 25 WG 0.003% - 30 gr/ha
T3	*Gnomonialeptostyla* (Anthracnose), *Sciaphobussqualidus*(ladybug) Codling moth- *Cydia pomonella*	Folicur solo 0.075% - 0.75 l/ha Calypso 0.02% 0.2 l /ha
T4	*Gnomonialeptostyla* (Anthracnose) Codling moth- *Cydia pomonella*	Signum0.05%- 0.5 kg/ha Decis 25 WG 0.003 % 30 gr/ha
T5	*Gnomonialeptostyla* (Anthracnose) Codling moth- *Cydia pomonella*	Flint plus 0.125% -1.25 kg/ha Calypso 0.2%- 0.2 l/ha
T6	*Gnomonialeptostyla* (Anthracnose) Codling moth- *Cydia pomonella*	B. Bordelaise 0.5% 5 kg/ha Novadim 0.075%- 0.75 l/ha

RESULTS AND DISCUSSIONS

Following the observations, the catches were recorded every two days, based on the data collected, the catches dynamics of the male species were compiled. The evaluation of the results was done by monitoring the flight activity of adults with the AtraPOM sexual pheromone, the traps being located in each experimental version of 3 traps, read every two days between May and July. The

data collection was performed on the same day for both treated and chemically untreated versions.

Table 3

Number of adults of *Cydia pomonella* (codling moth) in synthetic sex pheromone traps of the AtraPOM type, Variant 1

Year	G I		G II	
	Date of observation	No. of adults caught per trap	Date of observation	No. of adults caught per trap
2017	11.05	9	23.06	11
	13.05	4	25.06	6
	16.05	11	27.06	3
	18.05	10	29.06	12
	20.05	7	01.07	9
	22.05	3	03.07	4

In the observations made in version 1, generation I, where plant protection products were used, 9 adults were captured on 11.05.2017, exceeding the five butterflies / trap / week. After this date, when a maximum catch for the first generation was recorded, the number of catches decreased as phytosanitary treatments were carried out to control the pest. An increase in the number of butterflies was noticed in the data collection carried out on May 16th, with a number of 11 butterflies / trap. In case of variant 2, where only pheromone traps were located, 12 butterflies / trap were recorded on May 11thas compared to variant 1, where there were nine males / trap. The treatments were performed according to the indicated period, at the emerge of both generation 1 and generation 2.The maximum catch of the second generation was on June 29th with capture of 12 butterflies/trap at V_1 compared to V_2 where there were 19 butterflies /trap, but we notice a much smaller number of males in variant 1.

In the analyzed period, the largest number of butterflies captured (every 2 days) was in the case of the untreated plant-protection variant, with a number of 19 butterflies. Obtained information has rationalized the treatments, setting the right time to apply them (Ungureanu *et. al*, 2005).

Table 4

Number of adults of *Cydia pomonella* L. (codling moth) in synthetic sex pheromone traps of the AtraPom type (Iaşi, 2017, variant 2, walnut orchard)

G I		G II	
Date of observation	No. of adults caught per trap	Date of observation	No. of adults caught per trap
11.05	12	23.06	13
13.05	3	25.06	11
16.05	10	27.06	16
18.05	12	29.06	19
20.05	9	01.07	11
22.05	4	03.07	7

The flight curve was drawn up based on recorded catches as shown in the graphs (fig.1 and fig. 2).

The tip of the flight curve helped to set the warning times for treatments at the chemically treated variant. For the first generation, the period June 16th to 20thwas warned for treatments and in the case of the 2nd generation, the treatment warning was between June 25th and July 1st.

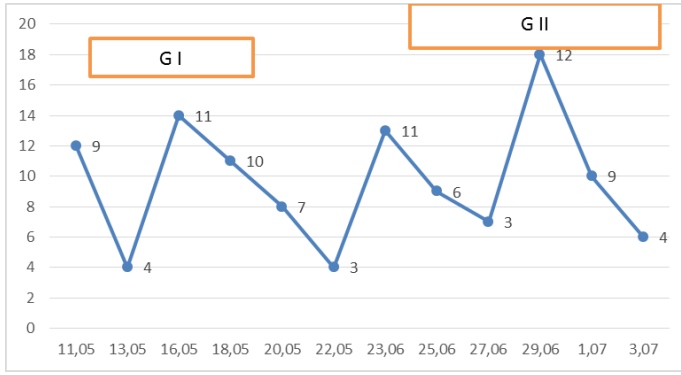

Fig. 1 The number of adults of *Cydia pomonella* (codling moth) in AtraPOM-type synthetic pheromone traps (Iaşi, 2017 variant1)

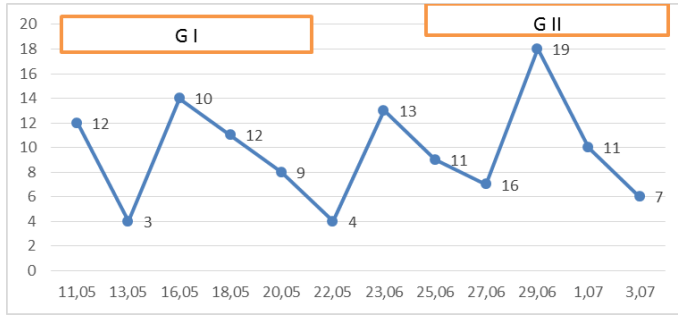

Fig. 2 The number of adults of *Cydia pomonella* (codling moth) in AtraPOM-type synthetic pheromone traps (Iaşi, 2017 variant 2)

CONCLUSIONS

1. Although chemical treatments provide greater protection against codling moth versus unconventional methods of control, the assessment of the number of adults trapped in the analyzed period demonstrates a high efficacy of both methods of control used but with a difference in the fruit pest attack.

2. Differences between the treated and untreated variant of walnut tree growing did not record significant differences regarding the attack on the fruit.

3. Pheromone traps can follow the biological cycle of the species in order to warn the treatments, but also to limit their number.

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ASPECTS REGARDING THE CONTROL OF PATHOGENS ON BELL PEPPER IN THE FIELD

ASPECTE PRIVIND CONTROLUL AGENŢILOR PATOGENI LA CULTURA DE ARDEI GRAS DIN CÂMP

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Abstract. *The main objective of this experience was to develop a program of treatments for the control of pepper diseases in the field. The experience was achieved in 2017 at RDIVFG Vidra, 5 variants, placed in randomized blocks, using Buzau 10 bell peppers variety. In the crop of pepper in the field, the highest yields were recorded in variant which was applied to the following succession of products: T1. Copper Max 50 WP 0.25%; T2. Bravo 500 SC 0.2%; T3. Champ 77 WG 0.25%; T4. Orius 25 EW 0.05%; T5. Copper Max 50 WP 0.25%; T6. Ortiva Top 0.1% with 29.9 t / ha (19.6% increased yield compared with untreated control) and variant T1. Copper Max 50 WP 0.25%; T2. Polyram DF 0.2%; T3. Champ 77 WG 0.25%; T4. Orius 25 EW 0.05%; T5. Copper Max 50 WP 0.25%; T6. Ortiva Top 0.1% with 29.7 t / ha (18.8% increased yield compared to the untreated control).*
Key words: bell pepper, fungicides

Rezumat. *Principalul obiectiv al acestei experienţe a fost elaborarea unui program de tratamente pentru controlul agenţilor de dăunare la cultura de ardei din câmp. Experienţa a fost realizată în anul 2017, la ICDLF Vidra, în 5 variante, aşezată în blocuri randomizate, folosind soiul de ardei gras Buzau 10. La cultura de ardei din câmp, cele mai mari producţii s-au înregistrat la varianta la care s-a aplicat următoarea succesiune de produse: T1. Copper Max 50 WP 0,25%; T2. Bravo 500 SC 0,2%; T3. Champ 77 WG 0,25%; T4. Orius 25 EW 0,05%; T5. Copper Max 50 WP 0,25%; T6. Ortiva Top 0,1% cu 29,9 t/ha (19,6 % spor faţă de martor) şi la varianta T1. Copper Max 50 WP 0,25%; T2. Polyram DF 0,2%; T3. Champ 77 WG 0,25%; T4. Orius 25 EW 0,05%; T5. Copper Max 50 WP 0,25%; T6. Ortiva Top 0,1% cu 29,7 t/ha (18,8 % spor de producţie faţă de martor).*
Cuvinte cheie: ardei gras, fungicide

INTRODUCTION

In Romania, green pepper crops in greenhouses and field are frequently attacked by some pathogens that cause significant damage, leading to the compromise of culture if no phytosanitary treatments are done. The main pathogens that cause disease are *Xanthomonas vesicatoria*, *Pseudomonas tomato*, *Botrytis cinerea*, *Alternaria tenuis*, *Leveillula taurica*, *Phytophtora capsici*, *Verticillium dahliae* and *Fusarium oxysporum* f. sp. *vasinfectum* (Costache *et al.,*

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2007). Other pathogens are also spread in other countries, such as *Ralstonia solanacearum, Clavibacter michiganensis* subsp. *michiganensis, Colletotrichum gloeosporioides, Cercospora capsici, Choanephora cucurbitarum, Stemphylium solani, Sclerotium rolfsii, Sclerotinia sclerotiorum* (Shankar *et al.,* 2014). Bacteria are controlled by copper based products, streptomycin sulfate, anthracnose with products based on azoxistrobin and pyraclostrobin, root, stems and fruits rot with products based on cyazofamid, dimethomorph + ametoctradin, fluopicolide, mandipropamid, mefenoxam + copper, oxathiapripoline + chlorothalonil or mefenoxam or mandipropamide (Meadows and Sharpe, 2017).

MATERIAL AND METHOD

The experience was realized in 2017 at RDIVFG Vidra, placed in randomized blocks, in 4 replicates using the Buzau 10 bell pepper variety.

Planting in the field was done on May 9, 2017. During the vegetation period were applied 6 foliar treatments (T1 - T6) at 12-16 days intervals: June 23, July 7, 19, August 4, 21 and September 6.

Technological control variants (tab. 1) were determined according to the sequence of pathogens in crops.

The main objective of this experience was to develop a program of treatments for the control of pepper pests in the field.

Table1

Variants for pathogen control on bell pepper cultivated in the field (Vidra, 2017)

Variant	23.06.2017	07.07.2017	19.07.2017	04.08.2017	21.08.2017	06.09.2017
	T1	T2	T3	T4	T5	T6
1.	Copper Max 50 WP 0.25%	Bravo 500 SC 0.2%	Champ 77 WG 0.25%	Orius 25 EW 005%	Copper Max 50 WP 0.25%	Ortiva Top 0.1%
2.	Champ 77 WG 0.25%	Cabrio Top 0.2%	Copper Max 50 WP 0.25%	Score 250 EC 0.05%	Champ 77 WG 0.25%	Ortiva 250 EC 0.075%
3.	Copper Max 50 WP 0.25%	Polyram DF 0.2%	Champ 77 WG 0.25%	Orius 25 EW 0.05%	Copper Max 50 WP 0.25%	Ortiva Top 0.1%
4.	Champ 77 WG 0.25%	Dithane M45 WP 0.2%	Copper Max 50 WP 0.25%	Score 250 EC 0.05%	Champ 77 WG 0.25%	Ortiva 250 EC 0.075%
5.	Untreated check	-	-	-	-	-

RESULTS AND DISCUSSIONS

The first pathogen reported to the pepper culture in the field was *Pseudomonas tomato* (6.07) and last *Leveillula taurica* (24.08). The pathogen attack began in the third decade of July (*Botrytis cinerea* – 21.07; *Alternaria tenuis* – 24.07; *Xanthomonas vesicatoria* – 26.07: tab. 2).

Table 2

The occurrence and evolution of pathogens and pests attack in field pepper crops in correlation with climatic factors (Vidra, 2017)

The pathogen or the pest	Date of the attack	Degree of attack / frequency of attack (%)/month, decade												
		May	June			July			August			September		
		III	I	II	III	I	II	III	I	II	III	I	II	III
Xanthomonas vesicatoria	26.07	0	0	0	0	0	0	0.7	1.5	2.8	4.1	6.4	7.5	8.9
Pseudomonas tomato	06.07	0	0	0	0	0.8	1.3	1.9	2.4	3.3	3.8	4.5	5.5	6.1
Alternaria tenuis	24.07	0	0	0	0	0	0	1.0	1.8	2.5	3.1	3.5	4.2	6.7
Botrytis cinerea	21.07	0	0	0	0	0	0	1.4	2.0	2.8	3.5	4.3	6.9	8.8
Minimum temperature (°C)	-	12.4	15.0	14.0	16.3	15.9	15.9	17.5	21.1	18.3	15.1	13.7	15.3	10.5
Maximum temperature (°C)	-	21.4	27.0	26.0	31.9	28.4	28.9	31.0	36.6	31.8	28.7	28.8	29.4	19.2
Average temperature (°C)	-	16.5	20.1	19.8	23.8	22.0	22.0	24.0	30.8	25.6	21.3	20.8	21.5	14.2
Minimum relative humidity (%)	-	57.0	47.5	43.8	36.4	46.0	37.8	35.7	26.9	27.4	30.2	29.3	30.8	41.7
Maximum relative humidity (%)	-	79.6	77.8	74.4	82.5	74.7	63.6	63.3	52.4	57.0	56.4	72.3	61.7	64.6
Average relative humidity (%)	-	66.9	59.5	56.8	56.4	57.9	47.6	46.8	36.7	38.7	41.7	46.9	44.8	50.7
Rainfall (mm)	-	7.5	20.0	22.5	1.0	84.0	8.5	6.5	0	0	45.0	30.0	1.0	2.0

Table 3

The efficacy of some variants of treatments for controlling the pathogen on bell pepper crop in the field (Vidra, 2017)

Variant	Yield			Degree of attack / frequency of attack (%) and efficacy (E %)										
	kg/m^2	t/ha	% increased yield compared to the untreated control	*Pseudomonas tomato* (GA %)	E (%)	*Xanthomonas vesicatoria* (GA %)	E (%)	*Alternaria tenuis* (FA %)	E (%)	*Botrytis cinerea* (FA %)	E (%)	*Leveillula taurica* (GA %)	E (%)	E average (%)
1	2.986	29.9	119.6	1.1	82.0	1.4	84.3	1.2	82.1	1.7	80.7	1.0	81.8	82.2
2	2.940	29.4	117.6	1.3	78.7	1.6	82.0	1.0	85.1	1.5	81.8	0.9	83.6	82.2
3	2.970	29.7	118.8	1.3	78.7	1.7	80.9	1.3	80.6	1.4	84.1	1.1	80.0	80.9
4	2.965	29.6	118.4	0.8	86.9	1.0	88.8	0.8	88.0	1.5	82.9	1.0	81.8	85.7
5	2.496	25.0	100.0	6.1	-	8.9	-	6.7	-	8.8	-	5.5	-	-

The attack of pathogens had a slow evolution due to the low rainfall from the second decade of July to the second decade of August (15 mm) and low atmospheric humidity (52.4 - 63.6%) and high temperatures (28.9 - 36.6 ° C).

Under these conditions, the mean efficacy of the treatment variants was relatively similar, ranging from 80.9% (variant 3) and 85.7% (variant 4, Table 3).

Regarding the bell pepper yield in the field, depending on the variants of experiments, it had values between 29.4 t / ha (V 2) and 29.9 t / ha (V 1), compared to 25.0 t / ha in the untreated control variant (tab. 3).

The best results were recorded in variant 1 where it was applied the next succession of products: T1. Copper Max 50 WP 0.25%; T2. Bravo 500 SC 0.2%; T3. Champ 77 WG 0.25%; T4. Orius 25 EW 0.05%; T5. Copper Max 50 WP 0.25%; T6. Ortiva Top 0.1% with 29.9 t/ha (19.6 % increased yield compared to the untreated control) and variant 3: T1. Copper Max 50 WP 0.25%; T2. Polyram DF 0.2%; T3. Champ 77 WG 0.25%; T4. Orius 25 EW 0.05%; T5. Copper Max 50 WP 0.25%; T6. Ortiva Top 0.1% with 29.7 t/ha (18.8 % increased yield compared to the untreated control). It can be appreciated that all variants where were applied treatments for pathogen control, have been obtained similar yield values.

CONCLUSIONS

The control of pathogens in field can be achieved with very good results on bell pepper crops using the following treatment program: T1. Copper Max 50 WP 0.25%; T2. Bravo 500 SC 0.2%; T3. Champ 77 WG 0.25%; T4. Orius 25 EW 0.05%; T5. Copper Max 50 WP 0.25%; T6. Ortiva Top 0.1%.

Bacterial control can be done with copper based products (Copper Max 50 WP 0.25%, Champ 77 WG 0.25%), and for the other pathogens Polyram DF 0.2%; Orius 25 EW 0.05% and Ortiva Top 0.1%.

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RESEARCH ON BIODIVERSITY CONSERVATION AND MANAGEMENT IN THE VITICULTURAL AGROECOSYSTEM IN THE DEALUL BUJORULUI VINEYARD

CERCETARI PRIVIND CONSERVAREA SI GESTIONAREA BIODIVERSITATII IN AGROECOSISTEMUL VITICOL DIN PODGORIA DEALUL BUJORULUI

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Abstract. *The paper presents the research carried out at the Bujoru Viticulture and Wine Research and Development Station between 2016 and 2017. Research has focused on conservation and enhancement of functional and planned biodiversity through the implementation of all bio-resources of the greenhouse system and multifunctional protection areas, which are conducive to reducing the pathological risks and reducing external inputs (diesel, pesticides). Assessment of the state of conservation of biodiversity in the viticultural ecosystem of pogoria Dealul Bujorului.Biodiversity is a specific feature of our planet that ensures the optimal functioning of ecosystems, the existence and development of the biosphere in general. Lately, the issue of protecting biodiversity at ecosystems, species and populations has become increasingly vital to reducing the human impact on the biosphere. The viticultural ecosystem is defined as the functional unit of biosphere created and controlled by man in order to obtain high yields of grapes, of high quality and in more economical and socially advantageous conditions.*
Key words: grapevine, biodiversity, ecosystems

Rezumat. *Lucrarea prezintă cercetările efectuate la Staţiunea de Cercetare şi Dezvoltare pentru Viticultură şi Vinificaţie Bujoru în perioada 2016-2017. Cercetările au vizat studii privind conservarea şi consolidarea biodiversităţii funcţionale şi planificate prin implementarea tuturor bio-resurselor a sistemului de înverzire şi a zonelor multifuncţionale de protecţie, favorabile reducerii riscurilor patologice şi diminuării inputurilor externe (motorină, pesticide. Evaluarea stării de conservare a biodiversităţii în ecosistemul viticol din pogoria Dealul Bujorului. Biodiversitatea reprezintă o particularitate specifică a planetei noastre, care asigură funcţionarea optimă a ecosistemelor, existenţa şi dezvoltarea biosferei în general. În ultima perioadă, problema protejării biodiversităţii la nivel de ecosisteme, specii şi populaţii a devenit tot mai vitală pentru reducerea impactului uman asupra biosferei. Ecosistemul viticol este definit ca fiind acea unitate funcţională a biosferei creată şi controlată de către om, în vederea obţinerii unor producţii ridicate de struguri, de calitate superioară şi în condiţii economice şi sociale tot mai avantajoase.*
Cuvinte cheie: viţă de vie, biodiversitate, ecosistem

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INTRODUCTION

Sustainable growth of production and income in vineyard culture requires extensive measures to combat pathogens and pests. Beside the beneficial effect of the phytosanitary measures on the vine, these may have negative effects on the preservation of biodiversity in wine ecosystems.

At the same time, reducing damages caused by diseases, pests and herbage, must be achieved by reducing the dependence of culture on conventional resources (D. Ball *et al.*, 1986; Tălmaciu M. *et al.*, 1996).

MATERIAL AND METHOD

Research was conducted between 2016 and 2017 in the vineyard plantations of the Bujoru Viticulture and Wine-growing Research and Development Station.

In order to evaluate the positive impact of implementation of bio-resources, of greening systems and of multifunctional protection areas on functional biodiversity in vineyard ecosystems in vineyards were identified and installed six experimental variants located on terraces located on the level cubes with a width of about 20 m and a length of 600 m (tab. 1).

Table 1

Identification data of experimental lots - SCDVV Bujoru

Culture	Parcel	The variety	Soil maintenance system	Lat. N	Long. E	Altitude (m)
Vine	Variant 1	Rkatiteli	black field	45.50.01.59	27.55.25.06	40
	Variant 2	Rkatiteli	string mulch chopped	45.50.01.20	27.55.24.22	45
	Variant 3	Fetească albă	black field	45.50.00.46	27.55.22.22	49
	Variant 4	Fetească albă	string mulch chopped	45.50.00.29	27.55.21.18	53
	Variant 5	Babească gri	black field	45.49.58.94	27.55.15.60	66
	Variant 6	Babească gri	string mulch chopped	45.49.58.60	27.55.14.97	71

RESULTS AND DISCUSSIONS

In order to assess the conservation status of biodiversity in wine ecosystems two indicators were taken into account, namely the amount of semi-natural elements in the landscape of the vineyard holding and their quality.

The quantitative indicator represents the share of the total surface area of the component elements (artificial landscape and infrastructure in relation to the surface of the vineyard).

The case of the six experimental lots, the surface actually occupied by vine is 17.11 ha, and the agro-ecological infrastructure represented by grasshoppers, isolated trees and other crops occupy 9,01 ha. Under these circumstances the ratio between IAE and UAE is 53% and the artificialism rate is 47%.

The structure and morphology of the viticultural habitat in the Bujoru ecosystem: Total wine-growing = 26.12 ha of which:
Surface occupied by multifunctional protection areas = 9.01 ha:

- grasshoppers: 13500 m x 5 m = 6.75 ha;
- isolated trees: 10 m x 10 m = 0.01 ha;
- trenches: 2m x 1250m = 0.25ha;
- wetland specific vegetation = 0.50 ha;
- squid = 1,00 ha and alfalfa = 0.50 ha.

Total surface actually occupied by vineyard culture: 17.11 ha
17.11 ha => IAE/UAE= 53% Rate of artificialization= 100-53= 47%

The qualitative indicator reflects the conservation status of the landscape elements. Quality is evaluated based on several indicators defined for each tipe of IAE. Indicators are divided into three categories: structure, composition and functions assimilated here to degradations. These indicators are being deducted for each type of IAE in rating grids and are then classified into three categories: good, medium, unfavorable, depending on their condition. Farm level, quality is assessed by aggregating all the conservation status obtained for all IAEs on the holding. This allows to obtain a radial pattern diagram showing the IAE share of good conservation, medium and unfavorable.

Barber soil traps, filled 2/3 with formalin solution (formaldehyde) 4%, 3/ each variant, have been installed on the vineyard rows in order to establish the quantitative and qualitative structure of entomofauna from the soil surface between May-August.

With Barber soil traps, entomological material (specimens of insects - juveniles, adults) was collected. Traps were disposed randomized in the experimental lot trying to cover as many ecological niches as possible (habitats). The entomological material collected and labeled was transported to the laboratory washed under water jet and then passed into a solution of ethyl alcohol 7%. The identification and counting of the entomofauna was done with the trinocular magnifier (KRÜSS) with two WF 10x20 magnifiers.

The relative numerical abundance (A.r.%) of a population is defined as the proportion represented by the number of individuals of a species or group compared to the total number of individuals belonging to all species in the sample.

In the observations on entomological material collected at ground level using Barber soil traps (May - August) we found the following (tab. 2):

Variant 1: 9 arthropod species or groups belonging to the *Myriapoda, Insecta* and *Arachnida* classes were identified, but most belong to the *Insectae* class. The highest relative abundance was recorded by the species of the *Formicidae* family (23.21%), followed by the *Lycosidae* (22.92%), fam. *Cicadidae* (11.75%) *Carabidae* (8.02%), *Apidae* (5.16%), *Diptera (*5.44%) and other species (18.91%).

Variant 2: Ground fauna consisted of 9 species or groups of arthropods belonging to the classes: *Insecta* and *Arachnida*. The largest population was represented by the *Lycosidae* family (23.08%) and the *Formicidae* family with (21.63%), fam. *Cicadidae* (9.62%), *Carabidae* (8.65%) and other species (19.23%). The *Coccinellidae* family recorded (0,48%).

Variant 3: Ground fauna consisted in 12 species or groups of arthropods belonging to the classes: *Insecta* and *Arachnida*. The most numerous population was the *Formicidae* family (26.00%), *Lycosidae* family (15.4%) and *Carabidae* family (14.54%).

Variant 4: the fauna at the ground level consisted in 9 species or arthropod groups belonging to the classes: *Insecta* and *Arachnida*. The largest population was represented by the *Formicide* family (26.64%), the *Lycosidae* family (14.29%), the *Carabidae* family (12,74%) and other species (23,55%).

Variant 5: 11 arthropod species or groups belonging to the *Insecta* and *Arachnida* classes were identified, but most belong to the *Insecta* class. The highest relative abundance was recorded by the species of the *Formicidae* family (37.88%), followed by the *Lycosidae* family (14.44%), the *Cicadidae* family (10.64%), the *Carabidae* (8.17%) and other species (15.53%).

Variant 6: 9 arthropod species or groups belonging to the classes of *Insecta* and *Arachnida* have been identified, but most of them belong to the *Insecta* class. The highest relative abundance was recorded by the species of the *Carabidae* (33.09%), the *Formicide* family (20.96%), followed by the *Lycosidae* (14.34%), the *Diptera* Order (4.41%) and other species (13,24%).

Slope grassy: 10 arthropod species or groups belonging to the classes of *Insecta* and *Arachnida* have been identified, but most of them belong to the *Insecta* class. The highest relative abundance was recorded by the species of the *Lycosidae* family (22.94%), followed by the *Formicidae* (17.59%), fam. *Carabidae* (13.77%), fam. *Gryllidae* (6.69%), *Diptera (*6.88%) and other species (18.93%).

To manage biodiversity in order to protect and preserve it, it is necessary to measure it. In this respect, the following biodiversity characterization indices were used to quantify the biodiversity of the studied agroecosystem: the number of species (species richness), the Simpson index (D), the Shannon (H) diversity index, the Shannon-Weaver index H) and equity (E) (tab. 3).

Table 2

Structure of the species caught in the Bujoru agroecosystem - 2017

Systematic classification (species, family, order)	The percentage (%) main culture														Total catch. es
	Vine												Slope grassy		
	V1		V2		V3		V4		V5		V6				
	Number of catches	A %	Number of catches	A %	Number of catches	A %	Number of catches	A %	Number of catches	A %	Number of catches	A %	Number of catches	A %	
Alopecosa pulverulenta/ fam. Lycosidae	80	22.92	48	23.08	53	15.14	37	14.29	53	14.44	39	14.34	120	22.94	430
Formica rufa / fam. Formicidae	81	23.21	45	21.63	91	26.00	69	26.64	139	37.88	57	20.96	92	17.59	574
Epicometis hirta Poda./fam. Scarabeidae	0	0	0	0	8	2.29	0	0	0	0	4	1.47	2	0.38	14
Apis sp./ fam. Apidae	18	5.16	8	3.85	5	1.43	10	3.86	20	5.45	7	2.57	8	1.53	76
Carabus sp./ fam. Carabidae	28	8.02	18	8.65	51	14.54	33	12.74	30	8.17	90	33.09	72	13.77	322
Eurigaster Maura. Subordimul Geocoridae	1	0.29	0	0	2	0.57	0	0	4	1.09	0	0	22	4.21	29
Gryllus campestris/ fam. Gryllidae	7	2.01	12	5.77	12	3.43	13	5.02	10	2.72	11	4.04	35	6.69	100
Fam. Vespidae	8	2.29	5	2.40	12	3.43	5	1.93	3	0.82	1	0.37	17	3.25	51
Coccinella septempunctata/ fam. Coccinellidae	0	0	1	0.48	0	0	0	0	0	0	0	0	0	0	1
Cicada viridis/ fam. Cicadidae	41	11.75	20	9.62	23	6.57	21	8.11	39	10.63	15	5.51	20	3.83	179
Ord. Diptera	19	5.44	11	5.29	18	5.14	10	3.86	11	3.00	12	4.41	36	6.88	117
Myriapoda	0	0	0	0	1	0.29	0	0	0	0	0	0	0	0	1
Forficula auricularia / fam. Forficulidae	0	0	0	0	0	0	0	0	1	0.27	0	0	0	0	1
Other species	66	18.91	40	19.23	74	21.14	61	23.55	57	15.53	36	13.24	99	18.93	433
TOTAL	349	100	208	100	350	100	259	100	367	100	272	100	523	100	2328

Table 3

Simpson Diversity Index (D); Shannon-Weaver (H) and Equality (E) diversity index for the Bujoru viticultural agroecosystem – 2017

Agroeco system	Number individuals of a species	Number total catches in the perimeter analyzed	Proportion of representation	Simpson index (D)		Diversity Index (H)	Equity (E)
the species	ni	N	pi=ni/N	(pi)2	lnpi	-pi*lnpi	E=H/ln(S)
1	430	2328	0.1847	0.0341	-1.6890	0.3120	0.1182
2	574	2328	0.2466	0.0608	-1.4001	0.3452	0.1308
3	14	2328	0.0060	0.0000	-5.1137	0.0308	0.0117
4	76	2328	0.0326	0.0011	-3.4220	0.1117	0.0423
5	322	2328	0.1383	0.0191	-1.9782	0.2736	0.1037
6	29	2328	0.0125	0.0002	-4.3855	0.0546	0.0207
7	100	2328	0.0430	0.0018	-3.1476	0.1352	0.0512
8	51	2328	0.0219	0.0005	-3.8209	0.0837	0.0317
9	1	2328	0.0004	0.0000	-7.7528	0.0033	0.0013
10	179	2328	0.0769	0.0059	-2.5654	0.1973	0.0747
11	117	2328	0.0503	0.0025	-2.9906	0.1503	0.0570
12	1	2328	0.0004	0.0000	-7.7528	0.0033	0.0013
13	1	2328	0.0004	0.0000	-7.7528	0.0033	0.0013
14	433	2328	0.1860	0.0346	-1.6820	0.3129	0.1185
Sum = 14				**0.1607**		**2.0172**	**0.7644**

CONCLUSIONS

1. The most common species of insects were: Formicidae (574 individuals. respectively 24.66%). Lycosidae (430 individuals and 18.47% respectively) and the Carabidae family (322 individuals and 13.83% respectively).

2. The results obtained in 2017 show that in the vineyards there is a rich fauna. both as a number of species and as a number of individuals.

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OBSERVATIONS ON *CYDIA POMONELLA* (APPLE WORM) DYNAMICS IN THR APPLE ORCHARDS AND WARNING ABOUT CHEMICAL TREATMENTS

OBSERVAŢII ASUPRA DINAMICII SPECIEI *CYDIA POMONELLA* (VIERMELE MERELOR), ÎN PLANTAŢIILE POMICOLE DE MĂR ŞI AVERTIZAREA TRATAMENTELOR CHIMICE DE COMBATERE

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Abstract. *Dynamics of adult the Cydia (Laspeyresia) pomonella flight was followed in the apple orchards owned by SC Service SRL Deleşti-Vaslui. For this purpose, it was used the pheromone traps such as AtraPOM were purchased from the Chemistry Institute in Cluj-Napoca country. The traps were installed in the plantation from the first decade of May to September, with the pheromone being replaced within at 6 weeks. The readings were recorded at 3-5 day intervals, inventing the catches at each reading and captured butterflies were removed from the trap. Depending on the dynamics of the butterfly flight, it was established for each generation: the beginning of the flight; maximum flight; the end of the flight. Finally, according to these data, the time of application of the chemical treatments for each generation was determined and according to the number of catches and the timeliness of their application.*
Keywords*: apple pests, biology, control,* phytosanitary *treatments.*

Rezumat: *Dinamica zborului adulţilor speciei Cydia (Laspeyresia) pomonella a fost urmărită într-o plantaţie pomicolă de măr, aceasta aparţinând societăţii SC Service Deleşti –Vaslui. Pentru aceasta au fost utilizate capcane cu feromoni de tipul AtraPOM achiziţionate de la Institutul de Chimie din Cluj-Napoca. Capcanele au fost instalate în plantaţie din prima decadă a lunii mai până în luna septembrie, feromonul fiind înlocuit la intervalul de 6 săptămâni. Citirile au fost înregistrate la intervale de 3-5 zile inventariindu-se capturile la fiecare citire iar fluturii capturaţi erau înlăturaţi din capcană. În funcţie de dinamica zborului fluturilor s-a stabilit pentru fiecare generaţie: începutul zborului; zborul maxim; sfârşitul zborului. În final, în funcţie de aceste date s-a stabilit momentul aplicării tratamentelor chimice pentru fiecare generaţie iar în funcţie de numărul capturilor şi oportunitatea aplicării acestora.*
Cuvinte cheie: *dăunători ai mărului, biologie, control, tratamente fitosanitare.*

INTRODUCTION

The codling moth is considered to have originated in Southeast Europe, over the last two centuries they have dispersed throughout the world and have reached an almost global distribution, being considered a cosmopolitan insect that

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occurs in almost all countries where apples are grown, becoming one of the most successful species of insect pests in terms of invasiveness (Miletic, 2011).

Cydia pomonella L. (*Lepidoptera: Tortricidae*) is one of the most detrimental and economically important apple pests in Romania, and the moth has the potential to cause complete crop losses in apple orchards frequently being about 25-50% and sometimes even larger, in many parts infestation level of fruits may reach 70-80 %.

The agroecosystems, as a type of highly antropic ecosystem, are subject to a great pressure in front of phytopathogenic agents and pests, which, in the absence of the application of any control measures, can prejudice to a great extent the production in the field of cultivated plants. The large variety of the complex of pests specific to fruit-growing plantations imposes the application of a great number of control treatments during a calendar year.

The codling moth, *Cydia pomonella L*. is one of the most detrimental and economically important apple pests, and the moth has the potential to cause complete crop losses in untreated apple orchards (Cârdei, 2006).

The codling moth is a multivoltine species, and adaptive behavior, such as facultative diapause and multiple generations per breeding season, have allowed the codling moth to adapt to diverse climatic conditions (Diaconu *et al.*, 1977). Although the flight capacity of the codling moth is limited, they can spread over long distances through the transportation of infested fruit and packing material, and this has become the most common method for colonization of new habitats.

The apple is a fruit species with the highest number of control treatments in the world (Blommers, 1994). In Romania, the total number of apple control treatments are around 10 and 15 against all diseases and pests, while the number of control treatment of codling moth ranges from 6 to 8 treatments during one growing season (Cârdei *et al.,* 1997, 2007). Despite ecological concern about the harmful pesticides effects on the environment, control of phytophagous species is mostly based on the use of chemical control (Choinard *et al.,* 2016; Blommers *et al.*, 1994). Biological control incorporates various aproaches called integrated pest management which combines a variety of pest control methods (Mahr *et al*., 2008, Hwan-Seok Choi, 2011).

The strategies used should be ecologic and should not include the use of certain toxic pesticides. One control method is the use of synthetic sex pheromones that have the purpose to monitor and decrease the pest populations.

Synthetic sex pheromones have provided useful information about the biology, but also about the control of the codling moth. Their use in plant protection has proved, in a short period of time, through multiple researches made on several species of pests, their decisive role in the integrated fight system. The most important function from this point of view is represented by the appreciation offered by the use of pheromones (Charmillot and Bloesch, 1987, Card, 1977,

Neumann, 1992) in the establishment of the moments of application of *phytosanitary* treatments (Cârdei, 2000; Istrate, 2007; Drosu, 2007).

The recent researches regarding the control of the species *Cydia pomonella* L. have emphasized certain changes in the insect's biology and the particular efficiency of some new generation insecticides.

During in the period 2017, in the company SC Loturi Service SRL Deleşti there have been developed experimentations regarding the control of the codling moth within the program of integrated control of pathogens and pests from apple orchards by using plant protection products which were recently introduced in the phytosanitary treatments.

MATERIAL AND METHODS

The researches regarding the biology, control and economic impact of the pest *Cydia. pomonella* L., have been performed in apple plantation, located at the SC "Loturi Servive" SRL with a total surface of 30 ha, cultivated with apple, obtained by purchasing from the private owners also orchards, with the restitution of the land to the former owners of significant areas of state exploited farms in the communist period. Considering the necessity of performing phytosanitary treatments at the optimal moments of control of the complex of pests and phytopathogenic agents specific to the apple, in the orchards belonging to SC "Loturi Servive" SRL, among the rows of trees is arranged a vegetal carpet consisting of a mixture of legumes *Lotus corniculatus, Trifolium repens, Trifolium pretense, Medicago sativa* or a mixture of legumes and graminees (*Lolium perenne, Phleum pratense*).

The varieties of apple used in this intensive planting are: Jonathan, Golden delicious, Starkrimson, Jonagold, Idared, Golden Reinders, Pinova and Elstar.

The evolution of weather conditions was recorded with the help of AgroExpert equipment, placed within the experimental site.

The dynamic of adult flight was monitored with the help of traps with AtraPOM synthesis sex pheromones produced by "Raluca Repan" Institute of Chemistry of Cluj Napoca, and the reading of captures was recorded for 3-5 day intervals in every week during their entire flight period.

The phytosanitary treatments were applied to the warning, according to the evolution of local weather conditions, of the pest biology and of the plant phenology.

RESULTS AND DISCUSSIONS

Climate characterization

Thus, from the thermal point of view, the January-September period recorded monthly average values over the multiannual values, and October lower values, which may characterize the year 2017 as very warm

During the period 2017 there have been recorded many deviations from the normal values of the main climatic factors, although these are very frequent in this area (fig.1).

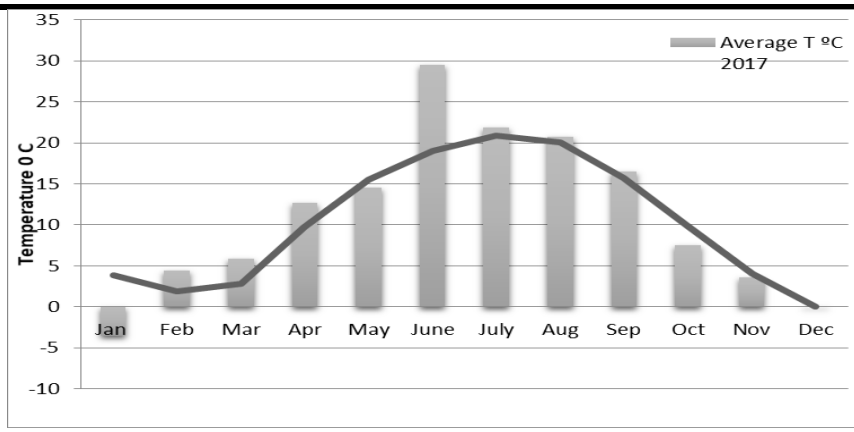

Fig. 1 Temperatures regime of 2017 in Delesti-Vaslui locality

The precipitation regime in January, February, May, June, July and September showed deficits compared to normal total 135.7, which means a droughty year, even though throughout the year the sum of rainfall is above normal (fig.2).

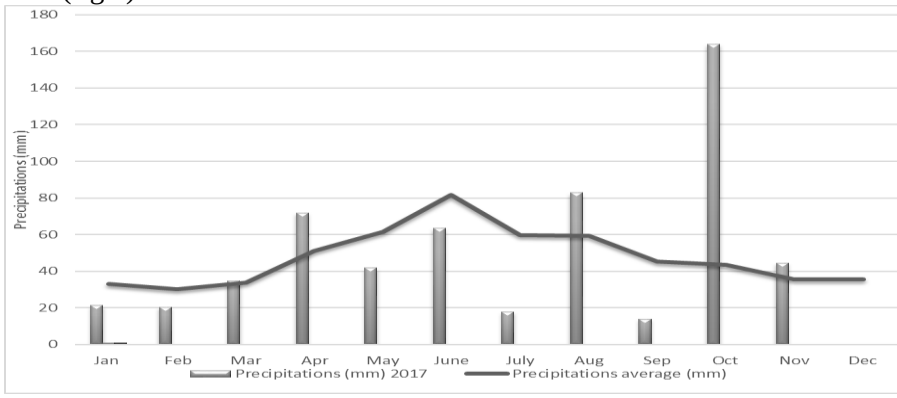

Fig. 2 Precipitation regime of 2017 in Delesti-Vaslui locality

In conclusion, 2017 can be characterized an excessively warm and dry year.

Table 1

Main climatic elements of 2017 in Delesti-Vaslui locality

Month	Average temperature (C^0)		Precipitations (l/m^2)	
	normal	**2017**	**normal**	**2017**
January	3.9	- 3.5	33.1	21.2
February	1.9	4.4	30.3	20.4
March	2.8	5.9	33.7	34.8
April	9.7	12.7	51.1	71.8
May	15.5	14.5	61.6	41.8
June	19.0	29.5	81.7	63.6
July	20.9	21.9	59.7	17.8

August	20.1	20.7	59.2	82.8
September	15.7	16.5	45.2	13.8
October	9.8	7.5	43.5	164.0
November	4.1	3.6	35.7	44.4
December	-	-	35.4	
Total	**10.20**	**9.42**	**570.2**	**576.0**

Characterization of the codling moth biology

It is known the fact that one of the main factors which influences the pest biology is temperature, so that for the development of a complete generation is necessary a sum of real temperature of 630 ^{0}C [$\sum(t_n-t_0)$], where t_n= daily average temperature, and t_0 = biological threshold, which is of 9^{0}C (Săvescu and Rafailă, 1978). From the analysis of the dynamic of adults' flight during of the vegetation period, recorded at Atra POM pheromone traps (fig.3), there resulted two flight curves, well-individualized during a vegetative season (fig.4).

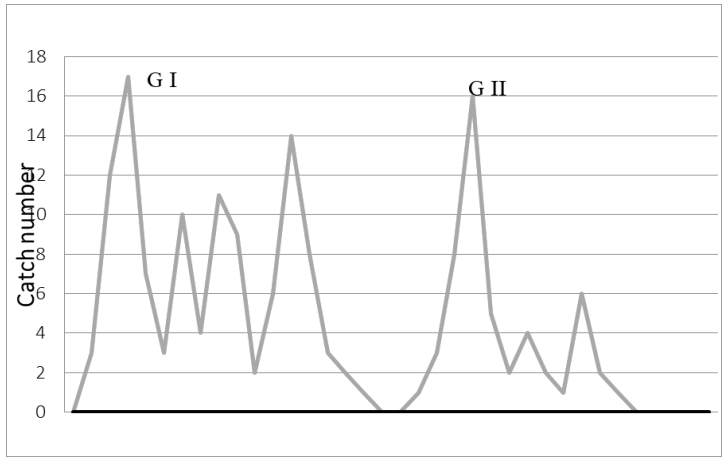

Fig. 4 Dynamic of the apparition of *Cydia pomonella* L. adults, during the 2017, in Delesti-Vaslui locality

Correlated with the sum of real temperature (tab. 3), the beginning of the flight of first generation adults takes place in the first part of May, where there

were accumulated approximately 183,4^{0}C, and at the second generation during July, after an accumulation of approximately 829^{0}C (representing 145 + 645,6^{0}C), sum of real temperature.

In the context of what we have presented, the first generation has two curves of flight and the second generation just one. The exception is represented by very warm years, as it was the case in the year 2017.

Through a complex analysis of climate data and of the flight dynamic of *Cydia pomonella L.* adults, there was confirmed the data from the literature (Diaconu, 1977, 2000) according to which, in the weather conditions of Delesti-Vaslui locality, the biological cycle has a first complete generation and a second incomplete one, with an interesting feature, regarding the alternation along two consecutive years of populations afferent to the three curves of flight during the vegetative season.

The establishment of optimum moments for the application of insecticides in order to control the codling moth is very important for obtaining productions of safe, reliable and high-quality fruits.

Therefore, according to current methods for the control of the codling moth (Săvescu, 1978), the first treatment is applied at 4-8 days from the date of laying the first eggs which takes place 3-6 days after the highest point of the curve of adult appearance at the traps with synthesis sex pheromones. The second treatment is applied at an interval of 8-12 days after the first treatment, according to the evolution of the local weather conditions and to the control period of the insecticides used.

In 2017, the appearance of butterflies was reported beginning at the beginning of May, at Σ (tn-t0) = 183.4°C. Flight and mating flight lasted about 15 days. Females begin to lay eggs in mid-May, the first eggs being deposited on branches, leaves and fruits. After a 10-11 day incubation period, the larvae begin to appear.

The first larvae were reported to Σ (tn-t0) = 285.5°C. At full development, the larvae leave the fruit through a lateral gallery and retreat to the cracks of the bark, where it builds a cocoon of silk yarns inside of which it turns into a stern. The first knuckles were reported at Σ (tn-t0) = 829°C. The first occurrences of second-generation butterflies were reported on Σ (tn-t0) = 891.7°C. The butterflies of this generation fly, feed and mating, and females deposites their eggs only on green fruits.

The incubation lasts 8-10 days, the second generation larvae being recorded starting on 05.08. The development of second-generation larvae lasts for 15 to 20 days, so at the end of August the larvae retreat for hibernation. The larvae of the second generation enter the hyemal diapause, in a fusiform cocoon, weaving at the exit of the fruit, preferring the bark at the base of the trunk or various shelters from the surface of the soil.

Taking into consideration the special evolution of the pest's biology in the ecosystem conditions of the current observations, with 2 curves of flight of the

adults which are well-defined in time it was necessary to apply 4 control treatments, two for each curve of the flight. Therefore, the first treatment was applied 4-5 days after the highest point of the adult flight at the first curve from G.1 and at 3-4 days from the highest point of the flight for the second curve from G1 and the curve afferent cu G.2.

The drought conditions during the first part of the vegetation period had a negative impact on the yields obtained, being lower than the biological potential of the apple plantation.

Regarding the dynamics of apple-specific pests reported in the company SC Loturi Service SRL Deleşti is presented as follows (tab. 2):

- San Jose scale (*Quadraspidiotus perniciosus*) attacked in 3 stages the first generation (G1) of the pest manifested the attack from 15.04 to 30.04, the second generation (G2) occurred at 10.07 and ended on 15.07, and the third generation pest attack was sampled from early August (03.08) to 16.09.
- Green apple aphid (*Aphis pomi*) is an extremely important and very common pest in apple tree plantations where it presents up to 8-12 generation per year. In 2017 he attacked between 5 May and 12 August.
- Red mite (*Panonichus ulmi*) throughout the development cycle presented 4 generations, the attack from 20 April to 28 August.
- The codling moth (*Cydia pommonella*) is perhaps the most important pest attacking apple fruit, and in the 2017 research period it attacked from May 11 to September 13.
- The apple leaf mining moth (*Phyllonorycter blancardella*) has a number of 3 generations per year, so in 2017 it attacked between May 15th and September 15th.

Table 2

The period of attack of apple-specific pests signaled at SC Loturi Service SRL Deleşti

crt. no	Pest		Attack period
	Scientific name	The popular name	
1.	Quadraspidiotus perniciosus	San Jose scale	15.04-30.04; 10.07-15.07; 03.08-16.09.
2.	Aphis pomi	Green apple aphid	5.05- 12.08
3.	Panonichus ulmi	Red mite	20.04 – 28.08
4.	Cydia pommonella	Codling moth	11.05- 01.06; 15.07-13.08.
5.	Phyllonorycter blancardella	Apple leaf mining moth	15.05 -28.06; 10.06 – 15.09

Different control methods are introduced for the control of the pest. The use of chemicals is very famous among the farmers but it may deteriorate the nutritional quality of the product. Against these pests were carried out a total of five chemical treatments, as follows:

- treatment no. 1 (T1) - against the San Jose scale, and the common red mite during 15-25.04
- treatment no. 2 (T2) - carried out during the period 15-20.05 against: apple worm (G1), green apple aphid and apple leaf mining moth.

- treatment no. 3 (T3) - performed against the common red mite, San Jose scale and the apple worm.
- treatment no. 4 (T4) - was performed against the San Jose scale, the common red mite, the green apple aphid, the apple worm, and apple leaf mining moth.
- treatment no. 5 (T5) - looked at the same pests as T4.

Graph on the dynamics of harmful stages and the moment of application of chemical treatments (fig.5)

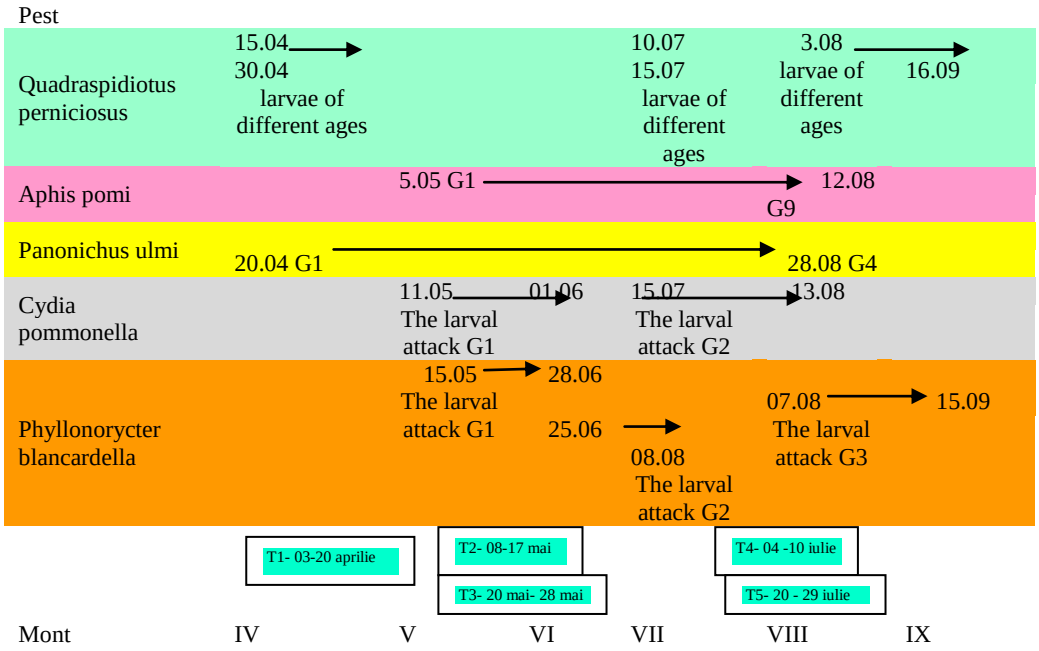

Fig. 5 Moment of attack and applied treatments

The selection of the insecticides used in the treatments of control of the codling moth has been correlated with the evolution of the entire complex of apple pests.

For each generation the first treatment was applied with Calypso 480 SC 0.02%, and Coragen 0.0075%. Calypso is a last-generation systemic product, with long-term action (over 15 days) and with a very good ovicidal effect beside the larvicidal and the adulticidal one. The oivicidal effect is maximal if the treatment is made at the beginning of the laying of eggs. Coragen proved to be very efficient having a method of action which is different from that of the other insecticides, being efficient and on long-term (14-21 days).

At the following treatments there have also been used new products with very good effect on the codling moth, such as: Proteus and Novadim 40EC.

Proteus insecticide contains thiacloprid and deltamethrin, both components being activated at contact and ingestion on the pest and Novadim 40EC, is an insect-acaricide with systemic action, contact and ingestion. The active substance, dimethoate 400 g/L, is rapidly absorbed by the plant and translocated inside it. The action consists in interrupting the nerve impulses to the insect's nervous system.

CONCLUSIONS

- the weather conditions during the period of development of the researches were favorable for the evolution and attack of the species *Cydia pomonella* L., multiple deviations from normal values being recorded;

- in the weather conditions of in the company SC Loturi Service SRL Deleşti, the biological cycle of the species *Cydia pomonella* L. has presented two generations/ year;

- the phytosanitary treatments applied for the control of the codling moth have also been correlated with the evolution of the other pests of the apple;

- during the vegetative season there were applied 5 treatments with insecticides;

- even if the weather conditions were very favorable for the pest evolution the optimal moments, the plans of application of the treatments and products used for the control of this pest had a very good efficiency.

In conclusion year 2017 was characterized as a favorable year for the attack of pathogens and pests. For fruit growers very important in the control of diseases and pests is the alternative use of contact and systemic products, applying treatments before and after flowering, the warning and consulting laboratories forecasting and warning of the Plant Protection Inspectorates, the forecasting and warning being the main pivots of the integrated control, the alarm signal regarding the presence of a phytosanitary danger in the area.

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PERMACULTURE – AN INTELIGENT DESIGN SYSTEM

PERMACULTURA – UN SISTEM DE PROIECTARE INTELIGENT

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Abstract. *In the early seventies there appeared a new ecological design system, a system called Permaculture aiming to sustain in an intelligent way a community set in a natural environment in order to create lasting strong independent ecosystems to protect the soil, the biodiversity and nature. The name of Permaculture has been obtained by combining two words: agriculture and permanent (lasting). The present work aims at introducing this concept to the public, a concept that is to be applied to unconventional agriculture since. Permaculture can be based on a biodynamic, organic, ecological, synergic agricultural method. There will be displayed principles and ethics which constitute the foundation of Permaculture, such as: the care for the soil, the care for the people, the equal division of the excess (surplus) and the setting of limits of consumption and reproduction, as well.*
Key words: permaculture, ecological system, unconventional agriculture.

Rezumat. *Începând cu anii '70 a apărut un nou sistem ecologic de proiectare numit Permacultură, menit să susţină în mod inteligent, în toate aspectele sale, o comunitate umană într-un mediu natural, pentru a putea crea ecosisteme durabile, rezistente şi autonome pentru protecţia solului, a biodiversităţii şi a naturii. Noţiunea de Permacultură a apărut prin îmbinarea celor două cuvinte: cultură (agricolă) şi pemanent(durabil). Lucrarea de faţă îsi propune să facă cunoscut acest concept cu aplicabilitate în agricultura neconvenţională, întrucât, Permacultura poate avea la bază o metodă agricolă biodinamică, organică, ecologică, sinergică etc. Vor fi prezentate etici şi principii care stau la baza conceptului de Permacultură, cum ar fi: grija faţă de pamânt, grija faţă de oameni, împarţirea echitabilă a surplusului, precum şi stabilirea unor limite de consum şi reproducere.*
Cuvinte cheie: permacultură, sistem ecologic, agricultură neconvenţională.

INTRODUCTION

The general notion of Permaculture was issued in the Modern Era, in the 1960s. The first man to work on Permaculture was the Austriac agriculturist, Sepp Holzer. His ideas were borrowed and improved later by the Australians Bill Mollison (scientist, professor, biologist) – the author of an important work in this field:" Permaculture - a designer's manual", published in 1974 and by his student, David Holmgren who managed to enlarge and develop this concept (Hazelip, 2014; Hemenway, 2015).

In Romania, Permaculture was talked about for the first time in 2008 when there were held the first courses about the concept, courses certified by a specific Certify of Design in Permaculture. As a reference we can mention the" Ermitaj

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Malin" farm in Transilvania (where there have been courses since 2010), "The Romanian Permaculture Research Institute" (RPRI) that is a non profit organization founded in 2014 and "Baza Ulmu" in Maramures (a permacultural didactic household) where many workshops are held.

MATERIAL AND METHOD

This present work has many objectives:

1.To promote the concept of Permaculture, among young people in particular and especially among the students studying about this field at specific universities.

2.To suggest alternative ideas of designing and reorganizing the hardly accessible areas (the mountains areas or those far away from the city) and the areas struggling with poverty.

3.To promote a healthy lifestyle and mentality, providing enough food to sustain the population's needs and using unconventional agricultural systems (the biodynamic, ecological, organic and synergic agriculture)

4.To provide information to the farmers that make a transition to the ecological agriculture, in order to create sustainable communities.

The name of Permaculture has been obtained by joining two words: agriculture and permanent (lasting).

Permaculture may be defined in many ways and that is why we should be careful not to limit this concept but instead try to clarify it (Holmgren, 2014).

Permaculture is a science that unlike other sciences refers to designing "living systems" (plants, animals, humans) in a permanent motion and change, meaning a way of designing the whole system of the humans' life, which contains (Holmgren, 2014; Mollison and, Reny Mia Slay, 1991) :

- Agricultural systems of unconventional farming;
- Ecological constructions;
- Producing and saving electrical energy;
- The intake and the distribution of rain water;
- Systems of water cleaning filters;
- The relationships with other people (the Social Permaculture);
- The recycling of household waste (composting).

RESULTS AND DISCUSSIONS

Permaculture is a design system starting from small scales and moving to large scales, such as a farm, aiming at obtaining fertile soils by using specific technologies and a series of principles and ethics. These „rules" have been comprised in three ethical ones and twelve principles (Mollison, 1979; Hemenway, 2015; Ross, 2005).

The three ethical rules of Permaculture are:

1.The care for the soil (soil, natural ecosystems);

The care for the soil refers to the fact that the soil is considered a living organical structure, the main source of life on Earth and that man was handed in this treasure to take care of it. By taking care of the soil is implied the combining of old traditional techniques with new scientific research as the quality of the soil is seen as the instrument that measures the health of the future generations. The

way the soil is being taken care of is a much disputed topic as there isn't a limit to which one can interfere. One thing is sure, that irrational exploitation of the lands can lead to the desctruction of the capacity the soil possesses to regenerate (Holmgren, 2014; Holzer, 2006; Stoleru *et al.*, 2014).

2. The care for the people (There are sustainable systems created for people, systems that reject slavery);

The care for people begins with the care for ourselves then for our family, our neighbour and for the community we live in. This pattern was respected by all ethical, traditional, tribal systems and not only.The more we manage to cut down the addiction to global economy, replacing it with local or family economy we reduce the negative effect caused by current disparities. „Look after yourself!" is not an urge to greadiness or selfishness but on the contrary an invitation to self responsabilities and self sufficiency (Holmgren, 2014; Hazelip, 2014; Hemenway, 2015).

3. The equal distribution of excess (surplus), setting limits of comsumption and reproduction.

The equal distribution of the excess imposes setting some limits to be able to underline the right distribution of the surplus. The apparent contradiction between these two concepts, abundance and limits, imposes us to speak about these concepts in nature (Holmgren, 2014).

When we speak about abundance in sense of richness, we refer to the gifts that nature offers us, in relation with the human activities (Holmgren, 2014)

We speak about limits when we think that everything in nature, including ourselves, has a limited time and space. We have the tendency to waste hoping to fulfill our most pretentious needs (Holmgren, 2014; Mollison, 1979).

Redistributing the surplus of the resources implies helping people who live outside the area where we live, the equal distribution of the material excess but a redistribution of information and of our time, as well (Munteanu and Stoleru, 2012).

The principles of Permaculture are:

1. Observe and interact (a way of learning)

A good design depends on a free balanced relationship with nature and the people around, in which the careful observation and interaction provides inspiration for the project. This way we can wearingly design with a solution of reduced energy (Holmgren, 2014; Mollison and Reny Mia Slay, 1991; Stoleru, 2013).

2. Collect and store energy, use and value the reusable services and resources

We must learn to save and preserve energy on a long term so that the future generations could enjoy a decent life, too. Man is a specific consumer of energy, guiding himself by the most important yet non-renewable sources of energy on Earth (Holmgren, 2014; Munteanu and Stoleru, 2012)

3. Obtain a yield (make sure you will have crops - natural patterns, plant competition, local species etc.)

Crops or a certain profit functions as a reward that encourages, maintains and develops the system that leads to those crops. This way the successful systems are proliferated and expanded (Howard, 1984; Holmgren, 2014; Mollison, 1979).

4. Self - Regulate and accepts feedback (be open to modify dysfunctional behaviours)

This principle speaks about aspects that limit and discourage inadequate "behaviours". By understanding the best way possible how a positive or negative feedback works in nature, we can design systems that have an effective self regulation (Holmgren, 2014; Munteanu *et al.*, 2008).

5. Use and value the renewable resources and services

Sources of renewable energy: the soil, the water, the trees, the seeds etc. (Davidescu and Davidescu, 1994; Holmgren, 2014; Munteanu *et al.*, 2008; Stoleru, 2012).

6. Produce no waste

The waste resulted from an activity (process) turns into resource for another activity, recycling (Davidescu and Davidescu, 1994; Holmgren, 2014; Munteanu and Stoleru, 2012; Stoleru, 2012).

7. Design from Pattern to Detail (observe natural/ social patterns and apply them to design - the forest, the neighbourhood)

Learning how to master a pattern brings benefits with application on a wide range of phenomena, some of them complex, the others simple. It's important to understand the relevance of seemingly irregular organic patterns in nature, patterns that can be an inspiration for the human systems (Howard, 1984; Holmgren, 2014; Mollison, 1979).

8. Integrate instead of separating (capitalize on haw things together, integration in the environment)

Each natural element has several functions and each function is sustained by many elements (Hazelip, 2014; Holmgren, 2014; Munteanu and Stoleru, 2012).

9. Use Small, Slow Solutions (local resources and responses, manageable scale)

We design from small to big and from pattern to detail so that the speed of each living organism (plants, animals), in various sectors, should be reduced to the minimum. When not constrained by different factors, plants with slow growing – with longer life- have a higher value (Howard, 1984; Ross, 2005).

Perennial plants, with slow growing, offer many benefits in designing sustainable ecosystems (Toncea *et al*., 2014).

10. Use and value diversity (diversity leads to greater resilience)

The problem of biodiversity is a topic highly discussed by various scientist, leading to a public acknowledgement of the loss, at a fast pace of the biodiversity, caused mainly by the humans. A fundamental redesigning is approached in order to find strategies of biodiversity conservation so that it could become a valuable and functional part of the world we live in (Fortier, 2018; Hazelip, 2014; Hemenway, 2015; Holmgren, 2014; Stoleru *at al.*, 2014).

11. Use and value "the marginal", (important things happen at the intersections - the border, the end, the shore)

The coming together of two bioregions where species of plants and animals from both territories live together, is called „an marginal", edges or an ecotone. It was noticed that the biodiversity in the ecotone is much larger than the one in the other two neighbouring regions (Holmgren, 2014; Toncea *et al*., 2014).

12. Creatively use and respond to change (use them constructively, flexibility and intervene in effective ways)

We must understand change, using it deliberately and creatively. We should have the capacity to design, interfering beyond what is under our control, reacting and adapting to change (Fortier, 2018; Holmgren, 2014; Munteanu and Stoleru, 2012).

In Permaculture we can speak about organizing in various zones (zoning), as follows below (Holmgren, 2014):

Zone no. 1 is the center of the other zones, being the closest to the main activities (the home, the farm);

Zone no. 2 is larger, being the next zone with fewer elements (vegetables, an orchard etc.);

Zone no. 3 consists of larger systems of the farm (the household), the pastures, the lakes, large fields;

Zone no. 4 is a forest zone (wood, mushrooms, plants of spontaneous flora, hives etc.);

Zone no. 5 is considered an observation zone. (the environment, the natural system).

CONCLUSIONS

1. Permaculture tries to create conditions for all forms of life so that the biological cycles could keep a balance and the living organisms could keep on living and reproducing. This system aims that all people should have the necessary resources to live in a satisfying way (to get food, have a home, get an education, a job, social interaction etc.).

2. Permaculture is not only a system of ecological design or just a horticulturist's skill to care for a garden and nor does it refer to building energetically effective ecological buildings, only.

3. Permaculture is the ability of designing, of making possible the management and the improvement of all things mentioned above, to which the individual effort and that of the family (the community) is added, in order to create a sustainable future.

4. In conclusion, Permaculture is the solution of a sustainable future that can build an adequate agricultural system, protecting the environment with a biodynamic, organic, ecological, synergic agricultural method as its own basis.

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RESEARCH REGARDING EFFECT OF SOME TREATMENTS APPLIED TO *PHOENIX DACTYLIFERA* SEEDS BEFORE SOWING

CERCETĂRI PRIVIND EFECTUL UNOR TRATATEMNTE APLICATE SEMINȚELOR DE *PHOENIX DACTYLIFERA* ÎNAINTE DE SEMĂNAT

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Abstract. *Date palm is a plant utilised both for its ornamental features as well as for its edible fruits. At this species seed's germination is realised with difficulty, germination duration, without interventions on seeds, could be between 8 and 12 months. The current paper present some aspects regarding the effect of some treatments applied to Phoenix dactylifera seed before sowing, on their germination and on plant's growing. So, were organised seven experimental variants: one control variant at which wasn't applied any treatment, a variant at which seeds were subjected to a mechanical treatment (filing), two hydrothermal variants and three variants with peroxide (3%) with different exposure period. Treatment of seeds before sowing caused the shortage of germination period up to 90 days. The best results were obtained at variant at which was applied the treatment with peroxide for 3 minutes, which caused a germination rate of 80%. At all variants at which were applied treatments, were obtained very significant results in comparison with control variant.*

Key words: *Phoenix dactylifera*, multiplication through seeds, treated seeds

Rezumat. *Curmalul este o plantă utilizată atât pentru însuşirile ornamentale, cât şi pentru fructele comestibile. La această specie germinația semințelor se realizează cu dificultate, durata germinației, fără intervenții asupra semințelor, poate fi între 8 şi 12 luni. Lucrarea de față prezintă câteva aspecte referitoare la efectul unor tratamente aplicate semințelor de Phoenix dactylifera înainte de semănat, asupra germinării acestora şi creşterii plantelor. S-au organizat şapte variante experimentale: o variantă martor la care nu s-a aplicat nici un tratament, o variantă la care semințele au fost supuse unui tratament mecanic (pilire), două variante hidrotermice şi trei variante cu apă oxigenată (3%) cu perioadă de expunere diferită. Tratarea semințelor înainte de semănat, a determinat scurtarea perioadei de germinație cu până la 90 de zile. Cele mai bune rezultate au fost obținute la varianta la care s-a aplicat tratamentul cu apă oxigenată timp de 3 minute, care a determinat o rată a germinației de 80%. La toate variantele la care s-au aplicat tratamente, s-au obținut rezultate foarte semnificative în comparație cu varianta martor.*

Cuvinte cheie: *Phoenix dactylifera*, înmulțirea prin semințe, semințe tratate

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INTRODUCTION

Date palm (*Phoenix dactylifera*) is a palm tree, known and appreciated since Antiquity, being considered by Egyptians as a symbol of fertility. Due to the long history of the nowadays culture, the exact origin of palm is unknown, but most probably comes from old Mesopotamia (Southern of Iraq) or from West of India (Wrigley, 1995). Cropping of palms is one of the oldest known fruits cropping and were cultivated in Northern Africa and in Middle East for at least 5000 years (Zohary and Hopf, 2000). Date palm was for a long period of time the source of the most important cultivated fruits from arid regions of Arabian Peninsula, Northern Africa and Middle East (Broschat and Black, 1988; Wagner, 1982). In continental temperate climate, date palms are cultivated in pots as ornamental plants through leave (Draghia and Chelariu, 2011; Chelariu, 2015).

Even if it is used with the torrid weather from origin country, date palm is very well suitable to be cultivated in pots for décor of apartments. Because prefer light, is recommended to be placed near a window. During summer, could be placed also on a balcony, with the condition to be daily wetted. But in winter, for date palm will be applied a decreasing of luminosity and water, and the temperature must be kept at a value of over 20ºC (Draghia and Chelariu, 2011; Chelariu, 2015). Date palms blossom when the temperature at shadow increase over 18ºC and the fruits are formed when the temperature is above 25ºC (Zaid *et al*, 2002).

Germination of date palm seeds could be influenced by more factors (technological, ecological, biological, etc.). Sowing deep is a factor which is often ignored but which could cause a reduced germination. Germination of palm seeds is, generally, very reduced if are sowed too deep, probably that seeds, by their nature, germinate at soil surface, and if sowing deep is too big, soil moisture will be also too high than at soil surface and could cause the decreasing of germination. Generally, palms dramatically respond to temperature at which seeds were placed for germination. Seeds germination temperature must be constant, 28ºC-32ºC. At temperatures below 26ºC germination of palm seeds could be delayed (Carpenter, 1988; Donselman, 1981).

For stimulating germination of date palm seeds could be applied special treatments for seeds, aiming to decrease the hardness of their tegument (Draghia and Chelariu, 2011; Chelariu, 2015)

In the current paper are presented the results regarding the influence of some treatments applied to date palm seeds for stimulating their germination.

MATERIAL AND METHOD

At studied species were organised experiments to highlight the influence of applied treatments at date palm seeds on germination process and plants growing. Research was carried out in didactical glasshouse of Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine from Iaşi, during January – September 2018.

Were organised 7 experimental variants (tab. 1) as follows: V1 – control variant without any treatment, V2 – was realised a mechanical treatment namely seeds' filing, V3 – was realised a hydrothermal treatment for 2 minutes, this operation being repeated by 5 times, with 2 minutes breaks, V4 – a 4 minutes hydrothermal treatment, with 5 repetitions and 2 minutes breaks, V5 – treatment with peroxide for 2 minutes, V6 – treatment with peroxide for 3 minutes, V7 – treatment with peroxide for 4 minutes, for each variant being utilised a number of 10 seeds. Sowing was realised on 16.01.2018.

Table 1

Experimental design

Variant	Treatment
V1	Control – untreated seeds
V2	Filing of seeds
V3	Hydrothermal treatment, 2 minutes (x5)
V4	Hydrothermal treatment, 4 minutes (x5)
V5	Treatment with peroxide, 2 minutes
V6	Treatment with peroxide, 3 minutes
V7	Treatment with peroxide, 4 minutes

During research period, March – September 2018, was observed the dynamics of seeds germination, germination rate, characterization of seedlings. Statistical interpretation of date was done using limit differences.

RESULTS AND DISCUSSIONS

In according with the experimental design, for each variant was utilised a different treatment type which was applied to seeds, in this way being observed the influence of treatment on germination and rate of plants' emergence (tab. 2, fig. 1, fig. 2).

Table 2

Dynamics of plants' emergence (%)

Variant	Date (2018)								
	12.III	16.III	19.III	23.III	27.III	30.III	10.IV	20.IV	16 IX
V1	0	0	0	0	0	0	0	3	20
V2	50	60	60	60	60	60	70	70	70
V3	20	20	30	30	30	40	40	40	50
V4	20	20	40	50	50	50	60	60	70
V5	0	30	40	40	40	40	40	50	60
V6	40	60	80	80	80	80	80	80	80
V7	0	20	30	30	40	40	60	60	70

After three month from the moment of sowing, germination rate was between 40% and 80 % at variants at which were applied treatments for seeds, face to 3% at untreated control (tab. 2, fig. 1). After 8 months from sowing, germination rate was between 50% and 80% at treated variants, face to 20% at control variant (tab. 2, fig. 2).

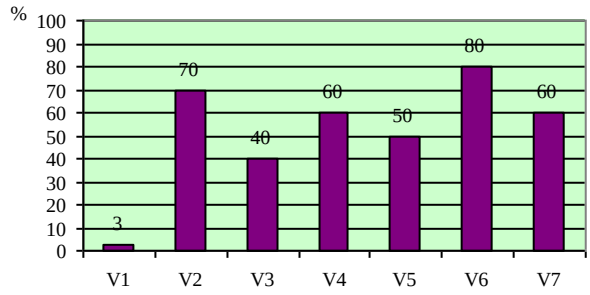

Fig. 1 Germination rate after 3 months from sowing

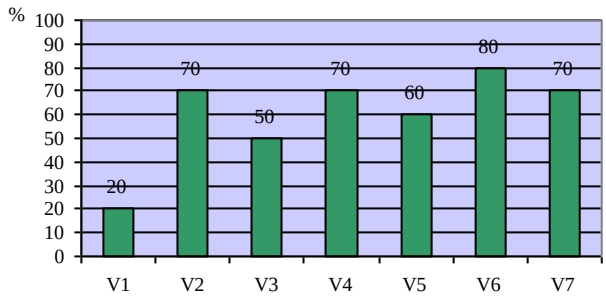

Fig. 2 Germination rate after 8 months from sowing

It could be observed that variant V6 had the greatest number of emergence plants, fact which show the efficiency of the treatment applied at this variant, namely treatment with peroxide for 3 minutes.

Analyzing the obtained results it was noticed the influence of treatments on seeds' germination in comparison with control variant, confirming the results from literature which affirm that date palm seeds germinate into an interval of 8-12 months if there is no interventions on them (Andrade, 1994; Carpenter, 1988; Zohary and Hopf, 2000; Draghia and Chelariu, 2011; Chelariu, 2015).

After statistical interpretation of results was observed that differences face to control were very positive significant at all variants with treated seeds, also after three months, as well as after 8 months from sowing (tab. 3).

In table 4, could be observed the general characteristic of seedlings after three months from sowing date. The best results were recorded at variant V2, followed by variants V6 and V3. It was tracked aspects like length, width as well as number of leave.

Table 3

Influence of treatments applied to seeds on germination rate

Variant	Germinated seeds (%)	
	after 3 months	after 8 months
V1	3	20
V2	70***	70***
V3	40***	50***
V4	60***	70***
V5	50***	60***
V6	80***	80***
V7	60***	70***
	$LD_{5\%}$ = 2.0; $LD_{1\%}$ = 2.8; $LD_{0.1\%}$ = 4.0	$LD_{5\%}$ = 2.7; $LD_{1\%}$ = 3.8; $LD_{0.1\%}$ = 5.3

Analyzing from statistically point of view was observed that differences face to control, regarding length, as well as width of leave were very positive significant at all variants with treated seeds (tab. 4).

Table 4

Characterization of plants after 3 months from sowing

Variant	Number of leave (pcs)	Length (cm)	Width (cm)
V1 control	1	0.20	0.10
V2	1	23.25***	0.52***
V3	1	18.75***	0.47***
V4	1	19.80***	0.42***
V5	1	16.92***	0.48***
V6	1	19.93***	0.54***
V7	1	14.71***	0.47***
		$LD_{5\%}$ = 2.6 cm $LD_{1\%}$ =3.7 cm $LD_{0.1\%}$ = 5.2 cm	$LD_{5\%}$ = 0.1cm $LD_{1\%}$ = 0.2 cm $LD_{0.1\%}$ = 0.3cm

In table 5 are presented the results regarding characterization of date palm plants at 8 months from sowing. It was observed that mean height of plants was between 29.10 cm and 34.79 cm at plants obtained from treated seeds face to 6.10 cm at control. Mean number of formed leave varied between 2.0-2.5 leave/plant face to 1 leaf/plant at control variant. Mean length of leave was situated in interval 23.85-26.85 cm at variants with treated seeds face to 5.90 cm at control, and mean width was 0.90-0.97 cm face to 0.42 cm.

Statistically speaking was observed that at all those four analysed characters limit differences face to control were very positive significant (tab. 5).

Table 5

Characterization of plants after 8 months from sowing

Variant	Height of plant (cm)	Number of leave (pcs)	Length of leave (cm)	Width of leave (cm)
V1 control	6.10	1.0	5.90	0.42
V2	34.52***	2.3***	26.30***	0.96***
V3	30.26***	2.0***	24.55***	0.93***
V4	29.83***	2.2***	24.62***	0.90***
V5	29.10***	2.0***	23.85***	0.91***
V6	34.79***	2.5***	26.85***	0.97***
V7	30.05***	2.0***	23.98***	0.92***
	$LD_{5\%}$ = 2.0 cm $LD_{1\%}$ = 2.8 cm $LD_{0.1\%}$ = 4.0 cm	$LD_{5\%}$ = 0.1 cm $LD_{1\%}$ = 0.2 cm $LD_{0.1\%}$ = 0.3 cm	$LD_{5\%}$ = 0.3 cm $LD_{1\%}$ = 0.4 cm $LD_{0.1\%}$ = 0.5 cm	$LD_{5\%}$ = 0.0 cm $LD_{1\%}$ = 0.0 cm $LD_{0.1\%}$ = 0.1 cm

CONCLUSIONS

The applied treatments to date palm seeds before sowing caused a shortage of duration till beginning of germination.

From those six applied treatments to seeds, the highest germination rate (80%) was caused by treatment with peroxide for 3 minutes (V6). Close results were caused by mechanical treatment (V2), treatment with peroxide for 4 minutes (V7) and hydrothermal treatment for 4 minutes (V4).

Morphological characters of plants at variants with treated seeds recorded close values, but with significant differences face to control variant.

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THE EFFECTS OF DIFFERENT PRESERVATIVE SOLUTIONS ON VASE LIFE OF *ERYNGIUM PLANUM* AND *ECHINOPS RITRO* CUT FLOWERS

EFECTUL DIFERITELOR SOLUȚII DE PĂSTRARE ASUPRA DURATEI FLORILOR TĂIATE DE *ERYNGIUM PLANUM* ŞI *ECHINOPS RITRO*

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Abstract. *The species of the Eryngium and Echinops genera, by their ornamental characters and their ability to adapt to the most diverse ecological conditions, can provide valuable opportunities for enriching the floral range of plants for landscaping or cut flowers. In this paper, the effect of different chemical agents used as preservative solutions to improve the keeping quality of Eryngium planum and Echinops ritro cut flowers had been studied. Five variants were obtained for each analyzed species: silver nitrate (0.002%); potassium benzoate (0.03%); boric acid (0.01%); Fleur Vital (40 g/L) and distilled water as control. The vase life of the cut flowers of Eryngium planum was not influenced by the substances used in the storage solutions, but for Echinops ritro, the longer storage time was in water and boric acid. In both Eryngium planum and Echinops ritro, the shortest duration of leaf retention was in Fleur vital.*
Key words: *Eryngium planum, Echinops ritro,* cut flowers, preservative solutions, vase life

Rezumat. *Speciile genurilor Eryngium şi Echinops, prin caracterele ornamentale şi prin capacitatea bună de adaptare la cele mai diverse condiții ecologice, pot reprezenta variante valoroase în îmbogățirea sortimentului de plante floricole pentru amenajări peisagere sau pentru flori tăiate. În lucrare este studiat efectul unor substanțe chimice asupra duratei de păstrare a florilor tăiate de Eryngium planum and Echinops ritro. La fiecare specie s-au constituit cinci variante: azotat de argint (0,002%); benzoat de potasiu (0,03%); acid boric (0,01%); Fleur Vital (40 g/L) şi apă distilată (martor). Durata de păstrare a florilor tăiate de Eryngium planum nu a fost influențată de soluțiile de păstrare, dar la Echinops ritro durata cea mai mare s-a înregistrat în acid boric şi apă. Atât la Eryngium planum, cât şi la Echinops ritro durata cea mai scurtă de păstrare a frunzişului a fost în conservantul comercial Fleur vital.*
Cuvinte cheie: *Eryngium planum, Echinops ritro,* flori tăiate, soluții de păstrare, durata păstrare

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INTRODUCTION

The intersection of art, design, and horticulture represented by the ornamental plant industry has led to the use of a very wide variety of plant organs and taxa for ornamental purposes (Reid and Jiang, 2012).

A wide variety of plant materials are grown and harvested for their ornamental value. The products that we think of as ornamentals include those that are cut for their flowers and/or foliage, and those that are sold as potted flowering plants or potted foliage plants. Whether cut or intact, ornamentals are complex plant organs, in which loss of quality may result in rejection in the marketplace (Reid, 2009). Harvesting and marketing of cut flowers vary according to crops, growers and marketing systems. The principal goal is should be so as to maximize postharvest life of the flowers (Reid, 2009).

Postharvest senescence is an integral part of normal developmental cycle of plants and it is highly regulated process that involves structural, biochemical and molecular changes in the plant tissue (Shahri, 2011, quoted by Biniam *et al.*, 2012).

The relatively brief postharvest life of most cut flowers can be extended by a range of technologies and the various chemical solutions used after harvest to improve the quality of cut flowers usually have specific purposes.

In order to preserve the cut flowers in time, substances are used to prolong the life of flowers, have in their composition carbohydrates, which serve as an energy substrate for the cut flowers, antimicrobial substances, which have the role of stopping the development of pathogenic microorganisms usually formed at the base of the stems storage water. Storage solutions used in the flower industry vary from one species to another, depending on their sensitivity. The use of solutions is aimed at fortification or strengthening of flowers after they have suffered from lack of water, for blooming or for longer storage for the consumer (Amariuței, 1987).

In the art of bouquets, the last years have brought to the wishes of art consumers, flowers that until now were not considered ornamental. The requirement for unusual flowers comes both for the interesting aspect and for the resistance in the vase, which is intended to be as long as possible (Ohana *et al.*, 1994).

Unusual plants, such as the *Eryngium* and *Echinops* genres, are increasingly appreciated and used for ornamental particularities, in modern flower gardens or in floral art. These plants, with moderate ecological requirements and a good adaptability, can be grown in sunny, poor, salt or low-water areas.

Eryngium planum and *Echinops ritro* show blue inflorescences and are used in floral workshops as a secondary part in arranging arrangements and bouquets, due to their color and appearance, but also for the time resistance of floral rods (Ondra, 2009). The aesthetic aspect of these plants is equally important for embellishing gardens or floral arrangements (Armitage, 1993).

In this paper, the effect of different chemical agents used as preservative solutions to improve the keeping quality of *Eryngium* and *Echinops* cut flowers had been studied.

MATERIAL AND METHOD

The present investigation was conducted at Floriculture lab of Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine of Iasi, Romania. The experimental material for the present investigation comprised of two ornamental species of *Eryngium* and *Echinops (Eryngium planum* and *Echinops ritro).* The two perennial species are known mostly as the immortals, but are as interesting as the fresh flowers.

Eryngium planum is a plant originated in Central Europe, Yugoslavia, Caucasus, Western Siberia, Central Asia (Armitage *et al*., 2003). It has a height between 70 and 100 cm and the pale blue flowers grouped in umbels (fig. 1a), blooms from July to August.

Echinops ritro, a species originated from the Iberian Peninsula, France, Italian Peninsula, Balkan Peninsula, East Central Europe, Turkey, Caucasus, Western Siberia, Central Asia (Hill *et al.*, 2012), has heights between 40 and 60 cm. The inflorescences are solitary, spherical, blue-grey (fig. 1b), blossoming from July to September.

a)

b)

Fig. 1 The general aspect of plants: *Eryngium planum* (a) and *Echinops ritro* (b) (original)

The experiment was subjected to analysis of variance, used randomized design with 3 replication. The treatments were performed with four storage solutions ($AgNO_3$ - silver nitrate, $C_7H_5KO_2$ - potassium benzoate, H_3BO_3 - boric acid, Fleur Vital - commercially preserved), to which was added, as a control, the distilled water. Thus, five variants were obtained for each analyzed species: V_1 - silver nitrate (0.002%); V_2 - potassium benzoate (0.03%); V_3 - boric acid (0.01%); V_4 - Fleur Vital (40 g/L) and V_5 - distilled water (control).

The harvesting of inflorescences was done in the morning hours (9 to 10 a.m.) with the help of a scissors. The cut inflorescences were immediately placed in storage solutions (fig. 2).

Observation was recorded by keeping the harvested inflorescences at green buds stage, in holding solution at room temperature (22-24ºC). Both water and

storage solutions were changed at two days, and the basal cut was refreshed. For each variant, a 0.25 L container of the storage solution was used.

The assessment of the flowers storage period was measured from the day when the cut flower was kept into the storage solution to the stage where the flowers have lost their characteristic color and decorative appearance.

a) b)

Fig. 2 Storage of *Eryngium* and *Echinops* flowering stems in conservation solutions (original)

Also, the influence of storage solutions on the duration of leaf preservation (to yellowing of the leaves) was evaluated.

The data was processed using analysis of variance, by testing the difference between variants with LSD test (Săulescu and Săulescu, 1967). As a control was considered the variant V_5 (storage in distilled water) and the average of experience. The symbols used to indicate the significance of the differences from the control are: ns=insignificant; o/x=negative/positive significant difference; oo/xx= negative/positive distinct significant difference; ooo/xxx=negative/positive very significant difference.

RESULTS AND DISCUSSIONS

The experience of *Eryngium planum* cut flowers, in the first stage proposed for harvesting, highlights the rusticity of these flowering species. Inflorescences harvested in the green buds stage resisted in the 5 storage solutions a statistically insignificant number of days, compared to the control (distilled water). The solutions that present in their component silver nitrate and potassium benzoate (tab. 1), extend the life of the flowers by two days, and the boric acid with another day. Compared to the average of the experience (18 days), the results obtained for all variants are statistically insignificant.

The inflorescences of *Echinops ritro*, harvested in the green buds stage used in the experience of cut flowers, have registered values for solutions based on silver nitrate, potassium benzoate and Fleur Vital, smaller than the control

(distilled water) by 3 days, which means distinctly significant differences in the negative sense (tab. 2). Compared to the average of the experience, the results are also statistically unsecured, with the exception of the flowers kept in boric acid and water, which register significant differences in the positive sense, the preservation time being higher with 1.8 days.

Table 1

The influence of the preservation solutions on *Eryngium planum* cut flowers

Variants (preservation solution)	Vase life (days)	Comparison with control (distilled water)		Comparison with average	
		d (±) days	Signif. of diff.	d (±) days	Signif. of diff.
V_1- $AgNO_3$	19	2.0	ns.	1.0	ns
V_2-$C_7H_5KO_2$	19	2.0	ns.	1.0	ns
V_3 - H_3BO_3	18	1.0	ns.	0.0	ns
V_4 - Fleur Vital	17	0.0	ns.	-1.0	ns
V_5 - distilled water (**control)**	17	-	control	-1.0	ns
Average	18	-	-	0.0	control
		$LSD_{5\%}$ = 2.5 $LSD_{1\%}$ = 3.6 $LSD_{0,1\%}$ = 5.4		$LSD_{5\%}$ = 2.1 $LSD_{1\%}$ = 3.1 $LSD_{0,1\%}$ = 4.7	

Table 2

The influence of the preservation solutions on *Echinops ritro* cut flowers

Variants (preservation solution)	Vase life (days)	Comparison with control (distilled water)		Comparison with average	
		d (±) days	Signif. of diff.	d (±) days	Signif. of diff.
V_1- $AgNO_3$	24	-3.0	oo	-1.2	ns
V_2-$C_7H_5KO_2$	24	-3.0	oo	-1.2	ns
V_3 - H_3BO_3	27	0.0	ns.	1.8	*
V_4 - Fleur Vital	24	-3.0	oo	-1.2	ns
V_5 - distilled water (**control)**	27	-	control	1.8	*
Average	25.2	-	-	0.0	control
		$LSD_{5\%}$ = 1.8 $LSD_{1\%}$ = 2.6 $LSD_{0,1\%}$ = 3.9		$LSD_{5\%}$ = 1.6 $LSD_{1\%}$ = 2.3 $LSD_{0,1\%}$ =3.5	

From a commercial point of view, the flower stems have to look aesthetically, both in terms of the quality of the flowers but also of the foliage. In the case of *Eryngium planum* stems, they resist about the same as flowers (tab. 3). The foliage that has resisted the least is in the case of the solution in which Fleur vital was used, this one resisting only 16 days, with 4 days less than the other variants (tab. 3), and with 1 day less than the flowers of the same variant. Compared to the average of experience, the values of the other

experimental variants are not statistically insured, the difference from these being 0.8 days.

Table 3

The influence of storage solutions on the foliage of *Eryngium planum*

Variants (preservation solution)	Vase life (days)	Comparison with control (distilled water)		Comparison with average	
		d (±) days	Signif. of diff.	d (±) days	Signif. of diff.
V_1- $AgNO_3$	20	0.0	ns.	0.8	ns.
V_2-$C_7H_5KO_2$	20	0.0	ns.	0.8	ns.
V_3 - H_3BO_3	20	0.0	ns.	0.8	ns.
V_4 - Fleur Vital	16	-4.0	ooo	-3.2	oo
V_5 - distilled water (**control)**	20	-	control	0.8	ns.
Average	19.2	-	-	0.0	control
		$LSD_{5\%}$ = 1.8 $LSD_{1\%}$ = 2.6 $LSD_{0,1\%}$ = 3.9		$LSD_{5\%}$ = 2.0 $LSD_{1\%}$ = 3.0 $LSD_{0,1\%}$ =4.5	

The foliage on the flowering stems of *Echinops ritro* lasts on average more with 3 days compared to the flowers on the same stems used in the experiment. The variants in which silver nitrate, potassium benzoate and boric acid have been used have significantly positive values compared to the control value, the difference being 3 days. With distinctly significant differences in the negative sense from the same control, it records the variant in which Fleur vital was used, the foliage being aesthetic only 20 days, with 4 days less than the flowers is the same rods. Compared to the average of the experience (25 days), the values significantly positive are also in the case of variants V_1, V_2 and V_3 and very significant in the negative sense in the variant of the storage solution with Fleur Vital (tab. 4).

Table 4

The influence of storage solutions on the foliage of *Echinops ritro*

Variants (preservation solution)	Vase life (days)	Comparison with control (distilled water)		Comparison with average	
		d (±) days	Signif. of diff.	d (±) days	Signif. of diff.
V_1- $AgNO_3$	27	3.0	*	2.0	*
V_2-$C_7H_5KO_2$	27	3.0	*	2.0	*
V_3 - H_3BO_3	27	3.0	*	2.0	*
V_4 - Fleur Vital	20	-4.0	oo	-5.0	ooo
V_5 - distilled water (**control)**	24	-	control	-1.0	ns.
Average	25	-	-	0.0	control
		$LSD_{5\%}$ = 2.1 $LSD_{1\%}$ = 3.1 $LSD_{0,1\%}$ = 4.7		$LSD_{5\%}$ = 1.5 $LSD_{1\%}$ = 2.2 $LSD_{0,1\%}$ =3.3	

Fig. 3 Fresh cut *Eryngium planum* flowers in beautiful bouquets and arrangements (original)

Uses of *Eryngium planum* (fig. 3) and *Echinops ritro* (fig. 4) are numerous due to their long-lasting resistance, but also to the aesthetic aspect of the inflorescences alongside the blue color.

Fig. 4 Bouquets and arrangements with fresh cut *Echinops ritro* flowers (original)

CONCLUSIONS

1. The longevity of the cut flowers for both the species *Eryngium planum* and *Echinops ritro*, it justifies their use in floral design.

2. The vase life of the cut flowers of *Eryngium planum* was not influenced by the substances used in the storage solutions, the results are not conclusive to affirm the importance of a substance to keep the inflorescences longer in the vase. But, for *Echinops ritro*, the longer storage time was in water and boric acid.

3. The foliage in the case of the *Eryngium planum* rods was not positively influenced by any of the variants, very little in the positive sense was the foliage of the *Echinops ritro* species, especially in the case of the use of silver nitrate, potassium benzoate and boric acid. In both *Eryngium planum* and *Echinops ritro*, the shortest duration of leaf retention was in Fleur vital.

4. Even with the slight influence of the substances proposed in the experiment, the species taken into study have a special ornamental importance and with a remarkable life span for the use in a fresh state in the floral art.

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RESULTS REGARDING THE DECORATIVE VALUE OF SOME *EREMURUS* TAXA CULTIVATED IN THE CONDITIONS OF IASI, ROMANIA

REZULTATE PRIVIND VALOAREA DECORATIVĂ A UNOR TAXONI DE *EREMURUS* CULTIVAŢI ÎN CONDIŢIILE DE LA IAŞI, ROMÂNIA

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Abstract. *Eremurus species are widespread in Central Asia and the Middle East and are commonly known as desert candle or foxtail lily because of beautiful inflorescences (racemes) long, cylindrical, with brightly colored flowers (white, pink, orange, yellow, golden yellow etc.). Several species of Eremurus and their hybrids are growing for garden design or as long lasting cut flower, in big bouquets. Although they are less known in Romania, these plants can be used very well, being perennial, with good resistance to cold and drought. In this study is analyzed the ornamental potential of three hybrids Eremurus x isabellinus ('Cleopatra', 'Pinokkio' and 'Romance'), in north east of Romania conditions. Some biometric indicators reveal that the Eremurus hybrids analyzed are characterized by floral stems over 100 cm high (116.8-148.7 cm), inflorescences with lengths of approx. 50 cm and diameter of plants 70-80 cm. The three hybrids ensure a flowering period of approx. one month (May 24-June 22).*
Key words: *Eremurus* x *isabellinus*, morphological characters, ornamental value

Rezumat. *Speciile de Eremurus sunt răspândite în Asia Centrală şi în Orientul Mijlociu şi sunt cunoscute în mod obişnuit sub numele de lumânarea deşertului sau coada vulpii, datorită frumoaselor inflorescenţe (raceme) lungi, cilindrice, cu flori viu colorate (alb, roz, portocaliu, galben, galben-auriu etc.). Mai multe specii de Eremurus şi hibrizii lor se cultivă pentru designul grădinilor sau ca flori tăiate, cu durată lungă de păstrare, în buchete mari. Deşi sunt mai puţin cunoscute în România, aceste plante pot fi valorificate foarte bine, fiind perene, rezistente la frig şi secetă. În acest studiu este analizat potenţialul ornamental la trei hibrizi Eremurus x isabellinus ('Cleopatra', 'Pinokkio' and 'Romance'), în condiţiile din NE României. O serie de indicatori biometrici relevă faptul că hibrizii de Eremurus analizaţi se caracterizează prin tulpini florale de peste 100cm înălţime (116,8-148,7 cm), inflorescenţe cu lungimi de aprox. 50 cm şi diametrul plantei de 70-80 cm. Cei trei hibrizi asigură o perioadă de înflorire de aprox. o lună (24 mai-22 iunie).*
Cuvinte cheie: *Eremurus* x *isabellinus*, caractere morfologice, valoare ornamentală

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INTRODUCTION

Eremurus (foxtail lilies, desert candles) are members of the family Liliaceae (Asphodelaceae) from the rocky meadows of semi-desert regions of Central Asia and the Middle East (Naderi Safar *et al.,* 2009).

These plants are herbaceous perennials, with fleshy roots, linear basal leaves and small flowers in dense racemes (Şelaru, 2007; https://www.rhs.org.uk). Because it is native to drier regions, it does not require a lot of water and prefer a full-sun environment in a well-drained spot.

The species commonly grown as ornamental are *E. himalaicus*, *E. robustus* and *E. stenophyllus*, but there are many hybrids very important especially for garden. *Eremurus* is a novel commercially important specialty cut flower (Ahmad *et al.,* 2014).

Hybrids *Eremurus* x *isabellinus* R.Vilm. (named in honor of Archduchess Isabella of Austria), derived from the crossing of *E. stenophyllus* with *E. olgae* (Vilmorin, 1905). *E. olgae* Regel. has linear grey-green leaves and produces racemes of white-pink stellate flowers from May to August; reach heights of 70-150 cm (https://en.hortipedia.com/wiki/Eremurus_olgae). *E. stenophyllus* (Boiss. & Buhse) Baker has stellate yellow flowers and leaves of 30-40 cm; height of floral stems is 90-150 cm.

The main aim of this study was to determine the ornamental potential of three *Eremurus* cultivars (hybrids *Eremurus* x *isabellinus*), in north east of Romania conditions.

MATERIAL AND METHOD

This experiment was conducted in 2016-2017. Objects of a research were *Eremurus* cultivars growing in Iasi conditions (north east of Romania), in experimental field of the University of Agricultural Sciences and Veterinary Medicine. The present study comprised of three cultivars of *Eremurus*: 'Cleopatra', 'Pinokkio' and 'Romance'.

'Cleopatra' (fig. 1a) has peach-orange flowers and orange anthers, bluish-green leaves in early and midsummer (https://www.rhs.org.uk).

'Pinokkio' (fig. 1b) has erect stems, to 1.5 m tall, with elegant orange-yellow flowers and burnt orange anthers (https://www.rhs.org.uk).

'Romance' (fig. 1c) has tall, stately spires of salmon pink flowers that appear as strap-like green foliage begins to die back.

The characters analyzed were: length and width of leaves, diameter of plants, height of floral stems, length and diameter of inflorescences. Also, the flowering period was recorded. Each cultivar analyzed was an experimental variant and as a control was considered the average of experience. The data was processed using analysis of variance (randomized design with three replications) by testing the difference between variants with LSD test (Săulescu and Săulescu, 1967). The symbols used to indicate the significance of the differences from the control are: ns=insignificant; o/x=negative/positive significant difference; oo/xx= negative/positive distinct significant difference; ooo/xxx=negative/positive very significant difference.

a) b) c)

Fig. 1 *Eremurus* cultivars: a) 'Cleopatra'; b) 'Pinokkio'; c) 'Romance' (original)

RESULTS AND DISCUSSIONS

In table 1 are present the biometric indicators of leaves, floral stems and inflorescences of *Eremurus* cultivars analized.

Table 1

Biometrics of *Eremurus* cultivars

Parameter	Cultivar		
	'Cleopatra'	'Pinokkio'	'Romance'
Length of leaves (cm)	73.0	48.5	60.5
Width of leaves (cm)	1.4	1.2	1.6
Diameter of plants (cm)	80.7	73.9	85.6
Height of floral stems (cm)	148.7	116.8	135.5
Length of inflorescences (cm)	48.8	44.6	56.7
Diameter of inflorescences (cm)	7.8	7.6	7.4

Values of biometric determinations were compared with the average of experience, considered as control. The statistically assured differences were registered at the length of leaves, diameter of the plants, height of floral stems and length of inflorescence. In tables 2 and 3 are presented the results for these characters and the statistical significances.

The length of leaves exceeds 70 cm la cv. 'Cleopatra' (73 cm) and the differences are very significant positive compared to the control. For cv. 'Pinokkio'

the differences are very significant negative (Table 2). The diameter of the plants varies between 73.9 cm and 85.6 cm, with lower values at cv. 'Pinokkio' (tab. 2).

Table 2

Comparative analysis of length of leaves and diameter of plants

Variant (Cultivar)	Length of leaves (cm)		Diameter of plants (cm)	
	Relative value (%)	Differences (±) and significance of differences	Relative value (%)	Differences (±) and significance of differences
'Cleopatra'	120.26	12.3 ^{xxx}	100.75	0.6 ^{ns}
'Pinokkio'	79.90	-12.2 ^{000}	92.26	-6.2 ^{00}
'Romance'	99.67	-0.2 ^{ns}	106.87	5.5 ^{xx}
Average (control)	**100.00**	**-**	**100.00**	**-**
		LSD 5% = 2.7; LSD 1% = 4.5; LSD 0.1% = 8.5		LSD 5% = 2.3; LSD 1% = 3.9; LSD 0.1% = 7.3

The height of floral stems varies between 116.8 cm and 148.7 cm. Compared to the average of the experience (control), the results are statistically assured (distinct significant differences), with the exception of the cv. 'Romance'. The largest height of floral stem (148.7 cm) was related to cv. 'Cleopatra' and the shortest (116.8 cm) was for cv. 'Pinokkio' (tab. 3).

Table 3

Comparative analysis of length of height of floral stem length of inflorescence

Variant (Cultivar)	Height of floral stem (cm)		Length of inflorescence (cm)	
	Relative value (%)	Differences (±) and significance of differences	Relative value (%)	Differences (±) and significance of differences
'Cleopatra'	111.20	15.0 ^{xx}	97.60	-1.2 ^{ns}
'Pinokkio'	87.36	-16.9 ^{00}	89.00	-5.5 ^{0}
'Romance'	101.35	1.8 ^{ns}	113.40	6.7 ^{xx}
Average (control)	**100.00**	**-**	**100.00**	**-**
		LSD 5% = 8.5; LSD 1% = 14.0; LSD 0.1% = 26.2		LSD 5% = 3.8; LSD 1% = 6.3; LSD 0.1% = 11.8

Maximum inflorescence height (56.7 cm) was for cv. 'Romance' while the minimum height (44.6 cm) was recorded for cv. 'Pinokkio'. The mentioned cultivars had positive distinct significant differences, respectively negative significant differences compared to the control (tab. 3). The values for this

character were closer to the control for cv. 'Cleopatra', so the differences were insignificant (tab. 3).

An important characteristic when designing a garden is to choosing plants and gardeners should consider the flowering period. Generally, *Eremurus* plants bloom in April-June and has a relatively short flowering period. In the studied hybrids, flowering begins around 24-26 May and ends on June 20-22 (tab. 4). Flowering stages analyzed are:

- flowering (first flower buds are opening);
- full flowering (most of flowers are opened);
- end of flowering (no more new buds are opening and the fruits appear at the base of inflorescence).

Table 4

Evaluation of flowering period of *Eremurus* cultivars

Calendar (Month/ day)		'Cleopatra'	'Pinokkio'	'Romance'
May	24			ʘ
	25			ʘ
	26	ʘ		ʘ
	27	ʘ		֍
	28	ʘ		֍
	29	֍		֍
	30	֍	ʘ	֍
	31	֍	ʘ	֍
June	1	֍	ʘ	֍
	2	֍	ʘ	֍
	3	֍	֍	֍
	4	֍	֍	֍
	5	֍	֍	֍
	6	֍	֍	֍
	7	֍	֍	֍
	8	֍	֍	֍
	9	֍	֍	֍
	10	֍	֍	֍
	11	֍	֍	֍
	12	֍	֍	֍
	13	֍	֍	֍
	14	֍	֍	֍
	15	֍	֍	֍
	16	֍	֍	ϕ
	17	ϕ	֍	ϕ
	18	ϕ	֍	
	19	ϕ	֍	
	20		ϕ	
	21		ϕ	
	22		ϕ	

Legend: ʘ - flowering; ֍ - full flowering; ϕ - end of flowering

The first to bloom are cultivars 'Romance' and 'Cleopatra'. 'Pinokkio' blooms a week later. The flowering period of these *Eremurus* hybrids is approximately three week (tab. 4).

CONCLUSIONS

1. The hybrids of *Eremurus* x *isabellinus* were found interesting and could be candidates for ornamental design in garden or inside, as cut flowers.

2. Floral stems have a height of over 100 cm (116.8-148.7 cm); the largest height was related to cv. 'Cleopatra' (148.7 cm) and the shortest (116.8 cm) was for cv. 'Pinokkio' (116.8 cm).

3. Maximum inflorescence height (56.7 cm) was for cv. 'Romance' while the minimum height (44.6 cm) was recorded for cv. 'Pinokkio'.

4. The three hybrids ensure a flowering period of approx. one month (May 24 - June 22); 'Romance' and 'Cleopatra' are the first to bloom and 'Pinokkio' blooms a week later.

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THE INFLUENCE OF DIFFERENT FERTILIZERS ON THE PODS YIELD OF THREE COMMON BEAN CULTIVARS

INFLUENȚA APLICĂRII UNOR FERTILIZANȚI DIFERIȚI ASUPRA PRODUCȚIEI DE PĂSTĂI LA TREI CULTIVARE DE FASOLE PITICĂ

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Abstract. *The paper aim is to evaluate the production capacity of three varieties of dwarf bean - Ferrari, Rocquencourt and Maxidor (C) - under different fertilization conditions: organic-Orgevit-600 kg/ha, chemical-50 kg/ha, with microorganisms-50 kg/ha and the non-fertilized control variant. The experiment was established in the Experimental Field of Vegetable Growing, the University of Agricultural Sciences and Veterinary Medicine Iasi, in the 2016-2017 period. The crop was set up by direct sowing in the field, in three-rows bands, the distance between the bands being 60 cm and between the rows 45 cm. Plant spacing was set at 5 cm, resulting in a density of about 400 thousand plants/ha. The experimental results, under the above mentioned conditions, demonstrate the usefulness of the fertilization of the dwarf bean culture for the pods, the highest yield being obtained by applying chemical and microorganisms fertilization.*
Keywords: *Phaseolus vulgaris* convar. *nanus*, fertilization, productions

Rezumat. *Lucrarea are drept scop evaluarea capacității de producție a trei soiuri de fasole pitică pentru păstăi - Ferrari, Rocquencourt şi Maxidor (Mt) - în condiții de fertilizare diferită: organică-Orgevit 600 kg/ha, chimică-350 kg/ha, cu microorganisme-50 kg/ha şi varianta martor-nefertilizată. Experiența a fost amplasată în câmpul experimental al disciplinei de Legumicultură, din cadrul U.S.A.M.V. Iaşi, în perioada 2016-2017. Cultura a fost înființată prin semănat direct în câmp, în benzi de câte trei rânduri, distanța dintre benzi fiind de 60 cm, iar între rândurile din bandă de 45 cm. Distanța între plante a fost stabilită la 5 cm, rezultând o densitate de aproximativ 400 mii plante/hectar. Rezultatele experimentale, în condițiile menționate, demonstrează utilitatea fertilizării culturii de fasole pitică pentru păstăi, producțiile cele mai ridicate fiind obținute în cazul fertilizării chimice şi cu microorganisme.*
Cuvinte cheie: *Phaseolus vulgaris* convar. *nanus*, fertilizare, producții

INTRODUCTION

Dwarf bean is an important agricultural crop because of its usefulness in the context of a growing global population. The field garden occupies the largest cultivated areas and provides the highest crop yield, both for direct consumption

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and for conservation. The nutritional value of bean pods is determined by the high content of nutrients essential for human nutrition (Stan *et al.*, 2003; Ruşti and Munteanu, 2008; Hnatuszko-Konka *et al.,* 2014; Jayamanohar *et al*., 2018).

The growing of the garden dwarf bean is suitable for the vegetable fields; it is easy to fall into the crops, being an excellent pre-plant for most of the vegetable species. Cultivation of this species contributes to the improvement of the soil structure, as well as to the increase of its nitrogen content due to the symbiosis relation with *Rhizobium* nitrogen fixation bacteria (Mwenda *et al.,* 2018).

Culture is relatively simple, through direct sowing, and includes a small number of maintenance work. Of these technological works, fertilization is extremely important because it influences production in quantitative and qualitative terms, as well as the quality of the environment. The use of chemical fertilizers is preferred by farmers due to the fact that the production is higher and their application is easier. At present, there is an increasing interest in the use of various products that improve yield without adverse effects on plant and environmental quality (Kocira *et al.,* 2018; Michałek *et al*., 2018).

The growing opportunity for high quality products of plant origin is a challenge in modern agriculture. Currently, agricultural production focuses on increasing plant yield and quality, respecting the principles of production safety (Hamburdă *et al.*, 2016; Kocira *et al.,* 2017; Burducea *et al.*, 2018;Caruso *et al.*, 2018; De Sio *et al.*, 2018).

In the realization of corresponding quantitative and qualitative productions, the cultivar chosen also has an important role, which must be well adapted to the environmental conditions specific to the area in which it is used (Teodorescu *et al.*, 2012a; 2012 b).

Starting from the above, this study has proposed a comparative assessment of the effects of chemical fertilization, organic fertilization and application of microorganism products on the production of dwarf bean varieties.

MATERIALS AND MEHODS

The experiment was established in the Experimental Field of Vegetable Growing, the University of Agricultural Sciences and Veterinary Medicine Iasi, in the 2016-2017 period. The experience was carried out a chernozemic soil, medium leachate, medium supplied in nutrients with 3% organic matter (Hamburdă *et al.*, 2016) and pH = 6.5. The weather conditions of the experimental period, shown in table1 (Burducea *et al.*, 2018), were favourable for this species.

The experimental culture protocol was a bifactorial experiment, organized in a split plot design with tree replicates, in which the influence of two experimental factors was studied, namely: Factor A – assortment used - common bean with determined growth, for pods - with three graduations: a1 = Rocquencourt - yellow pods and black seeds, a2 = Ferrari - green pods and white seeds; a3 = Maxidor (Mt) – yellow pods and white seeds; Factor B – crop fertilization variant - with four graduations: b1 = unfertilized variant (control); b2 = application of microorganisms (Micoseeds MB); b3 = chemical fertilization; b4 = organic fertilization (Orgevit).

Table 1

Experimental weather conditions

Month	Sum of precipitations (mm)		Average temperature (°C)	
	Year of experiment		Year of experiment	
	2016	2017	2016	2017
March	24	52	6.4	8
April	56	89	13.5	10.3
May	72	71	15.4	16.5
June	111	47	21.2	21.7
July	12	48	23.1	22
August	52	39	21.3	22.2
September	13	13	18.4	17.4

The fertilizations were carried out in two stages: 1) preparation of the germination bed, ten days prior to the establishment of the crop (starter fertilization) and 2) before flowering (root phase fertilization). 1) 30 kg / ha of Micoseeds MB, 150 kg / ha of ammonium nitrate and 350 kg / ha of Orgevit, and 2) 20 kg / ha of Micoseeds MB, 200 kg / ha NPK complex fertilizer (15: 15:15) and 250 kg / ha respectively, corresponding to the experimental variants. Fertilizers applied to phase fertilization were incorporated into the soil through a manual drill.

The crop was set up in the first decade of May, by sowing directly into the soil, according to the scheme: in three stripes spaced at 45 cm with intervals of 60 cm between the strips, the distance between the plants being 5 cm, resulting in a density of about 400 thousand plants / ha (fig. 1).

Fig. 1 Aspects from experience with garden dwarf bean

During the vegetation period, the care works performed were those recommended by the literature and mainly consisted of weed control, phytosanitary treatments, root phase fertilization (Stan *et al*., 2003). The pods were harvested in three rounds, corresponding to the optimum technological maturity. They were carried outdeterminations of the total harvest quantity, the data being processed by

appropriate statistical and mathematical methods (Săulescu and Săulescu, 1967; Jităreanu, 1999; Leonte and Simioniuc, 2018).

RESULTS AND DISCUSSIONS

The production of pods varied, within the two experimental years, within very wide limits, ranging from 4643.3 kg / ha (Maxidor x unfertilized in 2017) and 7568.0 kg / ha (Rocquencourt x Micoseeds MB in 2016), whereas the average production at the level of the experimental polygon for the two years under study was 6046.2 kg / ha (tab. 2).

Table2

Experimental production results (kg / ha)

No.	Year of experiment	Fertilization variant / Cultivar	Unfertilized (C)	Micoseeds MB	Chemical	Orgevit	Average
1.	2016	Rocquencourt	5718.0	7568.0	7505.3	5895.3	**6671.7**
2.		Ferrari	5341.0	7145.3	7150.3	5604.8	**6310.4**
3.		Maxidor (Mt)	5107.0	6769.0	6680.3	5552.0	**6027.1**
4.	**Average 2016**		**5388,7**	**7160.8**	**7112.0**	**5684.0**	**6336.4**
5.	2017	Rocquencourt	4966.3	6384.3	7418.7	5218.0	**5996.8**
6.		Ferrari	4745.3	6005.3	7092.0	5249.0	**5772.9**
7.		Maxidor (Mt)	4643.3	5629.3	6638.7	5081.0	**5498.1**
8.	**Average 2017**		**4785,0**	**6006.3**	**7049.8**	**5182.7**	**5755.9**
9.	Average 2016-2017	Rocquencourt	5342.1	6976.2	7462.0	5556.7	**6334.2**
10.		Ferrari	5043.2	6575.3	7121.2	5426.9	**6041.6**
11.		Maxidor (Mt)	4875.2	6199.2	6659.5	5316.5	**5762.6**
12.	**Averageyears 2016-2017**		**5086.8**	**6583.6**	**7080.9**	**5433.4**	**6046.2**

At the cultivation level studied, the yields ranged between 5498.1 kg / ha (Maxidor-2017) and 6671.7 kg / ha (Rocquencourt-2016) (tab. 3).

Table3

Comparative analysis of production determined by studied crops

No.	Year of experiment	Cultivar	Yield			Significance of differences
			kg/ha	% of C	differencescompared with C	
1.	2016	Rocquencourt	6671.7	110.70	644.6	*
2.		Ferrari	6310.4	104.70	283.3	-
3.		Maxidor	6027.1	100.00	0	C
DL 5% = 475.9 kg/ha. DL 1% = 789.2 kg/ha. DL 0.1% = 1474.0 kg/ha						
4.	2017	Rocquencourt	5996.8	109,07	498,7	**
5.		Ferrari	5772.9	105,00	274,8	*
6.		Maxidor	5498.1	100,00	0	C
DL 5% = 194.4 kg/ha. DL 1% = 322.4 kg/ha. DL 0.1% = 602.1 kg/ha						
7.	Average 2016-2017	Rocquencourt	6336.7	109,96	573,9	**
8.		Ferrari	6041.9	104,84	279,1	*
9.		Maxidor	5762.8	100,00	0	C
DL 5% = 199.4 kg/ha. DL 1% = 330.7 kg/ha. DL 0.1% = 617.7 kg/ha						

The influence of the variety on the production of pods, on average over the experimental period, revealed distinctly significant yields for Rocquencourt cultivar (573.9 kg / ha) compared to the indicated control (Maxidor variety). Also, the Ferrari cultivar achieved production differences to Maxidor that were statistically significant (279.1 kg / ha).

Depending on the fertilization variant, the yields varied from 4785.0 kg / ha, production obtained in the non-fertilized variant in 2017, to 7160.8 kg / ha, production obtained for Micoseeds MB fertilization in the year 2016. The average of the experimental years revealed productions of 5087.0 kg / ha, recorded in the unfertilized variant and 7084.3 kg / ha, in the fertilized chemical variant (tab. 4).

Table4

The average of the production results determined by the four variants of fertilization

No.	Year of experiment	Fertilization variant	Yield			Significance of differences
			kg/ha	% of C	differencescompared with C	
1.	2016	Unfertilized	5388.7	100.00	0	C
2.		Micoseeds MB	7160.8	132.89	1772.1	***
3.		Chemical	7112.0	131.98	1723.3	***
4.		Organic	5684.1	105.48	295.4	-
DL 5% = 352.6 kg/ha. DL 1% = 483.6 kg/ha. DL 0.1% = 658.3 kg/ha						
5.	2017	Unfertilized	4785.0	100.00	0	C
6.		Micoseeds MB	6006.3	125.52	1221.3	***
7.		Chemical	7049.8	147.33	2264.8	***
8.		Organic	5182.7	108.31	397.7	*
DL 5% = 317.1 kg/ha. DL 1% = 434.9 kg/ha. DL 0.1% = 592.0 kg/ha						
9.	Average 2016-2017	Unfertilized	5087.0	100.00	0	C
10.		Micoseeds MB	6583.8	129.42	1496.8	***
11.		Chemical	7084.3	139.26	1997.3	***
12.		Organic	5433.6	106.81	346.6	**
DL 5% = 244.9 kg/ha. DL 1% = 335.9 kg/ha. DL 0.1% = 457.2 kg/ha						

The analysis of the production results for this factor revealed the production differences registered by the chemically fertilized variants and microorganisms, which, compared to the non-fertilized variant, were positive at a very significant level, while the organically fertilized variant provided differences distinct positive. This proves the usefulness of fertilization of the dwarf bean culture for pods, recommending fertilization with chemical fertilizers and applying microorganisms to obtain high yields.

The interaction between the studied cultivar and the type of fertilization used determined, on average for the two experimental years, large variations in production, starting with 4875.3 kg / ha, a value obtained by the control (which in

our case is the Maxidor variety x unfertilized) and 7471.3 kg / ha, recorded by the Rocquencourt cultivar, to which chemical fertilizers were applied (tab. 5).

Table 5

Comparative results between variety combinations x fertilization (A x B)

Nr. crt.	Year of experiment	A x B	Yield			Significance of differences
			kg/ha	% of C	differences compared with C	
1.	2016	Rocquencourt x unfertilized	5718.0	111.96	611.0	*
2.		Rocquencourt x Micoseeds MB	7568.0	148.19	24610	***
3.		Rocquencourt x chemical	7505.3	146.96	2398.3	***
4.		Rocquencourt x organic	5895.3	15.44	788.3	*
5.		Ferrari x unfertilized	5341.0	104.58	234.0	-
6.		Ferrari x Micoseeds MB	7145.3	139.91	2038.3	***
7.		Ferrari x chemical	7150.3	140.01	2043.3	***
8.		Ferrari x organic	5605.0	109.75	498.0	-
9.		Maxidor x unfertilized	5107.0	100.00	0	C
10.		Maxidor x Micoseeds MB	6769.0	132.54	1662.0	***
11.		Maxidor x chemical	6680.3	130.81	1573.3	***
12.		Maxidor x organic	5552.0	108.71	445.0	-
DL 5% = 610.8 kg/ha. DL 1% = 837.7 kg/ha. DL 0.1% = 1140.2 kg/ha						
1.	2017	Rocquencourt x unfertilized	4966.3	106.96	323.0	-
2.		Rocquencourt x Micoseeds MB	6384.3	137.49	1741.0	***
3.		Rocquencourt x chemical	7418.7	159.77	2775.4	***
4.		Rocquencourt x organic	5218.0	112.38	574.7	*
5.		Ferrari x unfertilized	4745.3	102.20	102.0	-
6.		Ferrari x Micoseeds MB	6005.3	129.33	1362.0	***
7.		Ferrari x chemical	7092.0	152.74	2448.7	***
8.		Ferrari x organic	5249.0	113.04	605.7	*
9.		Maxidor x unfertilized	4643.3	100.00	0	C
10.		Maxidor x Micoseeds MB	5629.3	121.23	986.0	**
11.		Maxidor x chemical	6638.7	142.97	1995.4	***
12.		Maxidor x organic	5081.0	109.43	4377	-
DL 5% = 549.3 kg/ha. DL 1% = 753.3 kg/ha. DL 0.1% = 1025.4 kg/ha						
1.	Average 2016-2017	Rocquencourt x unfertilized	5342.3	109.58	467.0	*
2.		Rocquencourt x Micoseeds MB	6976.3	143.09	2101.0	***
3.		Rocquencourt x chemical	7471.3	153.25	2596.0	***
4.		Rocquencourt x organic	5557.0	113.98	681.7	**
5.		Ferrari x unfertilized	5043.3	103.45	168.0	-
6.		Ferrari x Micoseeds MB	6575.7	134.88	1700.4	***
7.		Ferrari x chemical	7121.7	146.08	2246.4	***
8.		Ferrari x organic	5427.0	111.32	551.7	*
9.		Maxidor x unfertilized	4875.3	100.00	0	C
10.		Maxidor x Micoseeds MB	6199.3	27.16	1324.0	***
11.		Maxidor x chemical	6660.0	136.61	1784.7	***
12.		Maxidor x organic	5316.7	109.05	441.4	*
DL 5% = 294.6 kg/ha. DL 1% = 404.0 kg/ha. DL 0.1% = 549.9 kg/ha						

Very significant positive differences were recorded in six combinations compared to the control variant: Rocquencourt x chemical (2596.0 kg / ha), Ferrari x chemical (2246.4 kg / ha), Rocquencourt x Micoseeds MB (2101.0 kg / ha), Maxidor x chemical (1784.7 kg / ha), Ferrari x Micoseeds MB (1700.4 kg / ha) and Maxidor x Micoseeds MB (1324.0 kg / ha).

As can be seen from the least significant differences calculation, all chemically fertilized and microorganisms variants, regardless of the variety chosen, generated very significant yields compared to the control.

At the same time, Rocquencourt was the only variety that determined productions at statistical level, regardless of the fertilization option we opted for.

CONCLUSIONS

1. Production of pods in the species *Phaseolus vulgaris* convar. *nanus* is influenced by the applied fertilization, the chosen cultivar and the year of production, the biggest differences being highlighted in the fertilization variants.

2. Chemically and microorganisms (Micoseeds MB) fertilized plants generated very significant differences compared to the non-fertilized control (39.26% and 29.42%, respectively), thus these fertilizers can be recomended to obtain high yields.

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THE BEHAVIOR IN NURSERY OF SOME FRUIT TREE SPECIES WITH HIGH ORNAMENTAL VALUE

COMPORTAREA ÎN PEPINIERĂ A UNOR SPECII POMICOLE CU VALOARE ORNAMENTALĂ RIDICATĂ

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Abstract. *Different ornamental characters, habitus, color, texture, given the adaptability of the various species to the site-specific environmental conditions, are the starting point for the choice of species for landscaping. Thus, it appears the opportunity to use a planting material well suited to the conditions of our country that create a sustainable ornamental effect. In the present paper we've studied the compatibility in grafting of ornamental fruit species grafted on different rootstocks and the behavior of the material in the nursery. Two grafting methods were tested: chip budding and grafting in 'T' with sleeping buds. For each of the five species studied, two types of rootstocks were used. For Prunus serrulata Kanzan Lindl. mahaleb rootstocks and wild cherry were used. Prunus cerasifera Pisardii Ehrh. was grafted on mirobolan and 'Roşior văratic'. And the species Malus baccata Borkh., Malus golden hornet Rehder. and Malus purpureea Rehd. were grafted on Malus sylvestris Mill and vegetative type MM 106.*
Keywords: *Prunus* sp., *Malus* sp., grafting, ornamental

Rezumat. *Diferitele caractere ornamentale, habitus, culoare, textură, în condiţiile adaptabilităţii diverselor specii la condiţiile de mediu specifice sitului, sunt punctul de plecare în alegera speciilor pentru amenajările peisagere. Astfel, apare oportunitatea folosirii unui material săditor bine adaptat condiţiilor ţării noastre care să creeze un efect ornamental sustenabil. În cadrul lucrării s-a studiat compatibilitatea la altoire a unor specii pomicole ornamentale altoite pe diferiti portaltoi şi comportarea materialului în pepinieră. Au fost testate două metode de altoire: chip budding şi altoirea în 'T' cu mugure dormind. Pentru fiecare din cele cinci specii luate în studiu s-au folosit două tipuri de portaltoi. Pentru specia Prunus serrulata Kanzan Lindl. s-au folosit portaltoii mahaleb şi cireş sălbatic. Prunus cerasifera Pisardii Ehrh. s-a altoit pe mirobolan şi Roşior văratic. Iar speciile Malus baccata Borkh., Malus golden hornet Rehder. şi Malus purpureea Rehd. s-au altoit pe Malus sylvestris Mill. (măr păduret) şi măr vegetativ tipul MM 106.*
Keywords: *Prunus* sp., *Malus* sp., altoire, decorativ

INTRODUCTION

Different ornamental characters, habitus, color, texture, given the adaptability of the various species to the site-specific environmental conditions, are the starting point for the choice of species for landscaping (Borza, 1947).

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Thus, it appears the opportunity to use a planting material well suited to the conditions of our country that create a sustainable ornamental effect (Grădinaru, 2002).

In the present paper we have studied the compatibility in grafting of ornamental fruit species grafted on different rootstocks and the behavior of the material in the nursery. Two grafting methods were tested: chip budding and grafting in 'T' with sleeping buds.

For each of the five species studied, two types of rootstocks were used. For *Prunus serrulata* Kanzan Lindl. *Prunus mahaleb* rootstocks and *Prunus avium* were used. *Prunus cerasifera* Pisardii Ehrh. was grafted on *Prunus myrobolan* and 'Roşior văratic'. And the species *Malus baccata* Borkh., *Malus golden hornet* Rehder. and *Malus purpureea* Rehd. were grafted on *Malus sylvestris* Mill and vegetative type MM 106.

MATERIAL AND METHOD

In order to achieve the objectives proposed, this study had as research material the ornamental fruit trees species found in Hemeiuş Park from Bacău County and the species studied at the Istrița Fruit Growing Research and Development Resort, Buzău County.

The researches carried out in Buzău County took place at the Istrița Fruit Growing Research and Development Resort, which has as main activity the production and marketing of trees of all species that are adapted to the pedoclimatic conditions in Romania.

Within the Istrița Fruit Growing Research and Development Resort, we analyzed the existing tree vegetative material in order to establish the compatibility in grafting of ornamental tree species, using as rootstock both species from the spontaneous flora and species obtained from the researches in the field, by the grafting in dormant eyes method (Zlati, 2007).

In order to achieve the objectives proposed and to obtain objective scientific results regarding the compatibility in grafting of some species of the genus *Malus* Mill. and *Prunus* L. grafted on different rootstocks, two working techniques were used (Kester, 1965; Iglesias *et al*, 2004). Observations and determinations were made during 2015-2017.

Observations and determinations made in the nursery referred to:

- Successful grafting percentage;
- Winter resistance of the grafted buds;
- Entering the vegetative stage of the grafted buds;
- Growth vigor of the propagating material.

As grafts the following species were used: *Prunus serrulata kanzan* Lindl., *Prunus cerasifera pisardii* Ehrh., *Malus purpurea* Rehd., *Malus baccata* Borkh. and *Malus golden hornet* Mill (Grivu, 2001).

The period when the grafting was made was from August 15 to 30, 2015, with the essential condition that the bark was easily detachable.

The planting distances used to set up Field I of the nursery were 90 cm between rows and 20 cm between seedlings per row.

Fig. 1 The experimental field, *Prunus cerasifera* Eheh. rootstock, (original, Istrița nursery, Buzău County)

Fig. 2 The height of the plants resulted from chip budding grafting (original, Istrita nursery, Buzău County)

RESULTS AND DISCUSSIONS

The organization of the experiment began in the spring of year 2015, with the set up of the Field I of the nursery. The planting distances used were 90 cm between rows and 20 cm between seedlings per row.

In the experiment, two types of rootstocks were used for each specie studied (fig. 1), respectively *Prunus mahaleb* and *Prunus avium*, were used for the species *Prunus serrulata Kanzan* Lindl., Prunus mirobolan and P.F. 'Roşior văratic' for *Prunus cerasifera Pisardii* Ehrh. and *Malus sylvestris* Mill (crab

apple) and vegetative apple type MM 106 for the species *Malus baccata* Borkh., *Malus golden hornet* Rehder. and *Malus purpureea* Rehd.

The determination of successful grafting of rootstock seedlings after one month from planting lead to reveal that the successful percentage was over 95% in all types of rootstocks.

Successful grafting was recorded in the fall of year 2015 for the two types of genus following grafting with dormant eyes, as it can also be seen in table 1. Grafting in the dormant eyes was achieved by the two methods, chip budding and T-budding, in August where 50 buds were grafted for each variety-rootstock combination.

Table 1

Biometrical data regarding the percentage of successful grafting of studied fruit tree species

No.	Specie/variety	Rootstock	Grafting success percentage	
			Grafting method	
			"T" grafting	***Chip budding grafting***
1	*Prunus serulata-Kanzan* Lindl.	Prunus avium	92.0	95.0
		Prunus mahaleb	95.0	97.0
2	*Prunus cerasifera- Pisardii* Ehrh.	Prunus mirobolan	92.0	92.0
		P.F. 'Rosior văratic'	92.0	94.0
3	*Malus purpurea* Rehd.	Malus sylvestris Mill	94.0	95.0
		MM 106	93.0	94.0
	Malus golden hornet Rehder. Rehder.	Malus sylvestris Mill	92.0	93.0
		MM 106	92.0	93.0
	Malus baccata Borkh.	Malus sylvestris Mill	93.0	93.2
		MM 106	92.0	92.0

Analyzing the successful grafting percentage (tab. 1), in relation to the rootstocks used does not reveal any significant differences between them, but it reveals there is a higher percentage of successful grafting with the chip budding grafting method, compared to the T-budding grafting method.

Winter resistance of the grafted buds in the climatic conditions of our country may be affected more or less by the low temperatures depending on each specie. Thus, were detached with a large number of viable scion buds the individuals resulted from the grafting of *Malus sylvestris* Mill. and vegetative apple MM 106 of the species *Malus purpurea* Rehd. Positive results were also recorded for *Malus golden hornet* Rehder., grafted on *Malus sylvestris* Mill., for *Prunus serulata Kanzan* Lindl., grafted on Prunus avium, as well as the species *Prunus cerasifera Pisardii* Ehrh., grafted on Myrobolan.

Entering the vegetative stage of the grafted buds occurred at different dates, being influenced by the genetic specificity of each specie taken into study, as well as by the variety-rootstock combination (Hartmann and Kester, 2002). Thus it was found that at the end of March, *Prunus serulata Kanzan* Lindl. enters the vegetative stage, followed by *Prunus cerasifera Pisardii* Ehrh., *Malus purpurea*

Rehd., *Malus golden hornet* Rehder., and the last species being *Malus baccata* Borkh. at the end of April (fig. 2).

Rgarding the biometrical data of the grafting growth of studied material we can conclude that the use of grafted plants in landscaping, it has been found that grafting in ornamental varieties may have the advantage of reducing the vigor (tab. 2) and hence the easier use in compositions intended for small spaces.

Table 2

Biometrical data regarding the grafting growth of studied fruit tree species

No.	Specie/ variety	Rootstock	Height of graft sprouts (cm)		Diameter in the graft area (mm)		Early shoots number	
			"T" grafting	*Chip budding grafting*	"T" grafting	*Chip budding grafting*	"T" grafting	*Chip budding grafting*
1	*Prunus serulata-Kanzan* Lindl.	Prunus avium	176.0	190,0	12.3	14.0	6	7
		Prunus mahaleb	178.0	178.0	11.8	13.4	4	5
2	*Prunus cerasifera-Pisardii* Ehrh.	Prunus mirobolan	170.0	181.0	12.3	12.8	6	8
		P.F. Rosior văratic	164.0	176.0	12.0	12.3	6	6
3	*Malus purpurea* Rehd.	Malus sylvestris Mill	168.0	172.0	11.8	12.10	7	8
		MM 106	172.0	170.0	11.0	12.0	7	8
	Malus golden hornet Rehder.	Malus sylvestris Mill	164.0	174.0	11.0	12.0	5	7
		MM 106	160.5	169.0	10.8	11.8	5	6
	Malus baccata Borkh.	Malus sylvestris Mill	158.5	168.0	10.8	11.8	6	6
		MM 106	156.0	164.0	11.0	11.5	6	6

CONCLUSIONS

1. From the diameter analysis to the callus, the species with very good results are *Prunus serulata* Kanzan Lindl., *Prunus cerasifera* Pisardii Ehrh. grafted on *Prunus avium* and *Prunus myrobolan*, and *Malus purpurea* Rehd. grafted on the *Malus sylvestris* Mill. As for the number of early shoots, the species *Malus purpurea* Rehd. and *Prunus cerasifera* Pisards Ehrh. saw a number of eight shoots, and *Prunus serulata* Kanzan Lindl., grafted on *Prunus mahaleb* in "T", marked a number of five shoots. The other species, irrespective of the rootstocks and the grafting type, fell within this range with the number of early shoots.

2. Also, the varieties studied have good compatibility with the chosen rootstocks.

3. Regarding the use of grafted plants in landscaping, it has been found that grafting in ornamental varieties may have the advantage of reducing the vigor and hence the easier use in compositions intended for small spaces.

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USING THE ANALYTIC HIERARCHY PROCESS TO SELECT THE MOST IMPORTANT NON-WOOD FOREST PRODUCTS FOR IASI COUNTY

UTILIZAREA PROCESULUI DE IERARHIZARE ANALITICĂ ÎN SELECTAREA CELOR MAI IMPORTANTE PRODUSE FORESTIERE NELEMNOASE DIN JUDEȚUL IAŞI

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Abstract. *In Romania, the non-wood forest products are mainly represented by the fauna of hunting interest, forest fruits, truffles and edible mushrooms and medicinal plants. The aim of this research was to study the most important non-wood forest products from Iaşi County. The analyze model used in similar studies done in the case of other counties across Romania was taken into account. The Analytic Hierarchy Process (AHP) was used to assess the performance of selected alternatives by means of pairwise comparisons. The analyses were carried out using the Expert Choice Desktop software package. Honey and pheasant were the most promising non-wood forest products, while the less promising was the European elderberry. According to the results of this study, we conclude that Iaşi County has a great potential for harvesting and marketing of NWFPs.*
Key words: AHP, Expert Choice Desktop, Iaşi County, non-wood forest products

Rezumat. *În Romania, principalele categorii de produse forestiere nelemnoase sunt speciile de faună de interes cinegetic, fructele de pădure, trufele şi ciupercile comestibile şi plantele medicinale. Scopul acestui studiu a constat în evidențierea celor mai importante produse forestiere nelemnoase pentru județul Iaşi. Modelul de analiză utilizat în studii similare efectuate în cazul altor județe din România a fost folosit. Procesul de ierarhizare analitică a fost utilizat pentru a evalua alternativele prin analizarea lor două câte două. Analizele au fost realizate cu pachetul software Expert Choice Desktop. Mierea şi fazanul s-au dovedit a fi cele mai importante produse forestiere nelemnoase, iar socul negru cel mai puțin important produs. Având în vedere rezultatele acestui studiu, concluzionăm că județul Iaşi prezintă un potențial ridicat în ceea ce priveşte recoltarea şi comercializarea produselor forestiere nelemnoase.*
Cuvinte cheie: AHP, Expert Choice Desktop, județul Iaşi, produse forestiere nelemnoase

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INTRODUCTION

In Romania, according to the Forest Code (Law no. 46/2008), the non-wood forest products (NWFPs), also known as non-timber forest products (NTFPs), include fauna of hunting interest, forest fruits, forest seeds, truffles and edible mushrooms, medicinal and aromatic plants, resin, a.s.o.

At national level, the most important NWFPs as regards the harvested and marketed quantities are the berries of European blueberry (*Vaccinium myrtillus* L.), raspberry (*Rubus idaeus* L.), dog rose (*Rosa canina* L.), sea-buckthorn (*Hippophaë rhamnoides* L.), common hawthorn (*Crataegus monogyna* Jacq.) and blackthorn (*Prunus spinosa* L.) and the edible mushrooms such as penny bun (*Boletus edulis* Bull.), honey fungus [*Armillaria mellea* (Vahl) P. Kumm.] and chanterelles (*Cantharellus cibarius* Fr.) (Enescu *et al*., 2018a).

In the last years, more stakeholders both from non-governmental and governmental organizations are interested in the utilization and promotion of NWFPs in several fields (Timiş-Gânsac *et al*., 2018). Also the private sector is very interested in harvesting and marketing of NWFPs, the forest owners paying an increasing attention to this category of forest products aimed to obtain new revenues (Janse and Ottitsch 2005), especially in rural communities (Barbir and Negrea, 2014), where they represent sources of food, medicines and others (Cioacă and Enescu, 2018).

The aim of this study was to assess the potential of the most common NWFPs from Iaşi County by using a multi-criteria decision analyze.

MATERIAL AND METHODS

Iaşi County is located in the north-eastern part of Romania, between Siret and Prut Rivers (fig. 1). It is situated in a plain region and it has an area of 5,476 km^2. The northern part of the county is situated in the Moldavian Plain, while the southern part is situated on the Central Moldavian Plateau, where the altitude may exceed 400 m a.s.l. In the west, the area is crossed by Siret River corridor, the last fragments of the Fălticenilor Plateau and also the "Big Hill", with altitudes exceeding 500 m a.s.l. The most important forested area is represented by Repedea-Bârnova massif, situated on the Central Moldavian Plateau, in the south of the county.

Forests account for more than 63.000 hectares, most of them being managed by Iaşi Forestry Directorate (IFD), a territorial branch of National Forest Administration ROMSILVA. IFD is divided into eight forest districts (ro. ocoale silvice), namely: Dobrovăț, Hârlău, Iaşi, Lunca Cetățuii, Pădureni, Paşcani, Podu Iloaiei and Răducăneni, respectively.

Fig. 1 Location of Iaşi County (Source: http://pe-harta.ro/iasi/)

The hardwood species are the main forest tree species, the oaks (Genus *Quercus* L.) - 21% being the main tree species. The resinous species hold only 2% of the forested area across the county.

The list of the most important NWFPs was done based on the data available in the forest management plans of the above-mentioned forest districts. The analysis model (*i.e.* 19 criteria, 8 alternatives – the selected non-wood forest products and 4 categories of NWFPs) was recently used for similar studies in the case of Prahova, Timiş and Bihor counties, respectively (Enescu *et al.,* 2018a; Enescu *et al*., 2018b;Timiş-Gânsac *et al*., 2018). The criteria used were the following ones: Criterion 1: Harvesting period (1: the shortest harvesting period … 8: the longest harvesting period); Criterion 2: Portfolio of derived products (1: the smallest number of deriver products … 8: the highest number of derived products); Criterion 3: Harvested quantity by one worker in 8 hours (1: the lowest quantity … 8: the highest quantity); Criterion 4: Harvesting cost (1: the lowest cost … 8: the highest cost); Criterion 5: Knowledge for recognition (1: most recognizable product … 8: hardest recognizable product); Criterion 6: Knowledge for harvesting (1: the less knowledge necessary … 8: most knowledge necessary); Criterion 7: Tools needed for harvesting (1: the least … 8: the more); Criterion 8: Complexity of harvesting process (1: lowest … 8: highest); Criterion 9: Distribution range (1: lowest … 8: highest); Criterion 10: Market potential (1: low … 8: high); Criterion 11: The price of raw product (1: lowest … 8: highest); Criterion 12: The price of the derived product (1: lowest … 8: highest); Criterion 13: Transport from the harvesting point to the storage center (1: the most easy … 8: the most complicated); Criterion 14: Perishability (1: lowest … 8: highest); Criterion 15: "Celebrity" of the product on the market (1: the least known … 8: the most popular); Criterion 16: Market demand (1: lowest … 8: highest); Criterion 17: Biotic threats (1: the fewest threats … 8: the most threats); Criterion 18: Abiotic threats (1: the fewest threats … 8: the most threats); Criterion 19: Development of the process of harvesting (1: undeveloped … 8: extremely developed). Analytic Hierarchy Process (AHP), a decision-making technique which can be used to analyze and support decisions that have multiple objectives (Mohammadi and Limaei, 2018), was performed in order to determine the most important NWFPs for Iaşi County. The analyses were conducted by the aid of Expert Choice Desktop (v. 11.5.1683).

RESULTS AND DISCUSSIONS

The selected non-wood forest products were the following ones: parasol mushroom [*Macrolepiota procera* (Scop.) Singer], penny bun (*Boletus* spp.), linden flowers (*Tilia* spp.), berries of blackthorn (*Prunus spinosa* L.), European elderberry (*Sambucus nigra* L.), peppermint (*Mentha piperita* L.), honey and the common pheasant (*Phasianus colchicus* L.). The AHP alternative ranking is given in table 1.

Table 1

AHP alternative ranking

Criterion	*Macrolepiota procera*	*Boletus* spp.	*Tilia* flowers	*Prunus spinosa*	*Sambucus nigra*	*Mentha piperita*	Honey	*Phasianus colchicus*
1	4	7	3	6	2	5	8	1
2	6	7	1	4	3	2	5	8
3	6	7	1	4	5	8	3	2
4	5	6	3	4	2	1	7	8
5	7	8	2	5	1	4	3	6
6	7	6	2	4	1	3	5	8
7	5	6	4	3	2	1	7	8
8	4	5	6	3	2	1	7	8
9	1	3	4	2	5	6	8	7
10	6	7	5	1	3	2	8	4
11	5	6	4	3	2	1	8	7
12	5	6	4	3	1	2	8	7
13	5	6	3	4	2	1	8	7
14	6	8	4	7	3	2	1	5
15	3	7	6	1	2	4	8	5
16	5	7	6	1	3	2	8	4
17	6	7	4	3	2	1	5	8
18	5	6	4	3	2	1	8	7
19	4	5	6	3	2	1	8	7

Based on AHP results, the most important NWFPs were the honey (that recorded the highest score in 8 out of 19 criteria), followed by the common pheasant and the representatives of genus *Boletus*, while the less important ones were the European elderberry and peppermint (fig. 2).

Honey is one of the most dense food in nature (Skinner, 1991), and it contains about 80-95% sugar, being a concentrated source of fructose and glucose (Bogdanov *et al.,* 2008; Murray *et al*., 2001, White *et al*., 1962). It also contains a large amount of essential vitamins and minerals (Iskander et al., 1995; Terrab *et al*., 2004) and components that act as preservatives, including ascorbic acid, flavonoids,

glucose oxidase, catalase and peroxidase (Crane, 1975; Ferreres *et al*., 1993; Nagai *et al*., 2006).

As regards the birds of hunting interest from Romania, the common pheasant is one of the most important one due to its population size and its distribution range, as well as to the favorable outlook for the growth of this species in an intensive system (Scărlătescu, 1977). In a similar study done for Bihor County, the pheasant ranked also on the second position (Timiş-Gânsac *et al*., 2018), while in the case of Prahova County, it ranked on the third place (Enescu *et al.,* 2018a).

The mushroom's mycelium (vegetative stage) is very important in the ecosystem as the substratum might start biodegrading and residues might be used for the agricultural production. The fructiferous body (reproductive stage) is also very sought after for its texture and taste, as well as for its chemical and nutritional characteristics (Manzi *et al*., 1999).

Furthermore, mushrooms are also useful from a therapeutic point of view, especially for treating diseases such as hypertension, cholesterol excess and cancer (Bobek and Galbavy, 1999; Bobek et al., 1995). These characteristics are mainly caused by dietetic fibres, namely chitin (Manzi *et al.,* 1999), a polizaharid structure of cellular walls, beta-glucans (Manzi and Pizzoferrato, 2000; Mullins, 1990) human and hetero glucans with β(1-3), β(1-4) and β(1-6), with glucose links.

The quality of mushrooms is influenced by certain parameters such as the development stage or the conditions recorded before and after harvesting.

Penny bun is considered to be an absolute market leader, being one of the most widespread non-timber forest products that is harvested for marketing purpose throughout the world (Sitta and Floriani, 2008; de Roman and Boa, 2006; Garibay-Orijel *et al.,* 2007; Mitchell and Hobby, 2007; Pilz and Molina, 2002). The importance of this species of edible mushroom for Romanian culture and gastronomy also resides in a large number of localities in our country for which their names are derived from the popular name of penny bun (Dincă *et al.,* 2016), but also for the very large harvested quantities (Vasile *et al.*, 2015). Penny bun also ranked first in a similar study done for Maramureş County (Enescu *et al.,* 2017).

Peppermint is one of the most commonly harvested plants in our country (Vasile *et al.,* 2015). In the eastern part of Romania, peppermint ranks among the first seven species of medicinal plants as regards the harvested quantity (Vasile *et al*., 2018). Linden flowers are harvested from Moldovan woods. The perception of their usefulness places them in the middle of the ranking made up of all NWFPs in the case of Iaşi County, as it was the case also for Timis County (Enescu *et al.,* 2018b).

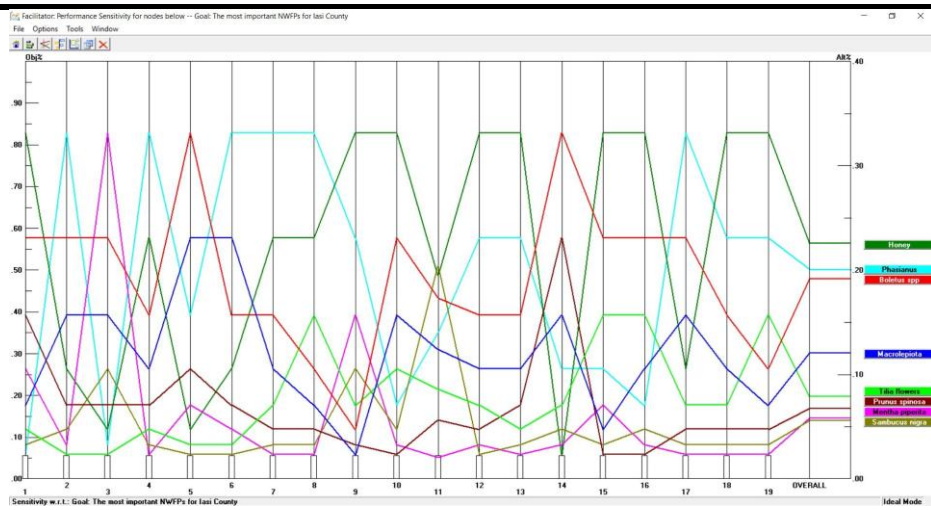

Fig. 2 The ranking of the non-wood forest products

Prunus spinosa L. is a wild shrub (Reynders-Aloisi and Grellet, 1994) frequently found in our broad-leaved forests. The species is pollinized by insects, while the seed's dispersion is realized with the help of mammals and birds (Yeboah and Woodell, 1987; Guitian, Guitian and Sa'nchez, 1993). It can also grow on calcareous, dry and cold soils. The leaves and fruit extract medicinal properties are recommending it for preparing ayurvedic remedies.

Sambucus nigra L., (elderberry), is a widespread species that develops well in sunny areas from most part of Europe, Asia, North Africa and the United States. It is a broad-leaved shrub, that can reach a height of 6 meters, with small white hermaphrodite flowers that bloom at the beginning of summer. The fruits are dark purple, almost black, with a diameter of maximum 6 mm that bloom at the end of summer. The elderberry extracts are used as drinks or food flavours (Christensen *et al*.,, 2007). The fruits are regularly used as drugs or food supplement (Dawidowicz *et al*., 2006; Lee and Finn, 2007).

Infusions from *Sambucus nigra* flowers are well known as traditional remedies for different types of diseases (Kohlmünzer, 1998). Their pharmacological properties result amongst others from the presence of flavonoids.

CONCLUSIONS

1. The diversity and the harvested quantities of NWFPs in Iasi County are not so high, mainly due to low forested area and its uneven distribution range. Even so, the honey was the most important non-wood forest product in the case of Iaşi County. This means that if a forest contains all the selected NWFPs and a manager or an owner will take into account the proposed criteria, one of the best management measures will be to focus on harvesting and marketing of honey.

2. The combination between Analytic Hierarchy Process and Expert Choice Desktop software package proved to be a good choice if someone wants to choose a certain non-wood forest product, based on the criteria taken into account. The more the hierarchy has been done more correctly, based on serious documentation and analysis, the more accurate the results are.

3. By taking into account the economic situation from Iasi County, we believe that local projects and policies aimed at encouraging the harvesting and marketing of NWFPs are needed, especially in rural and poor communities throughout the county. Of course that not only the economic target should be prioritized, but also the social and environmental aspects as well.

4. In conclusion, in our opinion, the results of this research should be regarded as an incipient step in analyzing the potential of certain forest products. Different stakeholders may want to use this multi-criteria decision model in the future when they will have to take important decisions that will be focus on economic, social and environmental aspects at local or national level.

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MODELING EROSION DEGRADATION ON SLOPING LAND USING GIS

MODELAREA DEGRADARILOR EROZIONALE PE VERSANTI FOLOSIND TEHNICA GIS

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Abstract. *This study presents the GIS techniques referring to the modelling of the process of degradation by erosion of the territory in the hydrological basin of Romania. On a surface of 4697 ha, the relief is strongly fragmented, presenting relief energy of around 395 m with averages slopes over 15%. The slopes are affected by the erosion and by the active sliding. The choice for this hydrographic basin is motivated also by the fact that there was the possibility of the validation of the results obtained by the simulation, comparing them with the measurements of the alluvial deposits in the lakes accumulation situated at the exit of the receiving basin.In our project, the geo-characteristic dates are represented as layers. This facilitated the analysis of the spatial variables and the distribution of the objects on the surfaces studied and the overall analysis of the information obtained, that supposes the simultaneous approach of more layers could be realized using the "overlay" technique. Along the application we used a module of software ArcGIS specialized for the operations with digital maps and of the large databases. The mathematical model used to determine the damage of the soil is based on the RUSLE (Revised Universal Soil Loss Equation) equation under the usual form from Romania. The results are presented in the form of digital thematic maps.*
Key words: modelling, erosion, spatial data, GIS

Rezumat. *În lucrarea de față este prezentat un studiu efectuat prin tehnici GIS, asupra evoluției proceselor de degradare a terenurilor prin eroziune dintr-un bazin de recepție din Romania. Suprafața de studiu este de 3963 ha, relieful este puternic fragmentat, prezentând o energie de relief de cca. 330 m, cu pante medii de peste 15 %.Versanții sunt afectați de eroziune în suprafață, în adâncime şi de alunecări active. Alegerea acestui bazin hidrografic este motivată şi prin faptul că a existat posibilitatea validării rezultatelor obținute prin simulare, comparându-le cu măsurătorile privind depunerile de aluviuni în acumularea situată la ieşirea din bazinul de recepție. În cadrul proiectului nostru, datele georeferențiate sunt reprezentate sub formă de straturi informaționale (layere), fapt ce facilitează analiza variabilelor spațiale şi a distribuției entităților de pe suprafețele luate în studiu, iar analiza globală a informațiilor obținute, ce presupune abordarea concomitentă a mai multor straturi, s-a putut realiza prin tehnica „overlay". În cadrul aplicației s-au folosit module sub software ArcGIS, destinat operațiunilor de lucru cu hărți digitale şi baze de date consistente. Modelul matematic pentru determinarea pierderilor de sol are la baza ecuația RUSLE (Revised Universal Soil Loss Equation), în forma uzuală din Romania. Rezultatele sunt prezentate sub forma de hărți tematice digitale.*
Cuvinte cheie: modelare, eroziune, date spațiale, GIS

INTRODUCTION

Soil erosion is one form of soil degradation along with soil compaction, low organic matter, and loss of soil structure, poor internal drainage, salinization, and soil acidity

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problems. These other forms of soil degradation, serious in themselves, usually contribute to accelerated soil erosion.

Soil erosion may be a slow process that continues relatively unnoticed, or it may occur at an alarming rate causing serious loss of topsoil. The loss of soil from farmland may be reflected in reduced crop production potential, lower surface water quality and damaged drainage networks.

Water erosion's complex hierarchy of processes mean that erosion by water operates (and is studied) over a wide range of spatial scales. Rainsplash redistribution and the initiation of microrills and rills occur at a scale of millimetres. Rill erosion on agricultural hillslopes operates at a scale of meters to tens of meters, while gully erosion can occur on a scale of hundreds of meters, or even kilometres. The offsite impacts of erosion can affect very large areas, sometimes hundreds or even thousands of square kilometres.

Soil erosion has a range of environmental impacts, including loss of organic matter and nutrients, reduction of crop productivity, and downstream water quality degradation (Moriasi *et. al*., 2007).

Effective control of soil erosion is a critical component of natural resource management when the aim is to achieve sustainable agriculture and acceptable ecosystem integrity (Mulligan, 2004; Nearing, 2000).

In this context, the implementation of the Geographic / Territorial Information Systems for the above mentioned purpose, in our country, is required and justified not only by economic reasons, but also by the safety and celerity ensured by the provision of required information "in real time".

MATERIALAND METHOD

Negative effects of surface runoff and soil erosion in watersheds can be controlled and mitigated through hydrological models. Moreover, they are suitable to simulate various combinations of different scenarios of land and water management in a watershed and therefore they are useful for comparative analysis of different options and as a guide to what Best Management Practices (BMPs) can be adopted to minimize pollution from point and nonpoint sources (Niacşu, 2012; Patriche *et al.,* 2015)

The erosion prediction in experimental plots and hillslopes or the erosion modelling of small basins at the same analysis scale have been successful using physical models that require a detailed parameters measurement and a considerable quantity of input data in many cases, with the purpose of being used in the planning and management of watersheds (Lal, 2001).

Several mathematical models were developed to estimate the soil loss by surface erosion, as aresult of the action of raindrops and sheet flow. One of the widely known and used model is RUSLE (Revised Universal Soil Loss Equation), developed Renard *et al.* (1997). It estimates soil loss from a hillslope caused by raindrop impact andoverland flow (fig. 1), taking into account factors such as rainfall erosivity, soil type, landscape characteristics, land use (including types of crops) and management practices of agriculture.

The model was developed by applying statistical methods on data obtained through experimental measurements and indicates, with a good precision, the areas with potential gully processes. The equation for calculating the mean annual rate of soil erosion is the following:

$$A=R\cdot K\cdot L\cdot S\cdot C\cdot P$$

where,

A– the average annual soil loss (t $acre^{-1}yr^{-1}$);

R- the rainfall erosivity factor, evaluated as a product of the total storm kinetic energy (E) and the maximum 30-min intensity (I_{30});

K –the soil erodability factor;
L –the slope length factor;
S –the slope gradient factor;
C –the vegetation and crop management factor;
P–the support practices factor.

A new version, RUSLE (Revised Universal Soil Loss Equation), was developed by Renard et al.(1997); it keeps the USLE form (developed by Wischmeier & Smith in 1977), being improved the methods for calculating the terms of the mathematical equation.

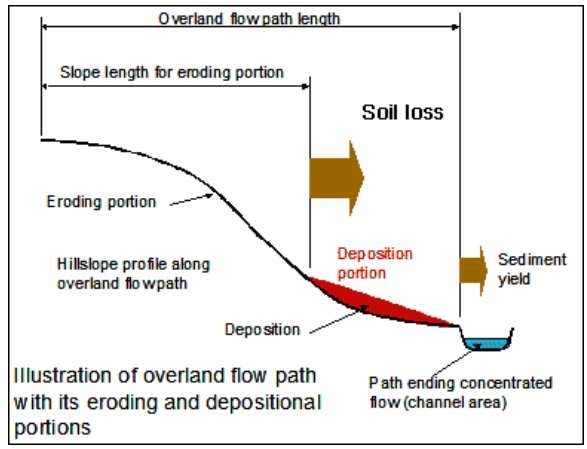


Fig. 1 Overland flow path

The recent methodology for applying the RUSLE or USLE models requires the use of the GIS techniques (etc.).

The importance of the GIS techniques integration to quantify the surface erosion risk is determined by the speed of the performing operations, the accuracy of the results and the possibility of their spatial representation (Biali and Cojocaru, 2015).

The water catchment area subject to research is called Gaiceana, is part of the higher water catchment area of Berheci river and is located in the East side of Romania, in Bacau county (fig. 2).

The reception area is of 4697.5 ha, with a highly fragmented relief, hilly type and average slopes of more than 17 %. Absolute altitudes ranging between 545.5 m and 150 m in the dam accumulation, resulting an energy relief 395.5 m. The slopes are affected by surface erosion, deep and. The sloping land was affected by sheet erosion, gully erosion and by active landslides. Dominant soils are chernozems and brown soils, and the most extended uses are: arable land – 36.31 %, pasture land – 18.89 % and forest - 47.15 %.

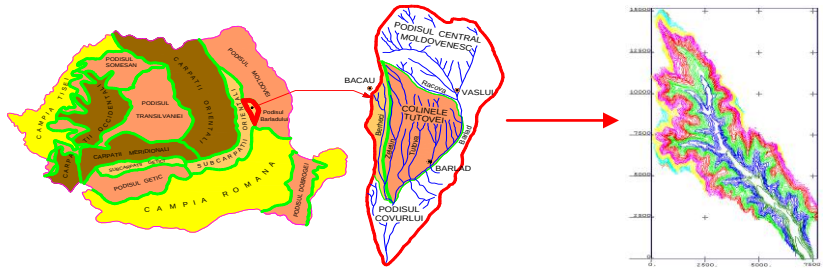


Fig. 2 Location of the study area (Gaiceana catchment)

RESULTSAND DISCUSSIONS

The georeferential data are represented in the GIS project as information *layers*, which enables the analysis of spatial variables and distribution of parameters on the surfaces studied. The global analysis of information obtained which implies simultaneous analysis of several information layers, was performed by the so-called "overlay" technique.

Such technique is based on overlapping or combination of several layers (following specific algorithms, set by the GIS developer), thus obtaining new layers (including new attributes and graphics). The "overlay" technique enables to perform multiple spatial analyses and refer to spatial entities and related databases included in a non-limited number of layers.

Graphical input data are supplied from the site plans on the scale of 1:5000 or orthophotoplans. Descriptive (non-graphical) input data are provided based on analogy with similar documentations and using data collected on site.

The first step in this project was Digital Elevation Models (DEM's) represented an important step within GIS project, and generated (fig. 3.) three information layers included in the computation algorithm of erosion-related soil loss. The Numerical Land Model was obtained by means of interpolation, based on "*weighted average method"* for local interpolation.Based on the map with level curves, the obtained Digital Elevation Model (DEM) provided fundamental layers for the GIS project, such as:Layer 1- Hypsometric map (fig. 3) ,Layer 2-Flowing direction map, Layer 2-Gradient map (fig. 4). Based on the status layouts of uses (cover) on sloping land, types of soil and types of land improvement coverage, the spatial topology methods generated the following information layers:Layer 5- Land coverage and agricultural management, Layer 6 - Soil erodibility factor, Layer7- Effect of soil protection and preservation actions and works.

By integrating the above mentioned seven layers inGIS with RUSLE model we obtained the information layer of the erosion risk -Layer 8 (fig. 5). Therefore, both the thematic layers included in the mathematic model and the water erosion calculation for the basin researched were completed up to the cell level.

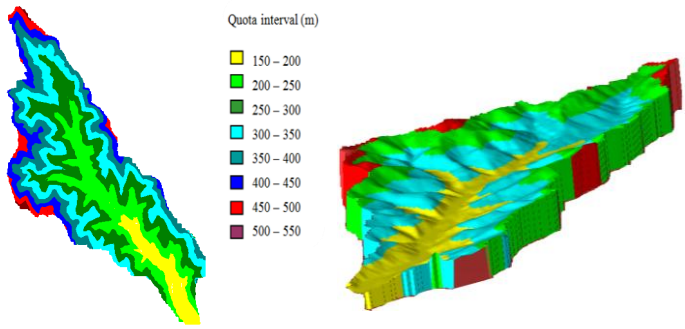
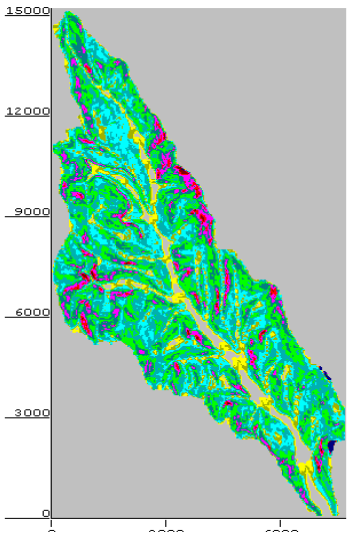


Fig. 3 Digital Elevation Models for Gaiceana catchment

Using DEM it was possible to determine the land declivity gradient, a very important factor in erosion modeling (fig.4). Using RUSLE model with ArcView results water erosion in the studied basin (fig.5).



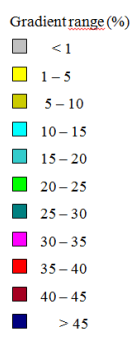


Fig. 4 Relief declivity map

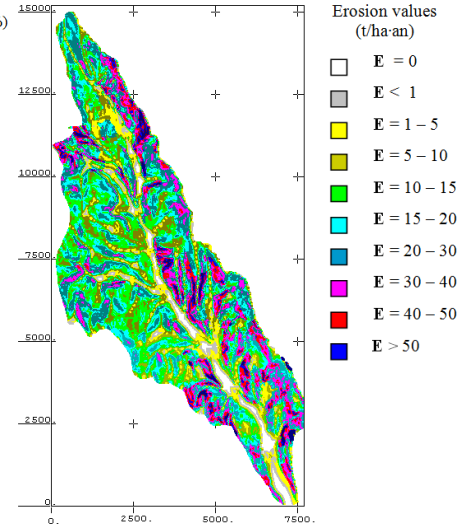
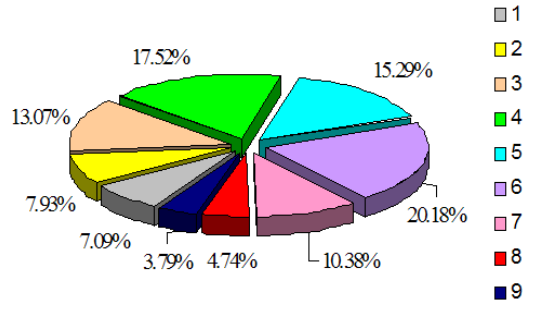


Fig. 5 Water erosion in Gaiceanabasin

Table 2

Distribution of water erosion and potential erosion in Gaiceana basin

Code		Erosion values (t/ha·an)	Surface (ha)	% of the total surface
1		< 1	333.00	7.09
2		1 – 5	372.44	7.93
3		5 – 10	614.00	13.07
4		10 – 15	823.19	17.52
5		15 – 20	718.38	15.29
6		20 – 30	915.56	20.18
7		30 – 40	487.63	10.38
8		40 – 50	222.56	4.74
9		> 50	178.25	3.79
Total			4697.50	100.00



CONCLUSIONS

1. The researches for this study set out the geo-spatial data flow from acquisition to obtaining the graphical and alphanumeric information related to erosion risk in a hydrographic basin of Romania. A digital elevation

model (DEM) was developed based on a rigorous mapping database.

2. This paper proves the computation accuracy of water erosion. Compared to classic procedures (where the computation areas are larger and with variable size), in this case the determination of water erosion takes place at elementary surface level (pixel / cell). Another great benefit of GIS technique consists of the possibility to incorporate/enter all factors (natural and anthropic) at cell level. The computerized data processing that characterizes the factors which determine the initiation and maintenance of water erosion process generate multiple possibilities of erosion simulation on sloping land.

3. After researches it was found that over 80% of the surface of the basin is affected by water erosion to different degrees according to table 2.

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ASPECTS REGARDING THE LAY-OUT OF THE FLOOD STRIPS AND THE ELABORATION OF HAZARD MAPS FOLLOWING THE SUBSIDENCE OF HYDROTECHNICAL WORKS

ASPECTE PRIVIND TRASAREA BENZILOR DE INUNDABILITATE ŞI ÎNTOCMIREA HĂRŢILOR DE HAZARD ÎN URMA CEDĂRII LUCRĂRILOR HIDROTEHNICE

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Abstract. *Current climate change, materialized by the increase in the number of extreme rainfall phenomena, combined with increasing anthropogenic activity (massive deforestation), causes the flood process to appear more and more often and with increasing impact on the human component and its habitat, causing hydrological accidents. . These accidents are called hydrological hazards. Hydrological hazards are natural phenomena, which imply the existence of water, which have a direct negative influence on people's lives, on society and on the environment as a whole. The results of the flood study can be better used if integrated into a GIS model. By over lay technique, all data of interest can be stored, with specific representations of levels, speeds, times, and other elements of the evolution of the phenomenon.*
Key words: dam, hazards, modelling, breach, flood strips

Rezumat. *Schimbările climatice actuale, materializate prin creşterea numărului de fenomene extreme asociate precipitaţiilor, coroborate cu activitatea antropică tot mai intensă (defrişări masive) determină ca procesul de viitură să apară din ce în ce mai des şi cu impact din ce în ce mai mare asupra componentei umane şi a habitatului acesteia, producand accidente hidrologice. Aceste accidente poartă numele de hazarde hidrologice. Hazardele hidrologice sunt fenomene naturale, ce implică existenţa apei, care au o influenţă negativă directă asupra vieţii oamenilor, asupra societăţii şi a mediului înconjurător, în ansamblu. Rezultatele studiului de inundabilitate pot fi mai bine utilizate dacă sunt integrate într-un model GIS. Prin tehnica over lay-urilor, toate datele de interes pot fi stocate, cu reprezentări specifice pentru nivele, viteze, timpi şi alte elemente privind evoluţia fenomenului*
Cuvinte cheie: baraj, hazard, modelare, breşă, benzi de inundabilitate

INTRODUCTION

The risk issue of hydrotechnical constructions gains other dimensions compared to other engineering domains. Any damage caused by the destruction of these constructions may reach the level caused by the major natural disasters.

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They have serious diffusion effects, which is why the risk assessment must be done with maximum responsibility (Biali, 2013).

With all the technical progress, both in terms of theoretical methods and the means of prospecting and realization and of control in execution and exploitation, according to statistics, accidents increased in number (Crăciun *et al*, 2011).

The failure of a hydraulic structure, important event that may occur during its existence, is a very complex phenomenon, both in terms of cause and the manner in which it is conducted. Regarding the time interval, this phenomenon can take place within a longer or shorter period of time. The slow or sudden character is given by the way the limit state is reached, state in which the construction collapses (Abdulamit, 2009)

From the statistical studies made, it results that the average risk of destruction of a hydrotechnical structure is about 0.5% and the risk of shutdown for a long period, due to accidents is about 2% - 3%. From the analysis of dam breaking, it was found that the percentage of destruction risk is much higher in dams of small heights than in the ones of large heights. Dams from local materials are less secure than concrete ones because they are subjected to specific phenomena related to construction materials, such as uneven settlements (Hartford and Baecher, 2004).

In a study done by the International Committee on Large Dams (ICOLD) on damages in hydraulic structures, it was concluded that the geological, design, execution and operation risk factors, are a fact proven by the destruction of about 2 % and serious damaging of other about 6% of the approximately 16,500 existing dams in the world (Abdulamit, 2009).

Dams and hydraulic structures in general, are today the subject of special attention and rigorous controls in terms of security.

MATERIAL AND METHOD

The effects of damage to hydrotechnical constructions are due to downstream damage due to breakage waves and the decommissioning of storage lakes.

Breaking waves are more dangerous than flood waves for the area immediately downstream of hydrotechnical constructions.

To determine the breaking waves that may result from the dam destruction, two hypotheses about the breakage mode have to be made:

- the duration of the breakage;
- the width of the breach created in the dam.

Modeling of dam failure can be addressed in different ways: by developing a breach at the crest level after discharge and / or failure of plant, disposed in the dam, followed by the development of a breach in the dam body (Boboc, 2014). Flood wave propagation caused by the breaking of a dam is carried out in the downstream area of the dam on a certain length that depends on the spatial characteristics. In terms of hydraulic calculation, the model is based on St. Venant equations. These equations are suffering simplifications when addressing a hydrological problem. These simplifications are induced by knowing some parameters based on previous measurements.

Analysis models of the rainfall - leakage phenomenoa analyze all leakage components, thus implicitly also in non-precipitation periods, when the water flow is formed only from the base runoff. In the internal structure of the hydrological system the continuous modeling of soil moisture is also found. So, in producing a high precipitation that will generate flood flows, the state of soil humidity is known, so the modeling of the rain-flow process is closer to reality. The Mike 11 by DHI, the NAM module (Nedbør Afstrømning Models / Rain Leakage Model) is a conceptual model that reproduces the terrestrial phase of the hydrological cycle. The model simulates surface leakage, intermediate leakage, and base leakage from a river basin. Mike 11 by DHI, NAM module (Nedbal Afstrømning Models / The Rain – drain module) is a conceptual model that reproduces the terrestrial phase of the hydrologic cycle. As input data for the model there can be used the hydrologic cycle parameters such as temporal variation of evaporation, soil humidity, aquifer recharge and aquifer water level evolution. As simulation results there can be obtained the evolution of the hydrological cycle parameters such as flow on slopes, intermediate flow and base flow (Danish Hydraulic Institute, 2014).

As a case study it was used Granicesti facility, located on the Horait brook, left branch of the Suceava River, Suceava county. In the summer of 2010 there were significant amounts of rainfall in several rounds of 2-3 days, which, in combination with high atmospheric pressures over the Russian Plain and in the central western Europe, have led to a dangerous development of hydrometeorological phenomena in Superior Siret, Suceava and Moldova river basins. The calibration of Mike 11-NAM model was done by the autocalibration procedure. It is a process that can address the most important simulated parameters (fig.1). Automated calibration routine includes nine parameters: maximum surface water quantity (Umax); maximum water content from the active area for plant roots (Lmax); surface flow coefficient (CQOF); infiltration time constant (CKIF); flow time constants (CK1,2); the threshold value of the unsaturated zone at which the surface discharge is initiated (TOF); the threshold value for initiating infiltration (TIF); time constant for base flow (CKBF); Aquifer recharge threshold limit (TG).

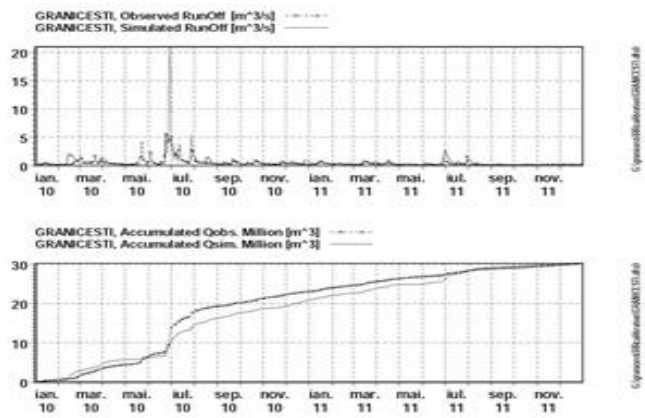

Fig. 1 Mike11-NAM model calibration result for river Horaiț hydrographic basin

RESULTS AND DISCUSSIONS

During the flood wave propagation downstream of the spilled infrastructure due to topography and large volumes of discharged water, the propagation velocities increase, according to the simulation, at a distance of 500 m from the dam at 6.0 m / s, decreasing to 5, 6 m / s at a distance of 1000 m from the dam.

The flood hydrographs caused by the canopy discharge and the breach in the dam body (fig. 2, fig. 3) have maximum discharge values of 193 m^3/s in the dam axis, the value of which decreases as we move downstream from the dam: 180 m^3/s of dam 500 m, 168 m^3/s of 1000 m dam, 154 m^3/s of 3000 m of dam, 147 m^3/s of 5000 m of dam and 130 m^3/s of 7000 m of dam.

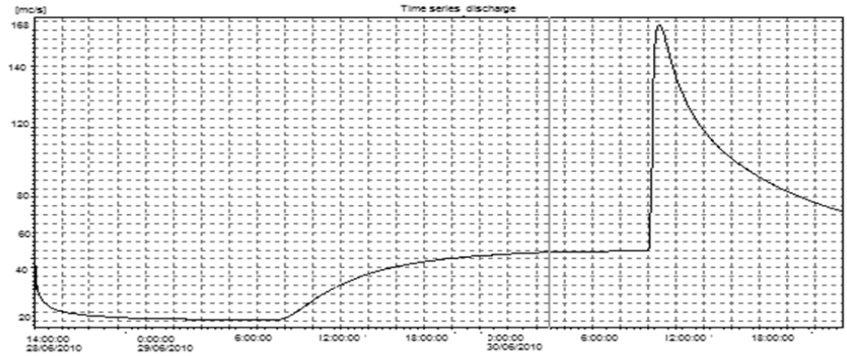

Fig. 2 Flooding hydrograph at a distance of 1000 m downstream of the dam (maximum flow rate of 168 m^3 / s)

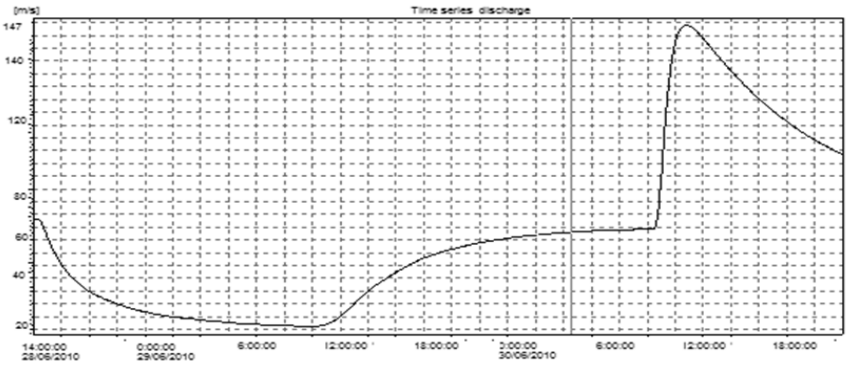

Fig. 3 The flood hydrograph at a distance of 5000 m from the dam (maximum flow rate of 147 m^3 / s)

The maximum flow in the dam shaft (193 m3/s) obtained by simulating the dam discharge is identified with the maximum flow rate with a probability of exceedance of 0.5%.

Velocity is reduced, condition that determines the attenuation phenonema in the riverbed (Boboc and Mitroi, 2016).

Between the time of the breach initiation and the one in which the lower level of the breach is reached, the water velocity reaches up to 3.0 m/s, which causes the development in height and width of the breach and the washing of the material from the dam. Structures made of local materials, that is various sorts of soils, can not avoid such erosion occurs if the discharge of the crest is produced or if breaches occur in their body. For this reason the structures designed to be discharged, are protected with coverings able to withstand erosion caused by these velocities (concrete, asphalt).

During the flood wave propagation, downstream from the discharged infrastructure, due to topography and large volumes of discharged water, propagation velocity increases, according to the simulation, at a distance of 500 m from the dam at 6.0 m/s, lowering to 5.6 m/s at a distance of 1000 m from the dam. Velocity is reduced, condition that determines the attenuation phenonema in the riverbed.

Flood strips established as a result of calculations or numerical simulations, and can be the basis for evacuation and emergency plans to protect the population and economic objectives downstream (fig 4). Also, these bands are important in making land management decisions and establishing destinations related to their use.

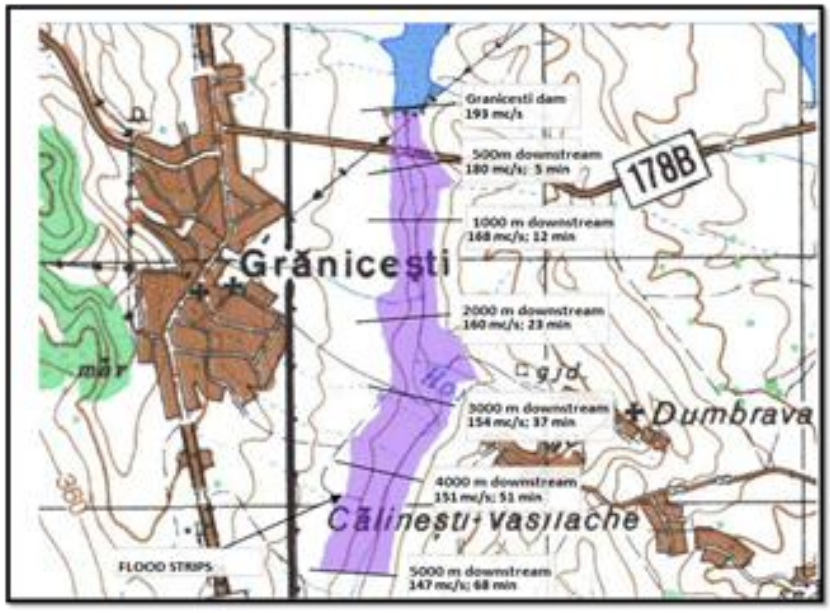

Fig. 4 Flood strips established for the downstream area the Granicesti dam

CONCLUSIONS

1. The results of the flood study can be better used if integrated into a SIG model. By over lay technique, all data of interest can be stored, with specific representations for levels, speeds, and times. Hazard maps and flood risk maps are developed according to Directive 2007/60 / EC. (www.rowater.ro)

2. The flood hazard map is an overall map that for each probability of overtaking should include the following elements: the flood limit, which represents the water extension for each case considered, the depth or water level for which 3 classes (water depth below 0.5 m, water depth between 0.5 m and 1.5 m, water depth greater than 1.5 m).

3. The existing global and European flood identification methodologies focus on complex analytical software geoinformatics, software that requires a wide range of input databases.

4. The effect of the spatial and temporal scale, tells its word on the prediction procedure a flood or flood. Therefore, it should be taken into account that by enriching the data fund hydrometric and information on how to use the reception basin, the floodplains for different probabilities of overtaking, it needs to be reassessed.

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OPTIMIZATION OF BIOSORPTION PARAMETERS FOR Cu (II) IONS REMOVAL BY RED AND GREEN MARINE ALGAE BIOMASS

OPTIMIZAREA PARAMETRILOR DE BIOSORBȚIE PENTRU REȚINEREA IONILOR DE Cu(II) PE BIOMASĂ DE ALGE MARINE ROŞII ŞI VERZI

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Abstract. *Marine algae are an important biomass resource because of the many properties they have in solving various environmental problems such as the ability to decontaminate wastewater, soil decontamination, soil fertilization, etc. Heavy metal pollution is a problem for the environment. The development of industrial activities has led to increased emissions of heavy metals into the environment, with negative consequences for soils, plants, rivers and waters. Therefore, it is necessary to find appropriate methods that should be environmentally friendly in removing metal ions in a more efficient and inexpensive way. In this paper we optimized the biosorption parameters (pH, initial concentration and contact time) for the retention of Cu (II) ions on algae biomass, using two types of marine algae: a red one Callithamnion corymbosum sp. and a green one - Ulva lactuca sp. from aqueous solution.*
Key words: marine algae biomass, biosorption, Cu (II) ions, experimental parameters

Rezumat. *Algele marine reprezintă o resursă importantă de biomasă datorită numeroaselor proprietăți pe care le au în rezolvarea diferitelor probleme de mediu cum ar fi capacitatea de decontaminare a apelor reziduale, decontaminarea solului, fertilizarea solului etc. Poluarea cu metale grele reprezintă o problemă pentru mediu. Dezvoltarea activităților industriale a condus la creşterea emisiilor de metale grele în mediu, cu consecințe negative asupra solurilor, plantelor, râurilor şi apei. Prin urmare, este necesar să se găsească metode adecvate care ar trebui să fie ecologice în îndepărtarea ionilor metalici într-un mod mai eficient şi mai ieftin. În această lucrare am optimizat parametrii de biosorbție (pH-ul, concentrația inițială şi timpul de contact) pentru reținerea ionilor Cu (II) pe biomasa algelor, folosind două tipuri de alge marine: una roşie- Callithamnion corymbosum sp. şi una verde - Ulva lactuca sp. din soluții apoase.*
Cuvinte cheie: biomasă de alge marine, biosorbție, ioni de Cu(II), parametrii experimentali

INTRODUCTION

Pollution with heavy metals is a problem of great environmental importance. Due to the toxicity, persistence and tendency of accumulation, large

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concentrations of heavy metals are found in the environment, becoming an important factor in the degradation of ecosystem quality (Hackbarth *et al.,* 2015). The main source of environmental pollution with heavy metal ions is industrial activity. The development of industrial activities has led to increased emissions of heavy metals into the environment, with negative consequences for soils, plants, rivers and underground waters (Volesky, 2001; Chen, 2004; Aji *et al.*, 2012). Copper and its compounds find a wide range of uses: in sheet metal manufacturing, as catalysts, dyes are used in the paint industry for radiators in electrotechnics and insecticides (Domnez and Aksu, 1999). Therefore, it is necessary to find appropriate methods that should be environmentally friendly and should eliminate heavy metal ions in a more efficient and cheaper way (Oliveira *et al.*, 2013). In recent years, studies of biosorption of metal ions on biological materials have increased significantly (Wang and Chen, 2009). The current trend of specialized research is to find new ecological alternatives and cheap materials for the retention of heavy metal ions through biosorption (Kratochvil and Volesky, 1998).

Marine algae are an abundant and diverse ecosystem. This biomass resource represent a great interest for environmental engineering due to its many properties in solving various environmental problems such as decontaminate wastewater, soil decontamination, soil fertilization (Vilar *et al.*, 2008; Wang and Chen, 2009). Under these conditions, the use of marine algae biomass as biosorbents for the removal of heavy metal ions from aqueous media is in agreement with the actual trends in this filed. It is well known that biosorption of a certain metal ions on certain biosorbent (marine algae biomass, in this case) occurs with maximum efficiency only well-established experimental conditions. Therefore, the find of these experimental conditions, which will ensure the maximum retention efficiency of the biosorption process represent the staring point in such studies. The objective of this study was to find optimal values of the most important biosorption parameters (pH, initial concentration and contact time) for the retention of Cu (II) ions on algal biomass using two types of seaweed: red one - *Callithamnion corymbosum sp.* and a green one - *Ulva lactuca* sp. from aqueous solutions.

MATERIAL AND METHOD

Preparation of biomass

For this study I used seaweed, red *Callithamnion corymbosum sp*. and green algae, *Ulva lactuca sp.* The algae were collected from the Black Sea in 2016. Preparation of the biomass consisted in: washing, drying and grinding into particles with grain-size of 1.0 – 1.5 mm.

Biosorption experiments

To determine the optimal pH, 0.05 g of algae biomass were mixed with 25 ml of Cu (II) solution (25.4 mg/L) with different pH (2.0 – 6.2). After 24 hours, the samples were filtered. To determine the influence of the sorbent dose, different amounts of algae biomass (0.05 - 0.5g) were mixed with 25 ml of Cu (II) solution (25.4 mg/L), and the samples were also filtered after 24 hours. The influence of the initial concentration

was examined in the Cu (II) concentration range of 12 – 178 mg/L, using 0.05 g algae biosorbent for each sample. After 24 hours, the samples were filtered. The influence of contact time was analyzed by adding 25 mL of Cu (II) solution (25.4 mg/L) to 0.05 g algae biomass. The phase's separation was done at certain time intervals, between 5 and 240 min.

Evaluation of biosorption performances

Concentration of Cu (II) ions from aqueous solution was determined spectrophotometrically (with rubeanic acid, 390 nm, 1 cm glass cells, VIS Spectrophotometer YA1407020), using a prepared calibration curve.

The biosorptive performances of algae biomass for Cu (II) ions was evaluated using biosorption capacity (q, mg/g) and removal percent (R, %) calculated from experimental results, according to the following equations:

$$q = \frac{c_0 - c}{m} \cdot V \quad (1)$$

$$R = \frac{c_0 - c}{c_0} \cdot 100 \quad (2)$$

Where c_o, c are initial an equilibrium concentration of Cu(II) in the solution (mg/L), V is volume of solution (L), and m is the mass of algae (g).

RESULTS AND DISCUSSIONS

The pH value for which the sorption process proceeds with maximum efficiency was considered the optimal pH value for retention of metal ions studied on algae biomass. As can be seen from (fig. 1), the amount of metal ions retained on algae biomass (q, mg/g) increases as the initial pH of the aqueous solution increases. In the case of *Ulva lactuca sp.*, the optimum pH is 5.0, where Cu(II) ions are retained approximately 95%, while for *Callithamnion corymbosum sp*., the optimal pH is 4.4, and the removal percent obtained is not greater than 79%.

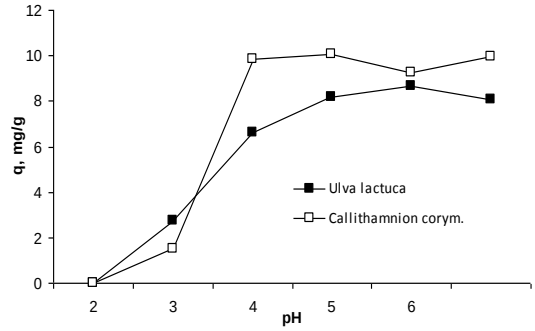

Fig. 1 Influence of initial solution pH

The optimum quantity of biosorbent (fig. 2) was determined on the basis of the values of the quantitative parameters of the biosorption process, being considered the value for which the Cu (II) removal efficiency is maximum.

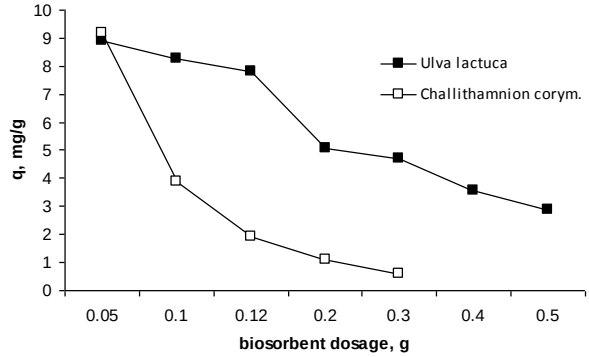

Fig. 2 Influence of biosorbent dosage

Such variation is determined by the increase in the number of active sites (superficial functional groups) with the increase of the quantity of algae biomass used as biosorbent (Ucun et al., 2003). Based on obtained experimental results (fig. 2), the optimal dose of biosorbent was considered 0.05 g for both types of algae biomass.

The increase in the initial concentration of Cu (II) ions over studied concentration range causes an increase of the biosorption capacity (q, mg/g) from 5.19 to 52.26 mg/g for red algae and 3.10 to 57.03 mg/g for green algae (fig. 3).

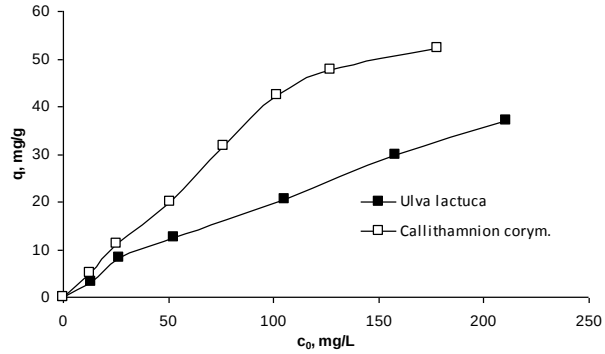

Fig. 3 Influence of the initial concentration

These values correspond to a decrease in the removal percent from 82% to 62% for red algae and 99% to 59% for green algae. Therefore, it can be said that *Ulva lactuca sp*. (green algae biomass) is much more effective in the retention of Cu (II) ions compared to *Callithamnion corymbosum sp.* (red algae biomass).

The influence of contact time has shown that with increasing contact time (Fig. 4), the amount of metal ions retained on the sorbent mass unit increases. The biosorption process is rapid in the initial stage when in the first 5 min the Cu(II) removal percent are higher than 53 % in case of *Ulva lactuca sp*. biomass and 65 % in case of *Callithamnion corymbosum sp.* biomass, respectively. After this initial step, the rate of the biosorption process becomes much slower near the equilibrium, which is obtained after 60 min in the case of *Ulva lactuca sp.* biomass and after 30 min in case of *Callithamnion corymbosum sp.* biomass, respectively.

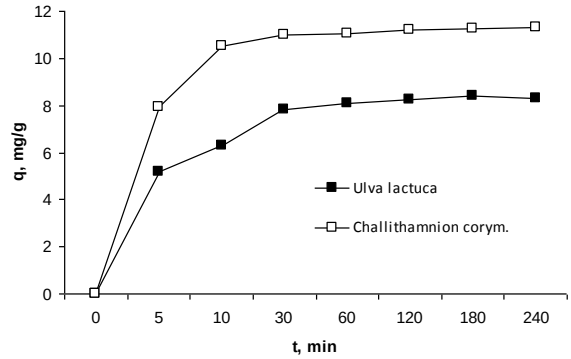

Fig. 4 Influence of contact time

According to these results, *Callithamnion corymbosum sp.* biomass is much more effective in the removal of Cu(II) ions by biosorption, because required a lower minimum contact time (30 min), compared with 60 min in case of *Ulva lactuca sp.* biomass.

In table 1 are summarized the optimal values of the biosorption parameters for the Cu (II) ions removal from aqueous media using *Ulva lactuca sp*. and *Callithamnion corymbosum sp*. algae biomass.

Table 1

Optimal values of biosorption parameters for Cu (II) ions removal on considered algae biomass

Parameters	Ulva lactuca sp.	Callithamnion corymbosum sp.
Initial pH	5.0	4.4
Biosorbent dosage	0.05	0.05
Initial concentration, mg/L	13.18 – 210.93	12.71 – 177.89
Minimum contact time, min	60	30

CONCLUSIONS

Removal of metal ions from wastewater by low-cost biosorption is an effective method that can be successfully applied for wastewater treatment due to the advantages it has. Algae biomass fulfils all the necessary conditions. According to experimental results, the *Ulva lactuca sp*. biomass is much more effective in removal of Cu (II) ions from aqueous solutions compared to *Callithamnion corymbosum sp.* biomass.

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REMOVAL EFFICIENCY OF Zn(II) IONS FROM AQUEOUS EFFLUENTS ON DIFFERENT TYPES OF WASTE BIOMASS

EFICIENŢA ÎNDEPĂRTĂRII IONILOR DE Zn(II) DIN MEDII APOASE PRIN BIOSORBŢIE PE DIFERITE TIPURI DE DEŞEURI DE BIOMASĂ

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Abstract. *In this study was analyzed the ability of three types of waste biomass for removal of Zn(II) from aqueous solution. The three types of biosorbents that have been used in experiments are: sawdust, mustard waste and soybean waste. These materials, which are waste from various branches of industry, can be used to remove metal ions from aqueous solutions, thus helping to reduce environmental pollution. The results for the influence of initial Zn(II) ions concentration and contact time on the removal efficiency from aqueous media were modelled using two isotherm models (Langmuir and Freunlich) and two kinetics models (pseudo-first order model and pseudo-second order model). The evaluation of biosorptive potential of these three types of waste biomasses in the removal processes of Zn(II) ions from aqueous solution was performed using the parameters obtained from the modelling.*

Key words: waste biomass, biosorption, aqueous solution, Zn(II) ions

Rezumat. *În acest studiu s-a analizat capacitatea a trei tipuri de deşeuri de biomasă de a îndepărta Zn (II) din soluţii apoase. Cele trei tipuri de biosorbenţi care au fost utilizate în experimente sunt: rumeguşul, deşeurile de muştar şi deşeurile de soia. Aceste materiale sunt deşeuri provenite din diverse ramuri ale industriei, şi pot fi utilizate pentru a elimina ionii metalici din soluţii apoase, contribuind astfel la reducerea poluării mediului. Rezultatele privind influenţa concentraţiei iniţiale a ionilor de Zn(II) şi a timpului de contact asupra eficienţei îndepărtării acestuia din medii apoase au fost modelate utilizând două modele ale izotermelor de biosorbţie (Langmuir şi Freudlich) şi două modele cinetice (modelul cinetic de ordin pseudo-unu şi modelul cinetic de ordin pseudo-doi). Evaluarea potenţialului biosorptiv ale celor trei tipuri de deşeuri de biomase în procesele de îndepărtare a ionilor de Zn(II) din soluţii apoase a fost realizată cu ajutorul parametrilor obţinuţi în urma modelării.*

Cuvinte cheie: deşeuri de biomasă, biosorbţie, soluţii apoase, ioni de Zn(II)

INTRODUCTION

With the development of economy, environmental pollution and large-scale ecological destruction have become increasingly serious, threatening the survival and development of all mankind (Dai *et al.*, 2018). The rapid urbanization and

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rapid advance of industrialization has resulted in the excessive discharge of heavy metal-containing wastewater into the environment, seriously affecting human health (Zhang *et al.,* 2016).

Zn (II) is considered an essential element for growth and metabolism of living organisms (Das *et. al*, 2015) but consuming large amounts of zinc, even for a short period of time, can cause stomach cramps, feeling weak, dry throat, cough, generalized pain, chills, fever, nausea and/or vomiting. The various utilization of Zn(II) in industrial activities (such as electroplating, metal processing, deodorants and cosmetics industry, medicine and ointment industry, paint and pigments production and fertilizers manufacturing) leads to contamination of surface waters with this heavy metal (Ahmaruzzaman, 2011).

In recent years, various methods, such as biological treatment, flocculation, chemical precipitation, electrochemical techniques, membrane related processes, osmosis, adsorbtion, ion exchange, coagulation, etc. (Jawad *et al*., 2015, Rosales *et al*., 2017. Agwaramgbo *et al.,* 2013), are used for the treatment of industrial effluents containing metal ions before their discharge. But these methods are either expensive or inefficient for the removal when the metals are at high concentration or has other important disadvantages, such as poor selectivity, high costs, high energy consumption, generation of large amounts of waste sludge, etc. (Kanawade and Gaikwad, 2011; Fu and Wang, 2011), which requires certain precautions in their application on an industrial scale. The search for new technologies involving the removal of toxic metals from wastewaters has attracted attention to adsorption, who has been shown to be an effective and costeffective method for removing of heavy metals, including Zn(II) ions, from aqueous effluents (Ashrafi *et al.,*2015).

The biosorption potential of some waste biomasses for Zn(II) ions removal from aqueous solution was examined in this study in batch systems. For the experiments have been used three types of biomass: mustard waste biomass, soybean waste biomass and sawdust. These biosorbents are derived from biofuels production or wood industry. The experimental data obtained from the influence of initial Zn(II) ions concentration and contact time on the biosorption efficiency on each type of biomass were modelled using two isotherm models (Langmuir and Freundlich) and two kinetics models (pseudo-first order and pseudo-second order). The parameters calculated for each model have allowed the evaluation of biosorption potential of these three types of waste biomasses in the removal processes of Zn(II) ions from aqueous solution.

MATERIAL AND METHOD

The experiments were conducted in batch system, using three types of waste biomasses as biosorbents: mustard waste biomass, soybeans waste biomass and sawdust. The sawdust comes from the coniferous wood processing industry, while mustard and soybean biomass wastes were prepared from mustard biomass and soybeans biomass after oil extraction in a Soxhlet extractor with n-hexane for 24 hour. Drying of all biosorbents was done in warm air, at 50-55 °C and after drying, they were mortared and stored in the desiccator.

The biosorption experiments were performed at room temperature (22 ± 0.5 °C), by mixing biosorbent samples (0.125 – 0.2 g) with 25 mL of Zn(II) ions solution of known concentration (5.23 – 209.24 mg/L), in 100 ml conical flasks. Working solutions of Zn(II) were freshly prepared by diluting the stock solution (containing 654 mg Zn(II)/L) with distilled water. The stock solution of Zn(II) was prepared by dissolving an appropriate amount of zinc nitrate in distilled water. The initial pH values of working solutions were obtained using 0.1 mol/L HNO_3 solution.

At the end of biosorption experiments, the phases were separated by filtration, and Zn(II) concentration in filtrate was spectrophotometrically analysed with xylenol orange (Digital Spectrophotometer S104D, λ = 570 nm, 1 cm glass cell, against distilled water), using a prepared calibration graph.

The biosorption capacity (q, mg/g) of each waste biomass for Zn(II) ions was calculated from experimental data, according with their definition. The mathematical equation of the isotherm models (Langmuir and Freundlich) and kinetics models (pseudo-first order and pseudo-second order) used for the modeling of the experimental data were taken from the literature (Gerente *et al.,* 2007).

RESULTS AND DISCUSSIONS

In our previous studies (Nacu *et al.,* 2017) we have shown that the optimal pH for Zn (II) retention on these biomass waste is around 6.00 and this value of pH was maintained in all experiments.

In figure 1 is illustrated the influence of initial Zn(II) ions concentration on the biosorption performances of the three types of biomass. As can be observed, the increase of Zn(II) ions concentration determined the increase of the biosorption performances of each waste biomass used as biosorbent; the highest adsorption capacity is assigned to soybean waste, followed by mustard and sawdust.

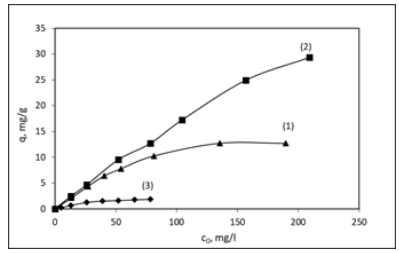
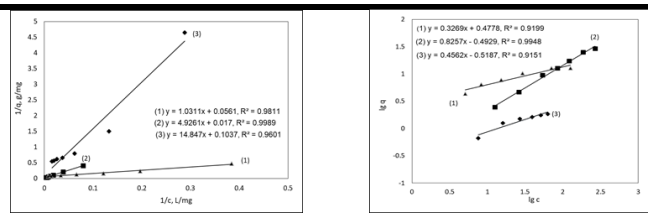


Fig. 1 Influence of initial Zn (II) ions concentration on the biosorption efficiency on (1) mustard waste biomass, (2) soybean waste biomass and (3) sawdust

This increased capacity of soybean biomass to retain Zn(II) ions can be explained by the presence of several functional groups on its surface in comparison to the other two types of waste studied.

The experimental data were analyzed using Langmuir and Freundlich isothermal models to obtain a quantitative measure of the Zn (II) retention capacity on biomass waste. The linear representations of each isothermal model are shown in figure 2, and the calculated isothermal parameters are shown in table 1.



(a) (b)

Fig. 2 Linear representations of Langmuir (a) and Freundlich (b) isotherm models for Zn(II) biosorption on (1) mustard waste biomass, (2) soybean waste biomass and (3) sawdust.

Table 1

Isotherm parameters for Zn(II) ions biosorption on the studied biosorbents

Isotherm model(*)		Mustard waste biomass	Soybean waste biomass	Sawdust
Langmuir	R^2	0.9811	0.9989	0.9601
	q_{max}, mg/g	17.8253	58.8235	9.6432
	K_L, g/L	0.0544	0.0034	0.0069
Freundlich	R^2	0.9189	0.9948	0.9151
	1/n	0.3269	0.8257	0.4562
	K_F, g/L	0.3328	3.1109	3.3014

It can be noticed that the (R^2) coefficient values are higher for the Langmuir model in comparison with the Freundlich model. Therefore, the Langmuir model has the higher applicability in the description of Zn(II) ions biosorption on the considered biosorbents. Consequently, we can assert that the biosorption process takes place up to the formation of monolayer coverage on the biosorbent surface (Gerente *et al.,* 2007). At the same time, by comparing the maximum biosorbtion capacities of the three biosorbents (q_{max}, mg/g), we can observe a higher biosorbtion potential of soybean waste in comparison to sawdust and mustard waste.

The contact time is the other parameter used to evaluate the biosorbtion efficiency of Zn(II) ions on the three types of waste biomasses and the experimental results, presented in figure 3, indicates that biosorbtion capacities increase with the contact time in all cases, reaching the maximum value after 30 minutes.

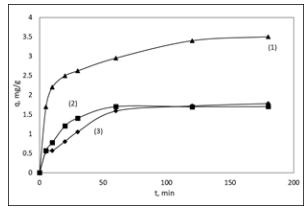
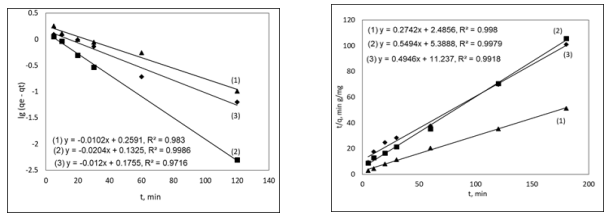


Fig. 3 Influence of contact time on the Zn(II) biosorption efficiency on (1) mustard waste biomass, (2) soybean waste biomass and (3) sawdust

For the kinetic modeling of the experimental data in figure 3, the pseudo-first kinetic model and the pseudo-second kinetic model were used and their linear representations was illustrated in figure 4. The values of the calculated kinetic parameters are shown in table 2.



(a) (b)

Fig. 4 Linear plots of pseudo-first order (a) and pseudo-second order (b) kinetics models, for Zn(II) biosorption on (1) mustard waste , (2) soybean waste and (3) sawdust

Table 2

Kinetics parameters for Zn(II) ions biosorption on the studied biosorbents

Kinetics model		Mustard waste biomass	Soybean waste biomass	Sawdust
Pseudo-first order kinetics model	R^2	0.983	0.9986	0.9716
	q_e, mg/g	1.8159	1.3567	1.4979
	k_1, 1/min	0.0102	0.0204	0.012
Pseudo-second order kinetics model	R^2	0.998	0.9979	0.9918
	q_e, mg/g	3.6469	1.8201	2.0218
	k_2, g/mg min	0.0302	0.056	0.0217

Accordingly with figure 4, the pseudo-second order kinetics model best describes Zn(II) ions biosorption on these three biosorbents and it can say that the biosorption process is limited by the chemical interactions between Zn(II) ions and functional groups present on the biosorbents surface.

CONCLUSIONS

1. To study the influence of the initial concentration of Zn (II) ions and contact time on aqueous effluent removal, three types of biomass waste were used (mustard, soybeans and sawdust) and the experiments were performed in the batch system.

2. The experimental results were modeled using two isotherm models (Langmuir and Freundlich) and two kinetics models (pseudo-first order and pseudo-second order).

3. The obtained results have shown that soybean waste biomass has the higest biosorption potential for Zn (II) ions from aqueous solution, in comparison with sawdust and mustard waste biomass.

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NATURAL PROTECTED AREAS FROM THE PANONIC BIOGEOGRAPHIC REGION, ROMANIA

ARIILE NATURALE PROTEJATE DIN REGIUNEA BIOGEOGRAFICĂ PANONICĂ, ROMÂNIA

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Abstract. *Although it only covers 3% of the territory of the European Union, the Pannonian bioregion is home to a high biodiversity with some endemic species. In Romania, the Pannonian bioregion covers 6% of the national territory, and lies on a strip in the Western part of the country. The main purpose of our study is to evaluate the number, surface and distribution of protected natural areas at the level of Pannonian bioregulation in Romania. According to the data processed by specific GIS methods, before the designation of Natura 2000 sites, the area covered by protected areas was 1.59% (22371.86 ha) in the Pannonian bioregion, and now the area covered by protected areas has increased up to 13, 92% (217409.01 ha). Of the 79 protected bioreales, 2 have management structures, 26 are managed by the custodians and 51 do not have management or custody facilities, and 25 are under an approved management plan.*
Key words: protected areas, Natura 2000, the Pannonian bioregion

Rezumat. *Deşi acoperă doar 3% din teritoriul Uniunii Europene, bioregiunea Panonică adăposteşte o biodiversitate ridicată, cu unele specii endemice. In Romania, bioregiunea Panonică acoperă 6% din teritoriul național, şi se întinde pe o fâşie din partea de vest a țării. Scopul principal al studiului nostru este de a evalua numărul, suprafața şi distribuția ariilor naturale protejate la nivelul bioregiunii panonice din România. În urma datelor prelucrate prin metode specifice de GIS, rezultă că până la desemnarea siturilor Natura 2000, în bioregiunea panonică suprafața acoperită de zone protejate era de 1,59% (22371.86 ha), iar în prezent suprafața acoperită de zone protejate a crescut la 15,52% (217409.01 ha). Din totalul de 79 de arii protejate la nivelul bioregiunii, 2 dețin structuri de administrare, 26 sunt administrate de către custozi şi 51 nu dețin nici structuri de administrare nici custode, iar 25 funcționează în baza unui plan de management aprobat.*
Cuvinte cheie: arii protejate, Natura 2000, bioregiunea Panonică

INTRODUCTION

Developments, particularly in the 20th century, have led to the widespread destruction of nature in Europe (Report of the Commission to the Council and European Parliament, Nature in the European Union, 2015), the local footprint of

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human consumption with an environmental impact on the environment is often higher in the EU than in any other area (Imhoff *et al.,* 2004).

The Aichi Targets, adopted in 2010 commits CBD to improve connectivity within existing networks of protected areas and to expand the global coverage of terrestrial protected areas up to 17% by 2020 (Venter *et al*., 2014).

The EU has taken on a global commitment and has made extensive efforts to preserve biodiversity by creating Natura 2000 network of protected areas. The national protected areas and Natura 2000 network currently cover more than one third of the European Union (Maiorano *et al.,* 2015) and globally these protected areas represent one of the most important responses to the global biodiversity crisis (Watson *et al*., 2014).

World Database on Protected Areas - updated every five years by the World Conservation Monitoring Center, shows that if in 1962 the number of protected areas was 9214, with an area of 2,400,000 km2, in 2014 worldwide there were 209,429 protected areas (32,868,673 km2), covering about 14.6% of the world's terrestrial areas and 2.8% of its oceans (Deguignet *et al.,* 2014).

Out of the total of these protected areas, about 65% are located in Europe. However, they represent only over 12% of the total area covered by globally protected areas (Deguignet *et al.,* 2014).

Of the nine biogeographical regions of the European Union, Romania has five, with our country having the largest number of such regions. The invaluable natural treasure of Romania is reflected in this great biogeographical diversity (Natura 2000 in Romania, 2012).

The Pannonian Region referred to in this paper includes the entire territory of Hungary as well as peripheral regions of Slovakia, the Czech Republic and Romania (among the countries of the European Union), and outside the territory of the Union, regions of Serbia, Croatia and Ukraine (Natura 2000 in the Pannonian region, 2010).

Due to varied and contrasting habitats, the Pannonian region has a wide variety of species, some of which endemic. Although it covers only 3% of the territory of the European Union, the Pannonian region houses more than 100 species of animals and over 40 species of plants included in the Habitats Directive but also over 50 types of habitats (Natura 2000 in Romania (2012), Natura 2000 in the region Pannonics, 2010).

In Romania, the Pannonian bioregion covers 6% of the national territory (Natura 2000 in Romania, 2012).

The main purpose of our study is to quantify and compare the number, surface area and distribution of protected natural areas in the panonian bio-region in Romania, before and after EU accession.

Studies on the number and distribution of protected areas for the Western region of Romania were also carried out by Pascu M. (2018), Cojocariu L. (2017).

MATERIAL AND METHOD

In the analysis of the protected natural areas, geospatial data were published on the website of the Ministry of Environment (http://www.mmediu.ro/articol/date-

gis/434),, respectively the limits of the protected natural areas and the boundaries of the biogeographical regions.

Protected natural areas have been analyzed based on Overlay procedures (multilayer analysis), Union, Intersect and Erase functions respectively, considering their overlay. Thus, the areas of each category (SCI, SPA, RONPA, RORMS, etc.) were obtained and, implicitly, the calculation on the total surface.

ArcGIS 10.1 software was used to process and generate cartographic materials.

Data on the number of protected areas with specially constituted or custodial management structures and those operating under an approved management plan have been taken over and processed from the Ministry of Environment database (http: //www.mmediu. ro / category / natural-protected areas / 208) and the National Agency for Protected Natural Areas (http://ananp.gov.ro/ananp/arii-naturale-protejate/vest/).

RESULTS AND DISCUSSIONS

According to the Romanian legislation, different categories of protected areas are distinguished at national level (the purpose and management of which are defined in Annex 1 to GEO 57/2007), depending on the different protection, conservation and use regime as follows: natural protected areas of national interest, of international interest, of community interest (Natura 2000 sites) and of county or local interest.

The largest number of protected natural areas of national interest was declared by Law 5/2000, the surface of which amounts to approx. 5% of Romania's surface. By Government Decision 2151/2004 the protected area increased to 7% and in the period 2006-2016 the surface of the protected natural areas increased to 8% of the country's surface by establishing new protected natural areas.

At the end of 2007, with the implementation of the Natura 2000 network, Romania proposed 273 sites of Community importance representing 13.81% of the country's area and 108 special avifauna special areas representing 12.54% of the country's surface. At the end of 2011, after the new sites were declared, the area of the country included in the Natura 2000 network increased, the number of SCIs reaching 407 and SPAs at 149, and in 2016 the number of SCIs was 435; SPAs of 149, totaling 6,057,700 ha, representing 22.74% of the national territory (Pacu *et al.,* 2018, O.U.G. 57/2007).

Thus, Natura 2000 network represents, at continental level, an important network of protected areas that act as a good complement to the existing national protected areas (Maiorano *et al.,* 2015). Natura 2000, together with nationally designated protected areas, covers approximately 1 222 725 km2 (or 21% of land and inland waters) and around 338 000 km2 (or 5.9% of EU marine areas), (https: //www.eea.europa.eu/soer-2015/countries-comparison/biodiversity#tab-based-on-indicators).

The Pannonian bioregion spreads in Romania on a strip in the Western part of the country, on the border with Hungary (Natura 2000 in Romania, 2012), and the processed data show that it has a total area of 1400132.21 ha.

The number and the area of natural areas currently protected at the bioregion level are as follows (fig. 1 and fig. 2): 24 natural reserves (RONPA):

5314.87 ha; 2 natural parks: 22375.57 ha; 1 wetland of international importance (RORMS): 17397.57 ha; 35 SCIs: 116077.13 ha and 17 SPAs: 179469.54 ha.

It results in a total area covered by protected areas of 340634.70 ha, which represents 24.32% of the Pannonian bioregion. However, due to partial or total overlapping of different categories of protected areas, the actual area is 217409.01 ha (15.52%).

Fig.1 Distribution of protected areas of national interest in the Pannonian Region, processed after (http://www.mmediu.ro/articol/date-gis/434)

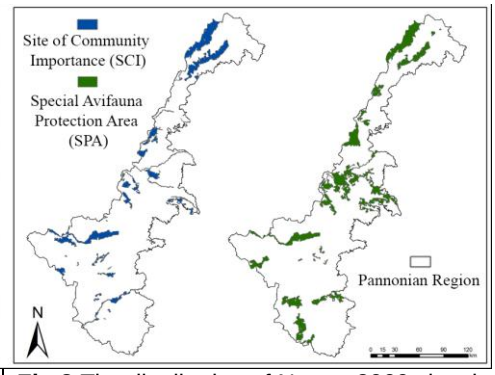

Fig.2 The distribution of Natura 2000 sites in the Pannonian Region, processed after (http://www.mmediu.ro/articol/date-gis/434)

Until the designation of Natura 2000 sites in the Pannonian region of Romania, the area covered by protected areas was 1.59% (22371.86 ha), and after 2007 the area covered by protected areas has progressively increased thanks to Natura 2000 sites, and of the Cefa Natural Park designated in 2010, amounting to 13.92% (195037.15 ha) of the total area covered by the Pannonian region.

Table 1

Spatial correlations between different categories of protected areas

RONPA	SPA	PN2	PN1	RORMS	SCI	AREA (ha)
RONPA	0	0	0	0	0	2866.90
0	SPA	0	0	0	0	96165.49
0	0	0	0	0	SCI	34714.23
RONPA	SPA	0	0	0	0	670.47
RONPA	0	0	0	0	SCI	358.34
0	SPA	PN2	0	0	0	1629.01
0	SPA	0	0	0	SCI	59191.87
RONPA	SPA	0	0	0	SCI	1066.14
0	SPA	PN2	0	0	SCI	3336.55
RONPA	SPA	PN2	0	0	SCI	12.44
0	SPA	0	PN1	RORMS	SCI	17057.00
RONPA	SPA	0	PN1	RORMS	SCI	340.58

Legend: PN1 - Lunca Mureş Natural Park; PN2 - Cefa Natural Park

By overlay operations, the surface area overlapping different types of protected areas was determined (tab. 1). It can be seen that the space protected by different categories of protected areas is smaller than the surface obtained by summing the values for each type of protected area, as they overlap in the "vertical plane". The data summarized in table 1 shows that on the 340.58 ha five types of protected areas were identified, and over 17057 ha overlapped 4 entities.

The association between different categories of protected areas in a given territory may suggest a differentiated "degree of protection" from one sub-area to another, so that specific restrictions are imposed on the respective territories.

Establishing and declaring natural protected areas by law is not sufficient, they should be managed through active and sustainable management, for this reason another objective of our study was to present the situation regarding the administration of the protected areas of the Pannonian bioregion (fig. 3).

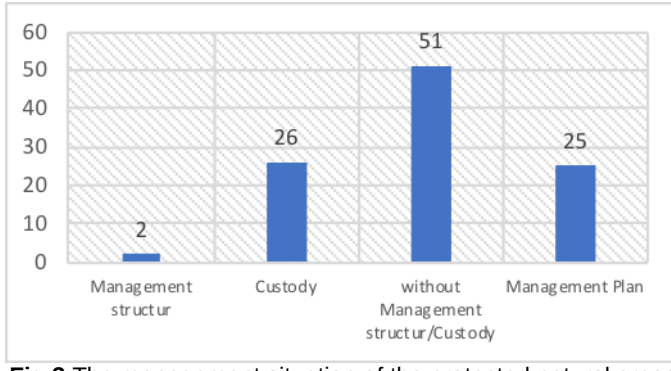

Fig.3 The management situation of the protected natural areas

Of the 79 protected bioregional areas, 2 are managed by management structures (the Lunca Mureş Natural Park and the Lower Mureş Floodplain), 26 are managed by the custodians and 51 have neither management nor custody facilities, and 25 operate in custody based on an approved management plan. Those without administration or custody, under Romanian law, are coordinated by the National Agency for Natural Protected Areas (ANANP).

CONCLUSIONS

In Romania, the Pannonian region occupies an area of 1400132.21 ha, 6% of the national territory, and the protected areas amount to 217409.01 ha (15.52%) from the region. The management of the 79 protected areas is partly provided through administration or custody facilities (2 and 26 respectively) and 51 do not have management or custody facilities. Of the total protected areas, 25 have an approved management plan.

Protected Areas are the most effective way of preserving in-situ biodiversity, with the widest possible diversity in the long term.

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SITUATION OF GARLIC IN ROMANIA

SITUAȚIA CULTIVĂRII USTUROIULUI ÎN ROMÂNIA

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Abstract*. The paper presents a general picture of on the garlic culture in Romania. The main goal is to evaluate the development possibilities of this crops when the garlic has become a high commercial competition product at national level and world one. The paper contains six distinct sections:* (1) *recent short history,* (2) *traditional zones for garlic cultivation,* (3) *areas and production,* (4) *garlic asortment,* (5*) cultivation technology and* (6) *marketing and selling problems.*
Keywords: crop history, traditional zones, garlic assortment, cultivation technology

Rezumat*. Lucrarea prezintă un tablou general asupra culturii usturoiului în România, având ca principal scop să evalueze posibilitățile de dezvoltare ale acesteia, în circumstanțele actuale în care usturoiul a devenit un produs de mare competiție comercială atât la nivel național, cât şi mondial. Lucrarea este structurată în şase secțiuni:* (1) *scurtă istorie recentă,* (2) *zone tradiționale pentru cultivarea usturoiului,* (3) *suprafețe şi producții,* (4)*sortimentul de usturoi,* (5*) tehnologia de cultivare şi* (6) *probeme de piață şi valorificare.*
Cuvinte cheie: istoria culturii, zone tradiționale, sortimentul de usturoi, tehnologia de cultivare

1. RECENT SHORT HISTORY

Although the garlic crop, in Romania has existed since the pre-Roman period, documented information about it appeared in the 19th century, when certain culinary recipes containing garlic, became popular. The development of towns increased the market demands for garlic since it was a traditional product to the population.

These circumstances stimulated and increased the interest of the farmersfor garlic; and the garlic crop area expanded, mainly in zones with favorable environmental conditions, and where certain traditions and experiences existed as well. A significant increase in garlic crop area was documented after the immigration of Bulgarian and Serbian growers. The growers rented the fertilized lands for vegetable crops, including garlic. They bought seeds, and employed migrant workers and in some cases local workers for garlic farming.

In comparison with other agricultural crops, vegetable crops are more difficult to farm, as they require a great deal of work and care. Usually,

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peasants who own a small land area were employed to work on the vegetable crop lands. In these circumstances, in certain regions with favorable environmental conditions (sandy-loam, fertile soils, irrigation facilities and a suitable climate etc.), the so-called traditional zones for garlic crop were developed. Under these circumstances, some local grades of garlic local populations as well as certain foreign origin (mainly from the Balcanic Peninsula) garlic varieties were introduced.

As a result, a well organized garlic market emerged. These traditional zones have been developed and spread, under objective conditions, in almost all the vegetable growing regions of the country. Although these traditional zones for garlic crops have been developed, the total yield at the national level was not sufficient to satisfy the market needs of the entire country, mainly from the large towns.

Rural populations from outside the traditional zones, in most cases, produced garlic for their own use in their family gardens, even though the yield was under 200 – 300 g/m^2.

During the socialist regime (mainly 1960 – 1989), most of the agricultural production cooperatives had been obligated to cultivate garlic, even if they were not experienced in it.

However, the state strategy had as itsmain objective to satisfy the needs of the food industry and consumer population. So, the expansion of the area cultivated with garlic crops was considered to be a sure means to increase the total national production. At the same time, special national research and development programs for this crop had been established, including the improvement of assortment (by importing new varieties from Spain and Turkey), the improvement of cultural practices and new management of the crop etc. Despite these measures, the yield/ha did not significantly increase, remaining in the limits of 1.5 – 3.5 t/ha.

The most efficient measure for increasing the production at a national level was managerial, which stimulated the workers to get a higher yield/ha. According to this new management, a worker received a certain percentage of garlic crops, with the obligation to give to the cooperative a fixed yield (60 – 80%) from the planned yield. The remaining yield was considered as a payment. This managerial measure assured garlic production for the cooperative and was very stimulating for the workers. Sometimes, this payment was very advantageous for the workers. For instance, for 1000 m^2, and an obligation of 400 kg to the cooperative, a worker could get a good yield of 800 kg, so he could receive 400 kg of garlic as payment. From this payment, he could sell a part to the cooperative, and another could be sold on the free market at an official

price or on the black market at a very high price. This system was applied only in the traditional zones, employing very good professional workers.

Nowadays, the garlic crop in Romania is, more or less, spread over the same locations as it was before 1990, but the largest areas are situated in the traditional zones. In these zones, in a village the cultivated area could be approximately 50 – 100 ha; but in the rest of the country, the garlic crop areas vary between 0.5 and 15 – 20 ha. Under these circumstances, in Romania, approximately 10 000 ha are cultivated, as commercial areas, with an average production of 5 t/ha. By comparison, at the world level, the yield is about 18 t/ha, with the highest productions in China and Egypt (over 20 t/ha).

One of the most recent problems of the garlic production in Romania is an economic issue, determined by the relatively small production/ha and high competition because of the large quantity of imported garlic. The main objective of commercial units in importing garlic is to meet market demands, and to get a good profit.

2. TRADITIONAL ZONES FOR GARLIC CULTIVATION

The natural, economic, social and historical conditions have determined the establishment and development of so-called traditional zones or regions for garlic cultivation.

These zones have been known since the end of the 19^{th} century. During that time, these zones were increased in area. An expansion of the cultivation area and extensive development of garlic production was a primary goal of the Romanian state during the socialist period. However, in recent years, the cultivation zones have returned to their initial size. This fact is demonstrated by the reduced area cultivated with garlic at the present time, which is around 10,000 ha.

Special studies, carried out during the 70's and 80's, demonstrated that soil and climatic potential of the agrarian land was higher (by 2-3 times) for the garlic crop. The lands that could be cultivated with garlic are more or less overlapped with the lands cultivated with onion crops.

An increase in the cultivated areas with garlic crops must be achieved through technological, economic, social and even political measures.

A short view on the agricultural crop map of Romania highlights the fact that the traditional zones for garlic crops are spread in all the regions of Romania, in which favorable conditions determine their establishment and development.

The traditional zones for garlic cultivation could be defined by:

- soil conditions (light or medium light, with good fertile soil);
- a specific assortment, usually containing 2 - 3 cultivars;
- a certain tradition, respectively, experience and cultivation practices.

The well-known traditional zones for garlic cultivation in Romania are the following, in the order of location on the map:

- Cenad – Şeitin, in Timiş and Arad counties;
- Măldăraşu de Câmpie, in Mureş county;
- Craiova - Işalnița-Amaradia, in Dolj county;
- Fălcoiu - Cioroiu, in Olt county;
- Dărăşti - Ciolpani, in Ilfov county;
- RâmnicuSărat – Buzău, in Buzău county;
- Răchiteni – Tămăşeni, in Iaşi and Neamț counties;
- Copălău, in Botoşani county.

The zones were named based on the main localities in which the garlic is cultivated. For this reason, the zones do not refer strictly to these locations, but to a larger territory.

These traditional zones cover over 70% of cultivated area with garlic and account for probably over 80% of total production in Romania. The actual potential of production of garlic is 3-4 times higher.

The traditional zones are included in larger areas, according to the certain zoning of garlic crops developed by the Economic General Direction of Horticulture, from the Ministry of Agriculture, published in the 1980's. This zoning underlined the fact that garlic could be cultivated more or less in the same areas as onion crop. Based on this zoning, the area for garlic could be 2-3 times higher.

It was noted that the area cultivated with garlic increased by 20-30% during the recent period, comparedwith the past 70 years, but the yield had a smaller increase. This could be explained by the fact that garlic producer in the traditional zone are more professional than producers in the larger zones. The professional garlic producers passed on their professional work from generation to generation, till this day.

3. AREAS AND PRODUCTIONS

The areas and production of garlic in Romania, during a50-years period, continuously increased, but could never satisfy the consumption needs.

According to statistical data, as well as informal data, there is an obvious disproportion between a much higher demand and an unsatisfactory supply.

Until the 1960's, the Romanian population was predominantly rural (over 70%), so the consumption needs for garlic were satisfied from their family gardens. After that period, when strong industrialization started, followed by a significant increase of the urban population, the market demands for garlic consistently and abruptly increased.

After the 60's a significant development of the food industry occurred, resulting in the demands for garlic substantially increasing. Because of the increase of urban population and needs in the food industry, the garlic market became more unbalanced. According to statistical data, it is clear that areas of production did not increase in a proper rate, which could satisfy market demands.

During 1962 – 1970, the cultivated area with garlic had an average of 7 500 ha, with a total production which varied between 9 000 and 2 500 tons; this means an average production under 3t/ha.

During the 1971 – 1980 period, the area was approximately 6 200 ha, and the total yield varied between 18 and 28 thousand tons, with an average yield of up to 4t/ha.

The 1981 – 1989 period is remarkable because of a significant increase in area: the areas reached 7-8 thousands hectares, and the total production had the variable amounts between 27 and 47 thousand tons, respectively an average production of approximately 5t/ha or even more.

The period of 1962 – 1990 is well known as the socialist agriculture period, when the state coordinated every resource: materials, money and workers. Many national programs were planned, including agriculture, to optimize the production and to increase the economic efficiency. For garlic crops, some of the measures to improve the situation of low efficiency and unsatisfactory yields were: the expansion of the areas cultivated with garlic, a new zoning for this crop, introduction of a new assortment of garlic seeds, improvement of garlic "seed" production by scientific selection methods, and a new managerial system to stimulate the garlic growers.

The new managerial system offered to pay the workers that grew garlic with a certain fraction from the total planned yield. In fact, usually, the average yield was of 5t/ha, and the payment was to give the worker a fraction of 25-30% from this planned yield. The workers were motivated because, by growing garlic through hard work, the yield could reach up to8-9 t/ha. Workers would sell the garlic either to the agricultural

cooperative or they would find another way of selling it in the black market for a very high price. It could be considered that this managerial plan was the key measure for increasing the total yield at national level (for instance 46 600 tons, in 1989).

After 1990, socialist influence on the land began to disappear; the great majority of agricultural land owners received back their historical properties. As for the workers they started to grow garlic under new economic and social terms: grow as much as they could within their family land and valorizedthe yields through certain acquisition centers or preferred to sell on the free market at very good prices. The high demands of the market for garlic, including supermarkets, were always a good opportunity for Romanian garlic growers to get a good profit.

Under these new conditions, the area and production of garlic crops significantly increased.

Between 1991-2000, the area reached ahistoricalmaximum of 12-14 thousands ha, and production increased from 32 210 tons (in 1991) to 84 542 tons (in 1999), with an average of about 5.5 t/ha.

After 2000, the area was reduced to approximately 10 000 ha, with a total production varying between 50 thousand tons (in 2007) and 82 thousand tons (in 2001).

In 2016, according to the website www.factfish.com, Romania is at 16th place, taking into account the areas cultivated with garlic, on the 23rd place for production (54 389 tons) and on the 71st place, from the point of view of the average production (5326 kg/ha).

The available data demonstrates that the average yield/ha in Romania is high. This fact is demonstrated by some experimental data with an average production of 10-12 t/ha. In this respect, it is important to note that the average production is 18 915 kg/ha, at a global level. China's production was 26 t/ha, Egypt - 23 t/ha, Russia -9 t/ha and Greece -7 t/ha.

As a general conclusion, usage of technology to help grow the garlic crop and doubling the size of the land area would double the production. In another section of this report, it is highlighted that the crop technology is more or less similar with the ecological/organic one with reduced yields, because of the use of non-intensive cultural practices.

4. GARLIC ASSORTMENT

The garlic cultivated in Romania, is the same as the one cultivated all around the world, belongs to the species *Allium sativum* L. (Brewster, 1994). It's originally from the Central Asiatic mountain zone, a related species -

A. longicuspis Rgl. is also cultivated. *A. sativum* is exclusively vegetative propagated-consisting of garlic cloves, but *A. longicuspis* could be propagated by seeds.

Garlic clones exist that are adapted to many ecological areas through their responses of growth and bulbing to temperature and photoperiod, their cold hardiness and duration of bulb dormancy (Takogi, 1990, cited by Brewster, 1994).

Garlic is categorized according to size, weight, color, cover leaf number, the size and number of bulbils on bulb, number and vigourof green leaves, etc. A special characteristic is either the presence or absence of stalk with an inflorescence in the apex; the inflorescence contains, exclusively, small bulbils which could be a mean for vegetative multiplication.

According to UPOV (Union for Protection of Varietal Origin), there are many other distinctivenesscharacteristics which could be more detailed. According to certain commercial characteristics, it is well known that there are two garlic groups and numerous garlic types. For instance, in the USA, certain specialists or garlic growers elaborated such a classification, with two groups: the softneck garlic and hardneck garlic. The softneck garlic group consists of the clones without floral stalk, but the hardneck garlic group belongs to the cloves with floral stalk.

These two groups contain more types, which were registered at Orie′s Garlic (http://wwworiesfarmfresh.om/garlic). Here is a comprehensive list of all varieties cultivated here along with their culinary attributes and suggestions for use.

a) The Softneck Group

- **The Artichoke Type** (cloves form in layers similar in shape to an artichoke) contains the following varieties: California Early, Early Rep Italian, Inchelium Red, K′s Bockyord, Lorz Italian, Lukak, Oregan Blue, Polish white, Red Toch, Susanville and Transilvania.

- **TheSilverskin Type** (can be stored for a long period of time) includes the following cultivars: California Selected, Nootka Rose, Sicilian Silver and Silver White.

b) The Hardneck Group

- **The Creole Type** (with origin in Spain, small size, good flavor) has four cultivars: Ago Rogo, Burgundy, Creole Red and Native Creole.

- **The Porcelain Type** (with satiny white bulb wrappers, large cloves) contains a large number of cultivars: Armenian, Georgian Crystal, Georgian Fire, German White Stiffneck, Iowa German White, Leningrad, Music and Romanian Red.

- **The Standard Purple Stripe Type** (is more or less similar to the Standard Purple, but the bulb wrappers are sometimes glossy) has only two cultivars: Brown Tempestand and Purple Glazer.

- **The Marbled Purple Stripe** (is a subgroup of Standard Purple that tends to have fewer yet larger cloves) contains three cultivars: Khabar, Metechi and Northe.

- **The Elephant Garlic** is considered a mega sized bulb garlic and has a mild flavor.

Usually, in each country, there are certain classifications, more or less technical, or scientifically grounded. In general, the market establishes different groups, types, forms etc. According to commercial criteria, to satisfy consumer expectations, classifications of garlic are: large – small garlic, white – red – streaky garlic, autumn – spring garlic, softneck – hardneck garlic, Romanian – Russian – Turkish – Chinese garlic and so on.

In principle, the assortments remained the same, but each cultivar is nowadays much more spread out, compared with the period before the 50' – 70's. According to the information from technical and scientific literature, it is clear that in the United States of America, a much diversified assortment is cultivated, containing cultivars from all over the world. This situation was perhaps created, in some cases, systematically and orderly but, more often, because of the free market and high free circulation of the people. This circulation has allowed an evident exchange of information and even biological material. The exchange of biological material was done motivated by the agronomic and alimentary values of the cultivars.

These values are determined by the specific genetic characteristics, but in many cases there are highly influenced by the proper ecological conditions of the culture zone. In this assessment, it must be borne in mind that cultivars are clones, so the environment is very important in the cultivar expression, and the so-called ecological plasticity is low. In the same time, applied cultivation technology is of great importance in assessing the garlic bulb quality. In this respect, the following types of technology are known: traditional non–intensive, conventional - more or less intensive, or organic/biological/ ecologic.

When a cultivar from a different region of the world is exported to another region with similar environmental conditions, it is considered as a well adapted cultivar. For example, the cultivars Red Romanian or Transilvania, originating from Romania, are grown in USA. If the environment of a new region does not ensure the original requirements of a cultivar, this cultivar will not be used by the growers of that new region.

The garlic cultivars from Italy, Spain or Turkey that could not be grown in Romania are well known. Perhaps some of the imported cultivars got good environmental conditions and became adopted cultivars, but systematic evidence does not exist or is difficult to be constructed.

The cultivated assortment from Romania, in the last 50 – 60 years is relatively diverse, containing local populations from the traditional zones, but also some cultivars were legally or illegally brought to Romania by different growers.

The legal cultivars assortment or the assortment from the Official List, issued by the Order of the Ministry of Agriculture, is based on the State Institute for Testing and Varieties Introduction recommendation. The introduction of a certain cultivar in the Official List is done after proper tests are carried out, established according to the specific procedures, similar to international ones, based on the recommendations of OECD (The Organization of Economic Cooperation and Development), UPOV (The International Union for the Protection of New Varieties), ISF (International Seed Federation) and ISTA (International Seed Testing Association).

The Official List contains the name of the new cultivar, introduction time and the name of the maintainer. The maintainer has the obligation to proceed to conservative selection and basic seed producing and, also, is the owner of the new cultivar with the property rights, according to the national legislation. The basic seed is multiplied in the specialized commercial farms. If the basic seed is not produced, the cultivar is erased from the List. According to the official legislation, in Romania only the cultivars from the Official List can be multiplied and cultivated. Growers can, under their responsibility, use their own seeds or planting material for their own production.

Based on the existent information from different sources (Official Lists, books, brochures, etc.) an evolution of the garlic assortment in Romania could be available.

During the 50's, Dumitrescu *et al*. (1956) presented and recommended four garlic cultivars: Alb de vară, Roz timpuriu, Roşu and De Cenad.

For the next period, Mihalache and Balaşa (1961) recommended the following cultivars: De Cenad, Roşu de toamnă, De Albania and De Moldova.

Maier (1967) presented three cultivars: De Cenad and Alb de Cenad, De Craiova and Roşu de Moldova.

Torje and Perceali (1967) officially presented only two cultivars, for the period of 1966-1970, for all the administrative regions of Romania: Alb de Cenad and De Moldova, as spring and autumn cultivars. The same authors, in 1967, presented and recommended along the other two, the cultivar De Işalnița.

Balaşa (1973) presented in his textbook „Legumicultura" (Vegetable Growing) four cultivars: De Cenad, De Işalnița, De Moldova and De Rovigo. The last one is an Italian cultivar, which after 3 – 4 years, disappeared from Romania.

Indrea *et al*. (1979) mentioned the following cultivars: De Cenad, De Moldova, Timpuriu, Amarandia 26 and De Işalnița.

After three years, Ceauşescu*et al.* (1982 and 1984) characterized and recommended the following cultivars for Romania: De Cenad, De Işalnița, Amarandia, De Moldova and De Rovigo.

The Official List from 1990 recommended a larger assortment: spring cultivars –Cenad, Dărăşti, Râmnicu Sărat; autumn cultivars – Cioroiu, Moldova and DărăştiIlfov; Rocambale garlic – De Bucovina.

In their textbook, Butnariu *et al*. (1990) presented a complete characterization of the garlic assortment cultivated in Romania. At that time, information on the garlic crops stated *Allium sativum* contains two subspecies: *sagittatum* and *vulgare*.

The subspecies *sagittatum* contains two groups of ecological forms – continental form and South Mediterranean premaritime one.

The continental form of *sagittatum* has its origin in North Hindustan, Afghanistan and Persia. The plants form floral stalks and the inflorescences have adventitious bulbils, get high yields and, from an ecological point of view, this form is an autumn kind and has a good resistance to the drought weather and low temperatures. In Romania this form is represented by De Ciolpani, De Moldova and De Bucovina cultivars.

The premaritime form originates from Turkey and Spain. The plants form floral stalks and the inflorescences contain adventitious bulbils. It has a high yield and an autumn ecological form, but it is susceptible to drought and low temperature. In Romania, it is represented by Turkish and Spanish cultivars.

The subspecies *vulgare* contains, also, two groups of ecological forms: the continental form and Est-Mediterranean premaritime forms.

The continental form of *vulgare* originates from Caucasus and Carpathian mountain regions. The plants do not form floral stalk and their yield is low. It is a spring ecological form with a good resistance to drought and low temperature. The bulbs are small and have a long storage

period. It is represented, in Romania, by the cultivars De Cenad, De Dărăşti, De RâmnicuSărat and De Copălău.

The premaritime *vulgare* form has an East-European origin and does not form floral stalk. It is an autumn ecological form, has a reduced resistance to drought and low temperature and has good storage features. It is well represented by the Amaradia, De Işalnița, De Seitin and De Cenad (autumn form) cultivars.

Stoian (1995) has recommended for the ecological/biological crops the following cultivars: De Dărăşti, De Cenad, De Moldova and De Bucovina.

Dumitrescu *et al.* (1998) presented and recommended a traditional and well known assortment in Romania and registered in the Official List in 1995: De Dărăsti, De Cenad, De Cioroiu, DărăştiIlfov, De Moldova, Favorit, Record, and De Bucovina.

Popescu and Atanasiu (2000) recommended the two known groups of cultivars, the spring and autumn kinds.

A cultivars assortment similar to the one presented by Dumitrescu*et al.* (1998), was also presented in the book of Stan and Munteanu (2001): De Dărăşti and De Cenad – as spring cultivars, and De Cioroiu, DărăştiIlfov and De Moldova – as autumn cultivars.

The last Official List of the varieties cultivated in Romania (in 2018), include only three authorized garlic cultivars: Ager (from 2009), Claudiu (from 2010) and Eduard (from 2010).

In conclusion, over 10 garlic cultivars were used in Romania and is still being used till this day. But, legally not all of the cultivars currently are in the official List.

Most of the cultivars belong to the "local population" categories and do not have the official maintainers and a scientific conservative selection scheme is not done anywhere, also, the basic seeds are not produced. Maintenance and multiplication of the local populations are done by empirical methods, rigorous enough, but not scientific, in whichonly the best produced plants with a good health are selected.

The existence and use of the local populations is typical in the traditional zones. From this point, it is possible to advance by the official registration and a special research program for the conservative selection and basic seed producing.

A detailed characterization of the processed garlic cultivars which were recommended and/or processed in the official list is based on the available information from existent scientific literature. This description is

not followed strictly according to UPOV recommendations, but it is more in accordance with the technological and commercial needs/ exigency.

As an accepted rule, this description is done following the Butnaru *et al*. (1990) recommendations.

a. Cultivars with floral stalks (the commercial hardneck type)

a1. The Asiatic - central continental group – with drought and low temperature resistance:

- **De Ciolpani:** autumn cultivar, early, with medium bulb (25-35 g), having round shape, flattened at base, with white-grey color of external covered leaves; each bulb contains 8-12 bulbils of curved shape, and blunt peak and of rose-yellowish color. It is recommended for the autumn crop, for green garlic (spring-summer period), as well as dried garlic (autumn and late winter period). The taste is pungent, pleasant. The yield potential is about 5-6 t/ha.

- **De Moldova:** it is an autumn cultivar, semi-late, with large bulbs (30-40 g), of a white or white with violet nuance color. Each bulb contains 7-11 bulbs of white-yellowish color. It is cultivated as autumn garlic for green garlic, but, mainly, for dried garlic, with good storage capacity. The taste is pleasant, balanced and pungent. Yield potential is about 6-8 t/ha.

- **De Bucovina:** it is an autumn, late cultivar, with a flattened globulous bulb, of external white-grey color, of large size (40-55 g); a bulb contains an average of 6-10 large well wrapped bulbils, a little bit curved, with a white-yellowish skin color. It is recommended for green or dried garlic, having a good storage quality. The taste is light pungent and the yield potential is very high (10-12 t/ha).

In addition there are also cultivars with uncertain populations that are well appreciated by the growers and consumers. For instance, Red of Moldova might be the same as Red Romania garlic from USA.

a2. The premaritime, South Mediterraneangroup (Turkey, Spain)

This group includes garlic strains from Turkey, Spain and Italy, but could not be recognized as specific cultivars. The group contains autumn cultivars, susceptible to drought and low temperatures, but with a good yield production.

b.Cultivars withoutfloral stalk (commercial softneck cultivars)

b1. **The continental group (Caucasian and Carpathian mountains),** with spring cultivars.

- **De Cenad** is a semi-late cultivar, of large to medium size (25-35 g), asymmetric-globulous, flattened at the base, with a white and silver reflection. Each bulb contains 8-15 bulbils of medium size. It is cultivated as a spring cultivar, but can be cultivated in autumn too. It has a good storage quality, a pleasant persistent taste, with a strong aroma. The yield potential is around 5-7 t/ha.

- **De Dărăşti** is a semi-late, cultivar, with a bulb of a globulous pyramidal shape, with a white-rose external color, having a small size (20-30 g), with small cloves (10-12). It has a good resistance to drought and low temperature and has good storage qualities. The yield potential is about 3-4 t/ha.

- **De RâmnicuSărat** is a semi-late cultivar, with medium size bulbs (circa 25 g) and white-pink color. The cloves are small, 10-12/ bulb and have white-yellowish color. The bulbs are very well wrapped and have a good storage capacity, during the winter, until late spring. The taste is pungent, pleasant and persistent. Yield potential is 4-6 t/ha. It is recommended as a spring cultivar, but could have good results as an autumn cultivar as well.

b2. The premaritime East- Mediterranean group (South East European) contains dedicated autumn cultivars.

-De Işalnița is a semi-late cultivar, with white -grey color bulbs, well wrapped, of big size (30-40 g), and 12-14 white-yellowish bulbils and very hot taste. The yield potential is great (6-8 t/ha) and it is recommended for autumn crop for green garlic and, mainly, for the preserved food industry.

-De Craiova/ De Amaradia is an autumn or spring cultivar, of a medium size (25-35 g) bulb. The bulb is round – elongated, of white color, with thin-elongated 10-12 bulbils; the taste is persistent pungent. The yield potential is medium (4-5 t/ha).

-De Cenadand **De Şeitin** are two autumn local populations, with medium-large bulbs of white color, more or less similar to the spring ecological form of De Cenad cultivar, but with larger bulbs (30-40 g).

-Roşu de Moldova (Red of Moldova) is an autumn, but also a spring cultivar, according to the applied technology. It is well known in Neamt and Iasi counties. The bulb is spherical – flattened and of white-gray color with reddish reflections. The bulbils are small and edged, with rose-violet color. It is resistant to drought and low temperature. Bulb size is big (35-45 g). Yield potential is good (5-6 t/ha).

As a conclusion, assortment is rather diverse, according to the four ecological groups, the autumn and spring forms, with floral stalk or without floral stalk (softneck), of white colors with many nuances and white-rose or white-reddish, with small, medium and large or even very large, varied between 25 mm (15-30 g) and 50 mm (40 - 50 g). According to the applied technology, the dimensions vary.

In Romania, as it will be shown in the next section, a non-intensive traditional cultivation system is used for the garlic crop. It cannot explore at a high level the cultivar's agro productive potential, but it achieves a yield more or less similar to an ecological/organic crop. For each cultivar, yield potential/ha depends on cultivar type (spring or autumn), the bulb

size (weight) and number of bulbils/bulb, in the conditions of an optimal number of plants/ha, using a certain technology.

From the processed data, it is evident that the spring type has smaller bulbs (15 – 40 g) and the autumn type has bigger bulbs (25 – 50 g). Important thing is the fact that in the same cultivar, in the same plot, the bulb in size varies. For instance, for spring cultivar with an annual yield of 7500 t/ha, a medium bulb size is about 25 g, but it can vary from 15 g to 35 g, and over 60-70% of bulbs have a weight under 30 g. An autumn cultivar can have a yield of 10 – 12 t/ha, with average size of bulb of 40g. The bulb weight could be between 25 g and 50 g, and the majority of 60 – 70 % has over 30 g.

For the commercial purpose, a distribution of the garlic yield on the different size grades would be very useful. Recent research is not available on the estimated quantities of these grades. So, a proper estimation is possible only from a theoretical point of view, taking into consideration the limits of size variation and average size of the two garlic variety types (spring and autumn). In the table below, an estimation of quantities of the two garlic types on the different size grades is shown. This estimation is based on field interviews with a number of garlic farmers across various key garlic growing regions in Romania.

Table 1

Distribution of garlic yield on the size grades

Spring variety (*vulgare* ssp.)			**Autumn variety (*sagittatum* ssp.)**		
size (g)	**%**	**quantity (kg)**	**size (g)**	**%**	**quantity (kg)**
> 15	2.5	188	> 25	2.5	300
15-20	7.5	562	25-30	7.5	900
20-25	20	1500	30-35	20	2400
25-30	35	2625	35-40	35	4200
30-35	25	1875	40-45	25	3000
35-40	7.5	563	45-50	7.5	900
<40	2.5	187	<50	2.5	300
TOTAL	**100**	**7500**	**TOTAL**	**100**	**12000**

5. CULTIVATION TECHNOLOGY

The cultivation technology covers the main activities flux, in a certain succession, in general, in chronological order, which assures the achievement of an optimal yield, by adjusting environmental conditions, according to the plants' needs.

The garlic cultivation technologies are relatively diverse, according to the intensification level, respectively to the use or non-use of energy and materials inputs. The main intensive factors are: proper cultivars, irrigation, mechanization and fertilization.

According to technological factors, cultivation systems are divided into two categories – conventional ones (intensive or non-intensive) and non-conventional ones (ecological/ organic/biological).

In Romania, the majority of garlic crops are grown, by the non-intensive method, but the crops are not officially certified as ecological, according to the National and International recommendations and, in this situation, the yield cannot be valorized on the market as an ecological product.

Moreover, the main technological elements of the garlic crops, will be synthetically presented, in the specific conditions from Romania.

-Land selection. This stage is considered to be the most important one for garlic crops, including the following steps: selection of bulbs, preparation of planting material, moment or time of planting, planting design, planting depth etc.

By land selection, the growers strictly respect a proper crop rotation of 4-5 years, to prevent specific diseases and pests attack/damage. The plants for bulbs, tubers, roots and for pulses (beans and peas) must be avoided.

-Land preparation. This technological stage is a common one for vegetable crops. If the garlic crops will be established in autumn season, then land preparation must be finished before the 10-15th of October, when cloves planting has to start. If the planting season will be planned for spring, land preparation could be later.

Between other operations, land preparation includes an organic fertilization using about 30-50 t/ha of farm manure or, better, mature compost; chemical fertilizers are usually not used.

Crop establishment. Garlic crop can be recommended to be established on all the agrarian lands of the country, but the commercial crops are carriedout in the so-called traditional zones, as soon as it was processed in a dedicated section of them. It is important to know that these

traditional zones are defined by specific pedo-climatic conditions which confer a finger-print on the bulb quality.

Material selection consists of a cultivar chosen specifically for a certain traditional zone; good quality bulbs selection means that the bulbs for planting must be specific to the selected cultivar, to have a medium of large size, to be well wrapped, free of diseases or pests and good root system, strongly fixed on the bulb.

Selected bulbs are detached in bulbils/cloves. The most recommended bulbils for the plantings must not be from the center of the bulbs. Detaching the bulbs is made a few days before planting.

There are two planting seasons, autumn or spring, according to ecological cultivar groups. The autumn planting is done between the 15th of October and the 15th of November, until the beginning of winter, the bulbils start in vegetation, but do not arise.

The spring planting is done early in the spring, when there are good environmental conditions for planting, but not laterthan the 15-th-20-th of April.

Lately, based on the growers' experience, in certain traditional zones, they plant spring garlic in the ground in autumn. The main constraints of the spring garlic are the low resistance to the cold temperatures, during winter time.

As for the green garlic, the crop is planted during autumn time in the open field or in plastic houses.

The establishment design of the crops is executed in parallel rows, with a distance of 20 – 25 cm between them, and 10 – 12 cm between plants on row; crop density varies between 400 – 450 thousand plants/ha.

Planting in the ground is done manually with the small drains/drills mechanically opening on the planned row. The drill depth is about 6 – 10 cm, and bulbils are fixed on the bottom of the drill. After that, the bulbils are covered with soil or the drills are closed. The work is finished with a light fixture.

Caring practices. The main goal of these practices is to permanently adjust the environmental conditions to the plant requirements to optimize these relations and, finally, to get a maximum yield.

The first step in caring practices is a light hoeing done with a rake, when the plants have a height of 5 – 6 cm. This operation is repeated 2 – 3 times, after 7 – 10 days. The aim of this step is to destroy the small and young weeds and the soil crust. Also, the soil becomes more aerate and warmer; so, in this way the young garlic plants grow much better.

After these light hoeings, the other 3 – 4 manual hoeings are done between and on the rows of the plants. The hoeings could be done in parallel with mechanical hoeing, if proper equipment exists. The hoeing is considered the key operation for a sure success of the garlic crops.

The weeding is another work that is done at any time when it is necessary. The weeding is always needed because of the farm manure used, with a great weed seeds reserves.

An important work in assuring a good success of the crop is irrigation, mainly, in the drought periods.

As a rule, the growers do not use chemical fertilizers, because of the great quantity of organic fertilizers, but some of the farmers applied 1 – 2 chemical fertilizations, based on complex fertilizers (NPK) or ammonium nitrate.

The final step in the field is harvesting, which will be usually done during June – July.

By a critical assessment of the technology above, it is easy to observe that only ploughing, form manure transport, drill opening and yield transport are done by using mechanical means, but most of the operations are manually done. In this situation much more works could be mechanically done, with a substantially decrease of cost. Some of these works are the following: planting of the bulbils, harrowing of the young crops for weeding, followed by the mechanical hoeing (using different cultivators), phytosanitary treatments against weeds, pests and diseases.

Harvesting. The last step of the cultivation technology-harvesting is a very important step because it includes transferring the crop from the field, to a vegetable product which can be sold to consumers.

The goods for the consumers, ensures a real possibility to evaluate the investment done during one year, by its quantity and quality. For this reason, a special attention must be paid to the harvesting process, because special risks can arise, usually determined by the unfavorable environment conditions (for instance, long duration rains).

The main steps of the garlic harvesting are the following: optimum moment for harvesting, harvesting technique, yield conditioning for temporary storage to complete post-harvest maturation of the bulbs. The garlic growers are familiar with these steps and always accomplish them at optimum level.

Harvesting time starts when the leaves become yellow and dry at the lower half and the false stem breakdown. In this vegetation stage, the bulbs have maximum size and are well wrapped by the external leaves.

Eventually, the quality of the bulbs could be tested by making a correlation between the above ground and underground parts of the plants. If harvesting is done too early, it determines a difficult post-harvest maturation and temporary storage will take place, but a later harvesting will determine the detachment of the bulbs and increase the pests' incidents.

Usually, the autumn garlic cultivars are harvested in the first half of June, but in the spring they are harvested one month later, in the first half of July.

Harvest techniques are quite simple and consist of digging the soil together with the bulb and detaching or lifting the plants (leaves, stalks and bulb) from the soil. The entire plants are put on the soil in rows or in small bunch for 1 – 2 weeks to air and dry. It is recommended that bulbs of the plant should not be in direct contact with the sun rays, because of forced dehydration and scalds/burns.

After that, the plants are bound in 20 – 30 sheaves and then transported under very well aerated shelters for final maturation of the bulbs. The bulbs are stored in well ventilated storehouses as sheaves (with dried leaves and stalks) or as so-called garlic lines of 10 – 12 bulbs or garlic garlands.

The preparations of garlic for the market are done a few days or weeks before commercialization. The preparation consists of a careful selection of the bulbs according to their size, general aspect and health. The best bulbs are prepared in lines or garlands by three strands plaiting and the other ones are prepared to be sold in bulk. The roots of bulbs are cut at the bulb base level and the leaves and stalk are shortened at 2 – 3 cm. The bulbs for bulk selling are packaged in 6 – 10 kg boxes or net sacks.

6. MARKETING AND SELLING PROBLEMS

In the economic and political circumstances after 1990, and the free market principles promotion. The Romanian garlic market imported products, mainly in the situation when the imported prices were under the prices of Romanian producers. The hypermarkets are interested to sell more and more at low prices, according to consumers' needs.

In such new conditions, a majority of garlic sold on the Romanian market are imported ones.

During 2011-16, a majority of imported garlic are from Holland, Hungary and Czech Republic. An interesting fact is that Holland does not

produce garlic, they import Garlic from China then they export it to Romania.

During the same period, Romania exported different garlic quantities, varying between 704.5 tones, in 2009, and 80.4 tones, in 2016, or 37.7 tones, in 2017. The fluctuations are very high and depend, mainly, on the conditions in overseas market.

Because of international garlic market circumstances, a high influx of Chinese garlic is evident. For this reason, some protective measures for the domestic garlic production in Romania have been undertaken by levying national and European taxes, as well as by educating consumers about the differences between the quality of Romanian and Chinese garlic.

In Romania, small garlic producers do not seem to be affected by the garlic import, because of the traditional quality of the Romanian garlic (Cioroiu, Cenad, Moldova, Copălău garlic and so on).

Currently, in Romania, two commercial methods are used for the garlic production. One is done by the commercial societies specialized as acquisition centers to achieve the large quantities for the supermarkets or even export. Another one is done by the producers, by selling their own produce from home or on the local open markets. A lot of farmers prefer selling their own goods which is considered more profitable, including varying prices, according to market demand and offer.

The best profit is achieved by selling the garlic lines or garlands. Garlic in bulk is, usually, sold on two dimension qualities, according to the EU rules for large garlic (40 – 50 mm) and small garlic (30 – 40 mm). The product of these qualities there are in supermarkets, according to the European standards, including the Romanian ones (see the Rule CE No. 2288/97 of the European Commission from November 18/1997, for the garlic commercial standards). According to this rule, garlic must meet the quality requirements for three categories: Extra, I quality and II quality. For Extra category, minimum diameter is 45 mm, but for categories I and II, the minimum diameter is 30 mm.

Some locally produced garlic that does not qualify to be commercialized in the hypermarkets would be because the sizes of these are not in accordance with the EU rules. Usually this garlic is sold in the local markets, with a good price.

In the biggest hypermarkets, the Romanian garlic is sold in bulk (in boxes or sacks), as Extra or First categories, nearby, on the same shelf alongside garlic of the same standard categories – Extra & First - from China and Spain, which are packaged attractively. It is unclear what the

price difference between Romanian is and Chinese garlic since it varies based on negotiations.

Most of Romanian garlic is categorized either in the in Second or First quality and rarely in the Extra quality category. In the same time, the Chinese garlic mainly is of Extra and First Quality category. In this situation in clear that local grown garlic (of small size) are significantly cheaper as compared to the big size of Chinese garlic.

A special problem is generated because of the smuggled garlic from China. There are some non-official information that would explain the high price of garlic reported in official Romanian documents is on account of costly (big size) Chinese garlic that is illegally smuggled into the country.

It is all known that China is the greatest garlic producer in the world (80% of the world′s output), according to FAO. Garlic in Europa is mainly produced in Spain, but also in France, Italy, Hungary, Romania and Bulgaria. Chinese garlic is often misdeclared as imports originating in countries, in which the EU has preferential arrangements in place, where normal customs duty do not apply.

In order to protect domestic producers, the EU introduced an import duty of 9.6 percent together with an excise duty of EUR 1,200 per ton on imported garlic in 2001. The excise duty is applied when the import quota of 59,000 Tons is exceeded. China is permitted to export 34,000 tons to the EU. This was considered a good measure for the European garlic producers, including the Romanian garlic ones.

Due to a 9.6 percent duty on imported garlic, dishonest exporters sneak tons of cheap Chinese garlic into EU. The garlic is smuggled in by ship through Norway, a non – EU country, where it is transported to EU .

Many examples of the smuggling garlic are shown on the media (journals, newspapers etc.). For some of them smuggled garlic is comparable with smuggled drugs

The illicit trade of garlic simply manifests the human greed. Sometimes, garlic produced in China is smuggled to Romania or Hungaria, and then re-smuggled to the French market. There it is further transformed into French garlic, introduced in the processed food sector. Then in the composition of French dishes it is labeled: certified or sold and consumed, in France or abroad (Montet and Ray, 2017).

By scientific and technological cooperation, special traceability program would detect the origin of raw materials and so it could stop or discourage smuggling. Many national or international authorities are involved in preventing garlic smuggling, for the benefit of the national garlic producers and consumers as well.

Anyway, garlic crops and garlic produces are and will be an interesting and fascinating subject.

CONCLUSIONS

Garlic crop in Romania is know from the pre-Roman period, but had a slow development mainly in the family garden.

Commercial crops were developed in the last century, when the urban population ant food industry increased in a high rate.

A specific development of garlic production occurred mainly in so called traditional zones, but the area and yield were and are under the natural potential: about 10.000ha and 50-60 thousands tons.

Assortments in rather diverse and consists in well adapted cultivars to the environmental conditions of traditional zones, including the softneck and hardneck cultivars or the spring and autumn cultivars.

Cultivation technology is not intensive one, but more or less similar to organic system, but the crops are not certified as organic.

The main characteristic off the marketing and selling is a high competitions between garlic from Romania and abroad; the smuggling phenomenon is also present.

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RESEARCH ON SENSORIAL AND PHYSICAL-CHEMICAL FEATURES OF SOME CORN OIL ASSORTMENTS SOLD ON IAŞI CITY MARKET

CERCETĂRI PRIVIND CARACTERISTICILE SENZORIALE ŞI FIZICO-CHIMICE ALE UNOR SORTIMENTE DE ULEI DE PORUMB COMERCIALIZATE PE PIAŢA MUNICIPIULUI IAŞI

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Abstract. *Corn oil is a food consumed by Romanian peoples, because have a varied range of utilisations, and consumed in moderate quantities is beneficial to human organism. The current paper aimed to establish the main quality characteristics of corn oils sold on Iaşi City market and their comparison in according with the values of actual standards. Corn oil samples gathered from three different producers (A, C, F) were achieved from Iaşi City market. The determined physical-chemical properties for the analysed assortments of corn oil were: humidity, density, acidity value, iodine value, saponification value, and peroxide value.*
Key words: corn oil, assortments, quality features

Rezumat. *Uleiul de porumb este un aliment consumat de români, deoarece prezintă o gamă variată de metode de utilizare, şi consumat în cantităţi moderate este benefic organismului. Această lucrare are ca scop evidenţierea principalelor caracteristici de calitate a uleiurilor de porumb de pe piaţa municipiului Iaşi şi compararea rezultatelor cu valorile STAS în vigoare. Probele de ulei de porumb de la trei producători diferiţi (A, C, F) au fost achiziţionate de pe piaţa municipiului Iaşi. Proprietăţile fizico-chimice ale sortimentelor de ulei analizate au fost reprezentate de următoarele determinării: umiditate, densitatea relativă, indicele de aciditate, indicele de iod, indicele de saponificare, şi indicele de peroxid.*
Cuvinte cheie: ulei, sortimente, caracteristici de calitate

INTRODUCTION

Edible oils are part of our daily diet, which provide energy, essential fatty acids and serve as a carrier of fat soluble vitamins (Dorobanţu and Beceanu, 2008; Latif and Anwar, 2009; Zahir *et al.*, 2017). Corn oil, obtained from seeds of *Zea mays*, is an important component usually used as food and pharmaceutical formulations such as in suspensions and emulsions (Alvarez and Rodriguez, 2000).

Different sensorial, physical and chemical features of edible oil are used to describe and monitor the compositional quality of oils (Ceriani *et al.*, 2008; Mousavi *et al.*, 2012; Zahir *et al.*, 2017; Nistor and Hoha, 2017). This physicochemical

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parameter includes iodine value (IV), saponification value (SV), viscosity, density and peroxide value (PV). Edible oils are one of the main constituents of the diet used for cooking purposes (Nistor and Hoha, 2013).

The advantages of using corn oil in human nutrition are justified by its high content in poly and monounsaturated fatty acids, thus helping to reduce the risk of developing a cardiovascular system, as well as regulating insulin levels (Nistor and Hoha, 2017).

MATERIAL AND METHOD

To complete the current study were achieved 15 bottles with corn oils from different batches, 5 for each studied assortment, and were bought from different stores localised in Iaşi City. Samples provided from three different producers were gathered in original package and transferred to the analysis laboratory.

Sensory evaluation of corn oil samples was conducted by a team of eleven assessors. Respecting a modern working method (Banu *et al.*, 2002; 2007) each of the board members received three coded samples, corresponding for each type of corn oil. Sensory appreciation of the samples was performed using the analytical method of assessing the quality by scoring, using a 5-point system scale for corn oil.

The criteria used for sensory evaluation were overall appearance and colour, taste, and smell. The obtained results are interpreted based on the scoring scale for quality evaluation (Banu *et al.*, 2002; 2007).

Determination of humidity, iodine value and density by pycnometer method was realised in according with standard *STAS 145-67,* which establish the determination methods for humidity, iodine value and density of vegetal oils and fats.

Acidity value represents the quantity, in mg, of potassium hydroxide necessary for neutralization of free fatty acids from one gram of fat material. Method is based on neutralization of free acidity of a certain fat quantity with an alcoholic solution of potassium hydroxide with a well-know titre and factor, in the presence of phenolphthalein.

For determination of saponification value, a known quantity of fat (oil) is subjected to saponification, by boiling with an in excess quantity of potassium hydroxide 0.5 n (alcoholic solution). At the end of saponification it is determined, by titration with an acid, the quantity of potassium hydroxide which didn't react (in excess); through difference is established the quantity of potassium hydroxide which was utilised at fat neutralization and saponification (Gunstone, 2004; Hamm and Hamilton, 2000).

Determination of peroxide value was realised in according with standard *STAS 145-67.* Product is titre in an acetic acid and chloroform environment, with solution of potassium iodide.

RESULTS AND DISCUSSIONS

At the end of sensorial analysis of the three studied oils assortments (fig. 1) and after processing the obtained data, and calculation of the weighed mean score for all the tracked sensorial features, were obtained a total mean score (fig. 2), which show the fact that rank one is occupied by oil F which remarked by: clear

aspect, light yellow colour, characteristic flavour of roasted corn seeds, pleasant taste, characteristic to raw material.

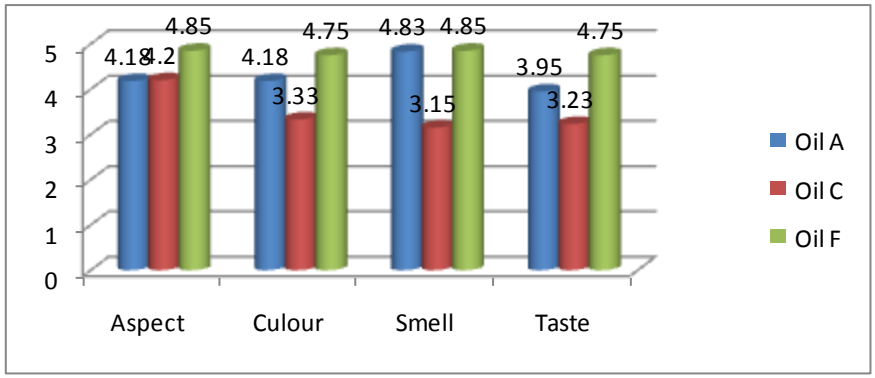

Fig. 1 Graphical representation of the average scores obtained by the analyzed corn oils

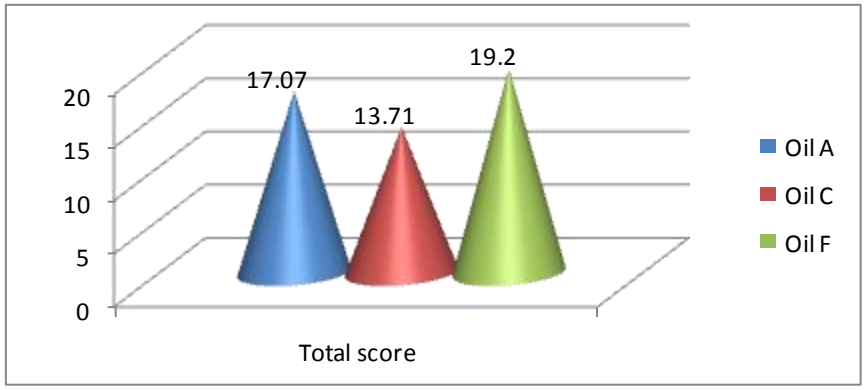

Fig. 2 Graphical representation of the total average scores obtained by the analyzed corn oils

In according with the total mean score of 19.02 points oil F receive the mark ***Very Good***. Rank second in tasters' preferences was oil A with a total mean score of 17.07, assortment characterised by: clear aspect, light-yellow colour; pleasant smell characteristic to roasted seeds; pleasant taste, without strange taste. In according with the score board oil A receive mark ***Good***. Ranked last was oil C with a total mean score of 13.71 points because some sensorial attributes didn't fulfil the tasters' desired conditions. In according with the score this assortment receive mark ***Satisfactory***.

Humidity is a physical-chemical parameter which shows the water content in oil. The analyzes performed on corn oil reported a 0.1203% humidity difference between the C and F assortments, while in the case of oil A we discovered an exceedance of almost 3 times the maximum allowed value. The results are presented in table 1.

Table 1

The results of moisture present in the corn oils (%)

No.	Product			Standard value
	Oil A	*Oil C*	*Oil F*	
1	0.4194	0.2023	0.1141	<0.15%
2	0.4465	0.2156	0.0931	
3	0.4449	0.2581	0.0954	
4	0.4158	0.2248	0.1425	
5	0.4648	0.2088	0.1057	
Average	**0.4373**	**0.2219**	**0.1016**	

Density represents the rate between the mass of a volume of analysed substance and the mass of the same volume of water, at the same temperature. Data obtained are presented in table 2.

Table 2

The results of relative density of corn oils (g/cm^3)

No.	Product			Standard value
	Oil A	*Oil C*	*Oil F*	
1	0.936	0.926	0.920	0.917-0.925 g/cm^3
2	0.938	0.927	0.922	
3	0.936	0.925	0.919	
4	0.937	0.926	0.918	
5	0.936	0.928	0.922	
Average	**0.936**	**0.926**	**0.920**	

From the determinations carried out, there was an exceedance of the standard value in the case of corn oil A. This fact can be correlated with the value of the moisture content obtained in the previous analysis. Also in the case of the C oil assortment, an exceedance of the standard value was also observed.

Acidity value is a physical-chemical parameter which allows us to appreciate the preservation degree of the oils (tab. 3).

Table 3

Acidity value of corn oils (mg KOH/g)

No.	Product			Standard value
	Oil A	*Oil C*	*Oil F*	
1	0.636	0.423	0.120	≤0.2 mg KOH/g
2	0.638	0.421	0.122	
3	0.636	0.423	0.119	
4	0.637	0.423	0.118	
5	0.636	0.424	0.122	
Average	**0.636**	**0.423**	**0.120**	

The differences obtained from the determinations cannot be neglected, indicating a high acidity of the corn oil assortment A 5.3 times higher than the assortment F. Also in the case of corn oil assortment C, the obtained values were double than the maximum levels. The high values of corn oil acidity generally reflect its lower stability and higher susceptibility to rancidity.

Determination of saponification value offers information regarding mean molecular mass of fatty acids from a certain fat. None of the assortments evaluated were within standards. By comparing the three assortments, the corn oil F registered an average value relatively close to the one mentioned by standard. The oil assortment C registered the lowest value of the saponification index of the three analyzed assortments (tab. 4).

Table 4

Saponification value, (mg KOH/1 g oil)

No.	Product			Standard value
	Oil A	*Oil C*	*Oil F*	
1	167	159	180	184-196 mg KOH/1 g
2	173	152	177	
3	170	153	179	
4	171	161	181	
5	169	157	180	
Average	**170**	**156.4**	**179.4**	

The iodine index is a very important analytical constant, being used for the characterization of natural lipids (tab. 5).

Table 5

Iodine values of corn oil samples, (g I_2/100 g)

No.	Product			Standard value
	Oil A	*Oil C*	*Oil F*	
1	127	83	98	103-128 g I_2/100 g
2	123	87	97	
3	120	83	99	
4	121	81	91	
5	119	81	90	
Average	**122**	**83**	**95**	

Analyzes carried out generally revealed small values of the iodine index, which may indicate a possible adulteration of the oil with other oils of vegetable origin. The exception is the corn oil A assortment.

Along with the acidity index, the peroxide index provides very important information on the age and stability of corn oil. Analyzes carried out generally revealed that the results obtained in the case of corn oil samples from assortments A and F fall into the standard limit (tab. 6).

Table 6

Peroxide value of the analyzed corn oils, (10 meq/100 g product)

No.	Product			Standard value
	Oil A	*Oil C*	*Oil F*	
1	9	11	6	≤ 10 meq/100 g product
2	10	17	6	
3	9	13	6	
4	9	8	8	
5	10	8	5	
Average	**9.4**	**11.4**	**7.4**	

As a result of this analysis, it is found that there is some depreciation of the oil samples taken in the analysis, especially in the case of the corn oil assortment C, the results indicating the oxidation of the constituent fatty acids.

CONCLUSIONS

1. The determinations of the main quality indicators for the three assortments of corn oil led, in large part, to inadequate results, in comparison to quality standards.
2.The results obtained from the analyzes carried out thus offer two possibilities to explain the results obtained thus: the oxidation reactions started either before the opening of the bottle, which shows an incorrect handling of the packages, or the oxidation reactions had a rapid unfolding, this last aspect bringing a question mark on product quality.
3. Taking into account the aspects presented above, we recommend to the producers a greater attention on the way of preserving the oil.

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CONTRIBUTIONS TO THE KNOWLEDGE OF THE QUALITY OF SOME OLIVE OIL ASSORTMENTS SOLD ON IAŞI CITY MARKET

CONTRIBUȚII LA CUNOAŞTEREA CALITĂȚII UNOR SORTIMENTE DE ULEI DE MĂSLINE COMERCIALIZAT PE PIAȚA MUNICIPIULUI IAŞI

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Abstract. *Olive oil is a food rarely consumed by Romanian peoples, even it if has a varied range of utilisations, and consumed in moderate quantities is beneficial to human organism. The aim of the current paper to establish the main quality characteristics of some olive oil assortments sold on Iaşi City market and their comparison in according with the values of actual standards. Olive oil samples gathered from two different producers (A and B) were achieved from Iaşi City market. The determined physical-chemical properties were: humidity, density, acidity value, saponification value, iodine value, and peroxide value.*
Key words: extra virgin olive oil, pomace olive oil, assortments, quality

Rezumat. *Uleiul de măsline este un aliment rar consumat de români, chiar dacă prezintă o gamă variată de metode de utilizare, şi consumat în cantități moderate este benefic organismului. Scopul prezentei lucrări este de a evidenția principale caracteristici de calitate ale unor sortimente de ulei de măsline comercializate pe piața municipiului Iaşi şi compararea rezultatelor cu valorile standardelor în vigoare. Probele de ulei de măsline de la doi producători diferiți (A şi B) au fost achiziționate de pe piața municipiului Iaşi. Proprietățile fizico-chimice analizate au fost reprezentate de următoarele determinări: umiditate, densitatea relativă, indicele de aciditate, indicele de saponificare, indicele de iod şi indicele de peroxid.*
Cuvinte cheie: ulei de măsline extra virgin, ulei din turte de măsline, sortimente, caracteristici de calitate

INTRODUCTION

Olive oil is used for culinary purposes as filler for canned fish (tuna) and not least, in the cosmetic industry. A better understanding of the benefits of this product, once referred by Homer "liquid gold", is gradually increasing sales across the globe.

The benefits of using olive oil in human nutrition are justified by its high content in monounsaturated fatty acids, thus helping to reduce the risk of cardiovascular disease (HTA, thrombosis) and regulating insulin levels, by

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improving its sensitivity. Also, the antioxidants in its content perform the neutralization of cellular oxidation (Banu *et al.,* 2007, 2013; Nistor and Hoha, 2017).

UC Davis (University of California, Davis) conducted in 2010 a study on the quality of extra virgin olive oil marketed on the California market, using the I.O.C. standards as a scientific benchmark.

Analyzes performed on the 56 oil samples, belonging to a number of fourteen brands imported into the U.S, they highlighted the non-compliance of a percentage of 73% of them (Frakel *et al.,* 2011).

There are many olive oil standards that have been approved and published by various associations and countries defining grades of olive oils and specifying chemical composition and quality parameters (Amirante *et al.*, 2002; Azizian *et al.,* 2015).

MATERIAL AND METHOD

The aim of this paper was to highlight the features related to the quality of olive oil, a controversial product, but which is the subject of an intensive distribution system, including in Iasi County.

To complete the current study were achieved 20 bottles with olive oil (10 extra virgin olive oil and 10 pomace olive oil) from different batches, 5 for each studied assortment, bought from different stores localised in Iaşi City. Samples provided from two different producers were gathered in original package and transferred to the analysis laboratory.

Sensory evaluation of olive oil samples was conducted by a team of twelve assessors. The criteria used for sensory evaluation were overall appearance and colour, taste, and smell. Respecting the method proposed by Banu et al. (2007) each of the board members received four coded samples, corresponding for each type of olive oil. Sensory appreciation of the samples was performed using the analytical method of assessing the quality by scoring, using a 5-point system scale for olive oil, and the obtained results were interpreted based on the scoring scale for quality evaluation (Banu *et al.*, 2007).

Determination of humidity, iodine value and density by pycnometer method was realised in according with *CODEX STAN 33-1981,* which establish the determination methods for humidity, iodine value and density for olive oil and pomace olive oil.

The method is based on neutralizing the free acidity of a known quantity of oil with an alcoholic solution of KOH (potassium hydroxide) 0.1 N, in the presence of phenolphthalein.

For determination of saponification value, a certain amount of oil is subjected to saponification by boiling with an excess amount of potassium hydroxide (KOH 0.5 N). Subsequently, by acid titration, the amount of KOH left un-reacted is determined.

Determination of iodine index. The oil is treated with iodine (excess), leaving it in contact with it for a certain amount of time, after which the titration is carried out to determine the amount of iodine remaining uncombined. The difference between the amount of iodine introduced into the work and the unmixed one is made and the amount of iodine on which the fat is fixed is determined.

Determination of peroxide value was realised in according with standard *STAS 145-67.* Product is titre in an acetic acid and chloroform environment, with solution of potassium iodide

RESULTS AND DISCUSSIONS

Regarding the extra virgin oil A assortment, in case of appearance, it was clear, free of impurities. The color, presented the characteristics of an oil rich in chlorophyll, being dark green. The smell was the most appreciated characteristic of this oil. The olfactory sensation created was described as fruity or rich, without the presence of foreign odors. The taste has been characterized as slightly pasty. Establishing a global score of 17.083 points ranks the extra virgin olive oil A in first quality class (fig. 1 and 2).

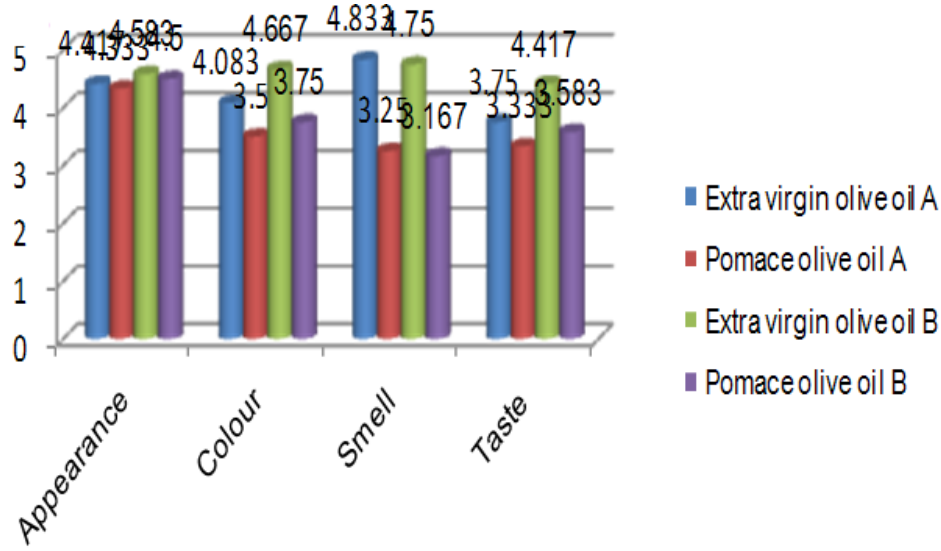

Fig. 1 Graphical representation of the average scores obtained by the analyzed olive oils

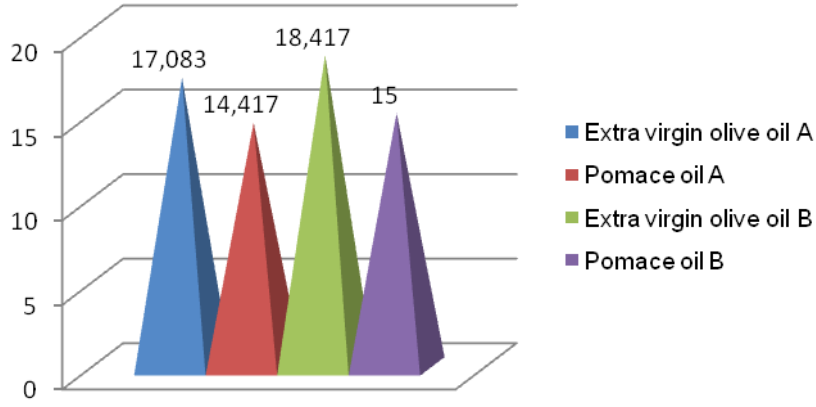

Fig. 2 Graphical representation of the total average scores obtained by the analyzed olive oils

Concerning the extra virgin oil B assortment, the appearance met the requirements of a conforming product, the oil being clear, without impurities. The color, presented the characteristics of an oil rich in chlorophyll, green to dark green. The smell was characterized as very fruity. Taste has been characterized as slightly bitter, pronounced by fruit, characteristic and free of foreign tastes. The results obtained when establishing the global score (18.417 points) receive the mark "***Very good***" and was classified in the "superior" quality class.

Regarding the assortment of pomace olive oil A, the appearance was according to the specific requirements, free of impurities and clear. The color was characterized by the participants as having a very low opalescence. The smell was characterized as being noticeable, almost non-existent, with no foreign odor. Taste, has been identified as oil, without creating taste sensations foreign to the specific one. The results obtained when establishing the global score (14.417 points) receive the mark "***Satisfactory***" and its classification in the second class of quality.

Regarding the assortment of pomace olive oil B, the appearance, met the requirements, being a conforming product, clear and free of impurities, the yellow-green hue, was characterized as having medium opalescence, characteristic of the refined oil. The smell was characterized as lacking intensity, no foreign smell. Taste was characterized by the participants as perceptible environment. The results obtained when establishing the global (15.00 points) receive the mark "***Satisfactory***" and its classification in the second class of quality.

Analyzes carried out on extra virgin olive oil reported a difference of humidity of 0.105% between brand A and B. The results are presented in table 1. In the case of pomace olive oil assortments taken in study a difference of humidity of 0.018% was reported, this not being significant. Both brands have resulted in being in compliance with specific quality standards.

Table 1

The results of moisture content present in the olive oils

Product	Average	Standard value
Extra virgin olive oil A	**0.208%**	<0.2%
Extra virgin olive oil B	**0.103%**	
Pomace olive oil A	**0.074%**	<0.15%
Pomace olive oil B	**0.092%**	

From the analyzes carried out, there was an overcome of the standard value proposed by the European Union legislation in the case of extra virgin olive oil A. This fact can be correlated with the humidity value obtained in the previous analysis. In the case of brand B, the value of the relative density was within the range required by the European Union legislation.

In the case of pomace olive oil, the resulting values revealed negligible differences in the case of oil A, while in the case of oil B we determined a value that falls within the limits imposed by EU regulations (tab. 2).

Table 2

The results of relative density of olive oils

Product	Average	Standard value
Extra virgin olive oil A	**0.9205 g/cm^3**	0.910-0.916 g/cm^3
Extra virgin olive oil B	**0.9145 g/cm^3**	
Pomace olive oil A	**0.909 g/cm^3**	
Pomace olive oil B	**0.912 g/cm^3**	

The acidity of the olive oil is the most important characteristic of its quality, its values being used in establishing the quality classes under which the product is marketed.

The results of analyzes carried out (tab. 3) showed possible non-conformities of the extra virgin olive oil of the brand A, the value resulting being twice higher than the limit presented in the standard.

Table 3

Acidity value of olive oils

Product	Average	Standard value
Extra virgin olive oil A	**1.7% oleic acid**	<0.8% oleic acid
Extra virgin olive oil B	**0.57% oleic acid**	
Pomace olive oil A	**1.17% oleic acid**	<1.00% oleic acid
Pomace olive oil B	**0.63% oleic acid**	

The differences recorded cannot be neglected, indicating an acidity of extra virgin olive oil A, with 1.13% higher than its competitor, B and 0.9% higher than that described in the literature and European Union legislation. The high values of the acidity of the oil, in general, reflect its stability and susceptibility to rancidity.

Regarding the pomace olive oil, the obtained values showed a similarity with those of extra virgin olive oil.

The saponification index provides information on the nature of the fatty acids that enter the composition of the oil, its value being inversely proportional to the length of the constituent fatty acid chain (Frega *et al.,* 1993).

Analyzes carried out revealed negative aspects of all the samples taken. Thus, none of the assortments evaluated were within the specific standards. By comparing the two manufacturing brands, the samples from A assortment have an average value relatively close to the requirements of EU legislation, while the samples from B assortment recorded a difference of 64.75 from its competitor and 86.25 from the minimum value allowed by standard (tab. 4).

Table 4

Saponification value

Product	Average	Standard value
Extra virgin olive oil A	**162.5 mg KOH/1 g**	184-196 mg KOH/1 g
Extra virgin olive oil B	**97.75 mg KOH/1 g**	
Pomace olive oil A	**162.8 mg KOH/1 g**	182-193 mg KOH/1 g
Pomace olive oil B	**96.12 mg KOH/1 g**	

Similar to the values resulting from the analysis performed on extra virgin olive oil, samples from pomace olive A recorded values close to the reference standard. The major differences appear in the case of pomace olive oil B, where the value of the saponification index is 85.88 lower than the minimum expressed by EU legislation. Such values often indicate the presence of non-conformities during storage or an extension of its duration.

The iodine index is an analytical constant of great importance, which is used for the characterization of natural lipids. Analyzes carried out generally revealed small values of the iodine index. The exception is extra virgin olive oil A, with values of the iodine index close to those specified by the standards. The low values of the samples taken can indicate an adulteration with other oils of vegetable origin (tab. 5).

Table 5

Iodine values of olive oil samples

Product	Average	Standard value
Extra virgin olive oil A	**96.55 meq/100**	75-95 meq/100
Extra virgin olive oil B	**50.39 meq/100**	
Pomace olive oil A	**70.73 meq/100**	
Pomace olive oil B	**51.65 meq/100**	

Comparing the extra virgin olive oils analyzed, there was a difference of 46.16 meq/100 g between assortments and in the case of the pomace olive oils, a difference of 19.08 meq/100 g between the two assortments was obtained.

The peroxide index provides essential information on the age and stability of olive oil. Analyzes revealed nonconformities for three assortments of the four analyzed, the extra virgin olive oil A falling within the specific standards. The peroxide index provides information regarding the degree of oxidation of the fats in the composition of the analyzed product. Considering this fact, it is deduced that most of the samples showed signs of oxidation, the differences between the obtained values and the standardized ones exceeding 2 meq/100 g of product.

Comparing the results obtained after carrying out analyzes for extra virgin olive oil, there is a difference of 3.66 meq/100 g between the assortments, presented in table 6.

Table 6

Peroxide value of analyzed olive oils

Product	Average	Standard value
Extra virgin olive oil A	**1.03 meq/100 g**	≤2 meq/100 g
Extra virgin olive oil B	**4.69 meq/100 g**	
Pomace olive oil A	**4.38 meq/100 g**	≤1.5 meq/100 g
Pomace olive oil B	**3.67 meq/100 g**	

In the case of pomace olive oil, the problem of the refining process arises, which is responsible for eliminating the oxidation products. This makes the analysis of their peroxidic index irrelevant. However, the percentage of virgin olive oil added for the purpose of obtaining marketable pomace olive oil must be taken into account. In this regard, the legislation of the European Union, together with the standards of the International Olive Council and the Codex Alimentarius, establish a limit of 1.5 meq/100 g of product.

As a result of this analysis, it was found, that there are some depreciations of the oil samples taken, the results indicating the oxidation of the constituent fatty acids.

CONCLUSIONS

1. The analysis carried out for the purpose of determining the acidity index revealed the possibility of problems encountered by the brand A regarding the storage mode, these values exceeding the limit allowed by the legislation and the specific standards.

2. The analysis performed for the purpose of determining the peroxide index presented values that exceed the maximum limits allowed by standards and specific laws for three of the four analyzed assortments. Thus, the oil sold by brand B showed signs of oxidation in both analyzed assortments.

3. The values of iodine index again bring up the possibility that the oil sold by brand B may show signs of oxidation. The results revealed a small number of fatty acids with double bonds, which could not add the excess iodine. The causes are multiple, but all indicate an inconsistent storage of the product.

4. Olive oil cannot be marketed under Romanian producers. The impossibility of renouncing the import is due to the climatic and pedological conditions in our country. This fact has influence on the finished product that goes through a long enough distribution chain. Also, the low consumption in our country makes the finished product, once it has reached the shelf, to last for a long period until the total consumption. All these factors influence the physical-chemical and sensory quality of the olive oil.

5. It is mentioned that the whole set of physical-chemical analyzes was performed three weeks after the opening of the product bottles. Between the two sets of analyzes, the olive oil was kept in the dark, without contact with the air. The results obtained from the analyzes carried out thus offer two possibilities: the oxidation reactions started before the opening of the bottles, which shows an incorrect handling of the packages, or the oxidation reactions had a very fast development, this last aspect bringing a question mark on the product authenticity.

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***** STAS 145-67 -** Oil and vegetable fats.

***** CODEX STAN 33-1981 -** *Standard for olive oils and pomace olive oils.*

L'IMPACT DES FRUITS SEC D'EGLANTIER ET D'AUBEPINE SUR LA STABILITÉ ET LA QUALITÉ DES SAUCISSES FONCTIONNELLES

IMPACTUL FRUCTELOR USCATE DE MĂCEŞ ŞI PĂDUCEL ASUPRA STABILITĂŢII ŞI CALITĂŢII CRENVURŞTILOR FUNCŢIONALI

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Résumé: *L'étude bibliographique et expérimental a établi les principes de l'incorporation dans les produits de charcuteriedes ajouts végétaux riches en antioxydants (baies secs de l'églantier et d'aubépine) en élucidant leur impact sur les transformations chimiques, physico-chimique et microbiologique du produit finit. Les saucisses fabriques avec fruits sec d'églantier et d'aubépine ont une stabilité microbiologique élevée par rapport au témoin, de 2 jours et respectivement 3 jours. On a élaboré la composition et la technologie de fabrication de saucisses avec addition des additifs végétale horticole (farine des fruits secs de l'églantier et l'aubépine).*
Mots clés: aubépine, églantier, saucisse, stabilité microbiologique, viande

Rezumat: *Studiul bibliografic şi experimental a stabili principiile de incorporare în crenvurşti a adausurilor vegetale bogate în antioxidanţi (boabe uscate de măcieş şi păducel) elucidând impactul lor asupra transformărilor chimice, fizico-chimice şi microbiologice a produsului finit. Crenvurştii fabricaţi cu fructe uscate de măceş şi păducel au prezentat o stabilitate microbiologică ridicată, majorând durata de păstrare cu 2 zile şi respectiv 3 zile în comparaţie cu proba martor. Compoziţia şi tehnologia de fabricare a crenvurştilor cu adaosuri vegetale horticole (făină de fructe uscate măceş şi păducel) a fost elaborate şi discutat cu cei din industria naţională.*
Cuvinte cheie: carne, cătină, crenvurşti, măceş, stabilitate microbiologică

INTRODUCTION

La science de la nutrition, dans des conditions de la civilisation moderne compte tenu des produits de la viande et à base de viande, a un rôle important dans la structure de la ration quotidienne. Par conséquent, la consommation de viande est un indicateur de standard de vie.

Une saucisse un produit decharcuteriecomposée principalement deviandehachée mélangée à d'autresingrédientstels que des épices et des condiments, la préparation est ensuite déposée dans unboyau, d'origineintestinal ou synthétique, en forme de tube et refermé aux extrémités (H.G. nr. 720/2007).

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L'importance trófico-biologique des produits à base de viande est atteint par son rôle plastique et énergétique, essentiellement reflétée dans la qualité et le contenu des acides aminés essentiels nécessaires pour maintenir un équilibre d'azote normal dans le corps humain (Joosen *et al.,* 2009).La production et la transformation de la viande ainsi que la fabrication de préparations et de produits à base de viande exigent d'énormes connaissances concernant le traitement d'une matière première délicate (Devillers, 2010). On distingue deux grandes catégories de produitsde charcuterie: les produits qui proviennent de découpes primaires non fermentées et les produits à base de viande crue, hachée et transformée par fermentation (fig. 1).

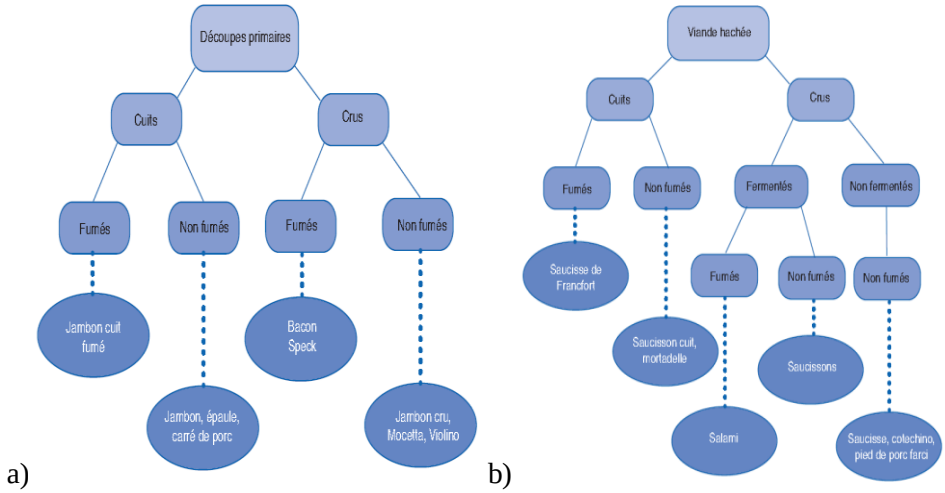


Fig. 1 La classification des produits: a) de charcuterie découpes primaires non fermentées et b) à base de viande hachée (Bourgeois *et al.,* 2006).

Dans les dernières années, l'industrie alimentaire cherche d'identifier de nouvelles sources végétales efficaces de pigments, non toxiques et non polluants, dans le but de remplacer les colorants synthétiques utilisés actuellement et largement en raison de leur stabilité et de prix bas. Parmi les principaux domaines de développement et de la production de produits de charcuterie fonctionnels, on peut souligner:

- l'enrichissement de produits de charcuterie avec des micronutriments - vitamines, minéraux et autres substances;
- l'enrichissement des produits de charcuterie avec des fibres alimentaires;
- l'augmentation de la biodisponibilité des micronutriments;
- l'obtention des produits de charcuterie avec stabilité microbiologique élevée et des propriétés sensorielles spécifiques, etc. (Banu *et al.,* 2002).

Les plantes représentent en générale des ressorts importantes de ressources utiles comme: la nourriture, les fibres textiles, les médicaments, le bois, les parfums, les colorants, d'autres connus attendent d'être découverts et exploités.De la grande diversité des plantes horticoles appartiennent l'églantier, l'aubépine, l'argousier, la prunelle, etc. Ces espèces sont des plantes de notre pays, à portée de main, des plantes sauvages qui poussent sur la route où dans les bois. Dans la plupart de cas sont utilisés des fruits, qui sont recueillent l'automne, idéal serait après les premières gelées.

Églantier (*Rosa canina*) – est non seulement une rose sauvage, une décoration décernée à nos jardins, mais aussi un véritable entrepôt de vitamines et de minéraux (le fer, le phosphore, le chrome, le potassium, le magnésium, le carotène, la riboflavine, la rutine et le manganèse), parmi lesquels il faut noter en particulier la vitamine C (en églantier est de 50 fois plus de vitamine C que dans les citrons et les oranges). L'administration des fruits d'églantier: favorise le développement du système nerveux, améliore l'appétit et l'anémie chez les enfants par son contenu élevé en vitamines C, B et minéraux; prophylaxie des maladies et des infections respiratoires (bronchite, pneumonie, infections virales, etc.); (Vogl *et al.,* 2013) renforce le système immunitaire en cas de stress et de fatigue intellectuelle; prophylaxie des maladies articulaires; baisse la tension artérielle, aide à la fragilité capillaire, prévient l'athérosclérose et autres maladies cardio-vasculaires.

Aubépine (*Crataegus monogyna*) - est un arbrisseau,les baies accumulent une large gamme d'acides organiques (ursolique, caféique, citrique, tartrique, vinique, oléique), des glucides (groupe de glycosides, flavonoïdes, les phytostérols, la choline et ses dérives), et d'autres composés chimiques ayant activité biologique élevée. Le plus actif est l'acide crataegy, un composé de triterpène comprenant trois acides organiques (cratagolique, neotegolique et acantolique). Les fruits révélé une optimum des oligo-éléments (fer, cuivre, magnésium et zinc), qui les rend utiles dans le traitement des maladies cardio-vasculaires (Belz *et al.,* 2002). En outre, les fruits aubépine contient du sélénium, qui a des propriétés anti-cancer et améliore l'immunité, utiles pour les personnes qui souffrent de myopie car il est riche en carotène. Les graines de baies d'aubépine contiennent plus de 30 % huiles grasses, qui peuvent être utilisés pour les besoins alimentaires et industriels (Dalli *et al.,* 2011).

Dans les produits de viande – saucisses, bacon, saucissons, on rencontre moins fréquemment addition des plantes horticoles. Ilssont utilisés actuellement pour maintenir la couleur rose, rouge et pour leur effet bactériostatique, antioxydant et la diversification de la saveur des produits (www.usamvcluj.ro, 2012). Le but de cette recherche consistait à établir les principes d'incorporation des ajouts végétaux riches en antioxydants (baies secs de l'églantier et d'aubépine) (GOST 1994:93) dans les saucisses, en élucidant leur impact sur les transformations chimiques, physico-chimique et microbiologique.

MATÉRIAUX ET MÉTHODES

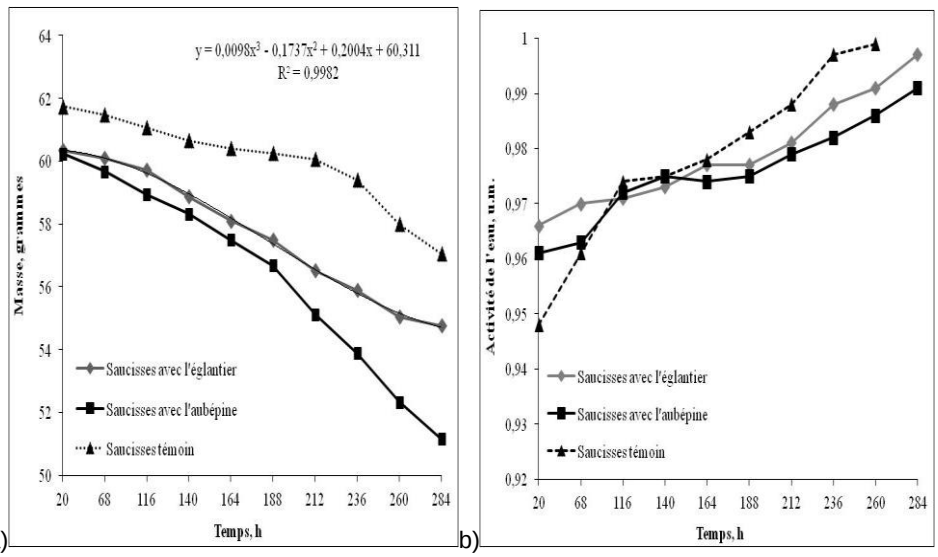
Cette section fait état de la matière première utilisée au cours de ce travail ainsi quedes protocoles de fabrication des échantillons d'étude, selon SM 221:2001, SM 241:2005 et H.G. nr. 696/2010. La farine d'églantier et d'aubépine a été obtenue par broyage de l'organe desséché de ces fruits, puis tamisées (10÷15 μm) et incorporé à l'étape de préparation de la composition des saucisses. L'étude des produits carnésa été accompli–l'analyse sensorielle, microbiologique et physico-chimique des saucisses avec églantier et aubépine par rapport au témoin.

Dans les échantillons des saucisses – produits finis ont été déterminés les indicateurs suivants, dès le départ et dans chaque jours de stockage (t de 2 à 5 °C, l'humidité de l'air 75 ± 3 %,):

- le nombre total de germes (NTG);
- la teneur en matières grasses (G) avec le dispositif Soxhlet;
- le changement de masse (Δm);
- le pH et la teneur en humidité (W);
- l'activité de l'eau (a_w) avec l'appareil Rotronique AG;
- la capacité de liaison d'eau (CLA);
- les propriétés sensorielles par la dégustation, etc.

RÉSULTATS ET DISCUSSIONS

On a étudiéles propriétés technologiques, sensorielles, microbiologiques et physico-chimiques des saucisses avec additifs végétaux horticoles par rapport au témoin durant le processus technologique de fabrication. La variation de certaines paramètres physico-chimiques: la masse et l'activité d'eau dans les échantillons témoin, avec l'églantier et l'aubépine est présenté dans la figure 2.



a) b)

Fig. 2 L'évolution des paramètres technologiques: le poids des barres (a) et l'activité de l'eau (b) des échantillons de saucisses lors du stockage

La diminution du poids des saucisses sans addition horticole (échantillon témoin) constitue 3,6 % au cours de la période de validité de 5 jours. Pour les saucisses avec l'addition d'aubépine le poids a été diminué de manière significative pendant le stockage de 12 jours, à partir de 60,23 g jusqu'à 51,15 g ce qui constitue 15,07 %. Au cours de validité de 7 jours la perte de poids est de 4,5 % et à partir de 7^{e} jour au 12^{e} jour de stockage, la perte de poids a augmentée jusqu'à 10,57 %, ce qui change l'aspect extérieur et la forme de barres par une forte membrane plissée. Les pertes de poids pour les saucisses avec addition d'églantier pendant le stockage de 12 jours constituait 9,26 %.

Un indice assez important dans les produits de charcuterie est l'activité d'eau. Des représentations de la figure 2 (b) on observe l'augmentation de la valeur de l'activité d'eau au cours du stockage, car d'une valeur initiale de 0,948, après 68 heures elle augmente jusqu'à 0,961 et après 212 heures à 0,988 dans les échantillons témoin. Le taux de croissance de la valeur de l'activité d'eau est plus modéré dans les saucisses avec addition horticole. Dans un premier temps a_w= 0,966, au jour 7 de stockage a_w=0,977 et après 12 jours de stockage a_w=0,99 valeur maximale. Ainsi, le produit devient instable microbiologiquement, parce que l'activité physiologique des microorganismes dépend de la teneur en activités d'eau dans les milieux nutritifs.

La stabilité microbiologique des produits de charcuterie représente un indice de qualité et de sécurité, inclus dans la figure 3 (a) (NTG–le nombre total de germes dans 1 g de produit).

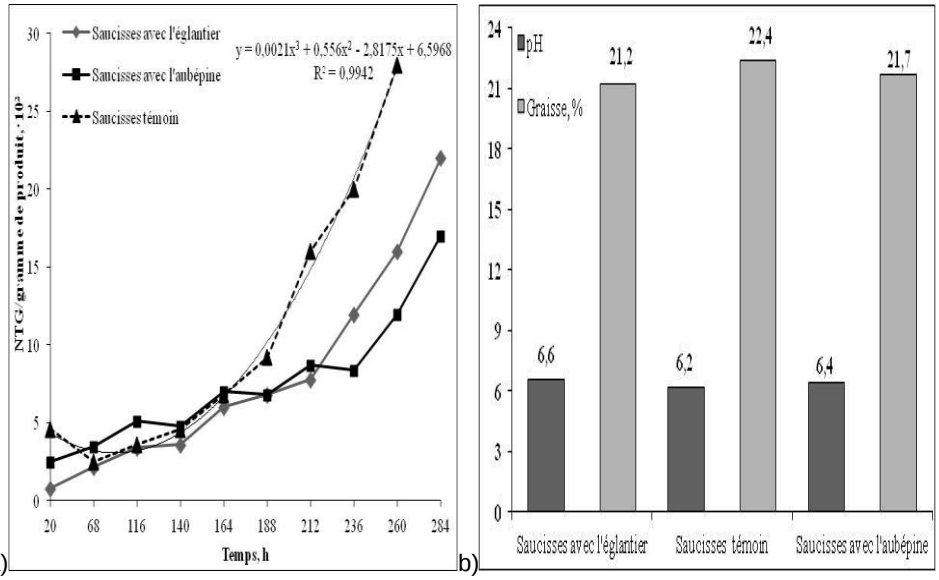


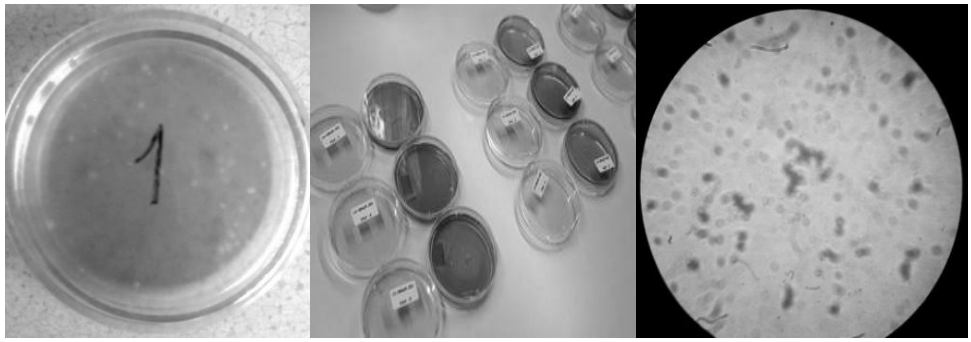
Fig. 3 L'évolution du nombre total de germes dans 1 g de produit(a) lors du stockage et la valeur du pH/ la teneur en graisse des échantillons de saucisse (b)

Le témoin présent un niveau de NTG au départ de $4,6 \cdot 10^2$ UFC/g, au début de 5 jours de stockage NTG diminue a $3,6 \cdot 10^2$ UFC/g et après 5 jours de stockage les saucisses sont stable microbiologiquement encore 3 jours.

A partir de 9 jours de stockage NTG est de $16 \cdot 10^2$ UFC/g et ça indique que le produit donné ne corresponde pas aux critères microbiologiques pour les produits alimentaires (H.G. nr. 221/2009), car la limite est de $10 \cdot 10^2$microorganismes mésophiles aérobies et facultatif anaérobies dans 1 g de produit. Les échantillons avec d'aubépine montre un indice NTG au départ de $2,5 \cdot 10^2$UFC/g, au bout de 7 jours de stockage NTG devient $7,0 \cdot 10^2$ UFC/g, le produit donné fait partie des règles relatives aux critères microbiologiques pour les produits alimentaires (H.G. nr. 221/2009). Les saucisses sont stable microbiologiquement pendant 10 jours stockés à t = + 2 à + 5 °C, l'humidité de l'air W = 75 ± 3 %, mais à 11 jours de stockage NTG devient $17 \cdot 10^2$ UFC/g. Pour les échantillons avec d'églantier, NTG initiale est de $0,8 \cdot 10^2$UFC/g, a 7^e jours de stockage NTG devient $6,0 \cdot 10^2$UFC/g et sont stables microbiologiquement pendant 9 jours de stockage.

L'analyse comparative des paramètres de la figure 3 (b) la teneur en matière grasse et la valeur de l'acidité active –pH révélait des variations non significatives dans les échantillons de saucisse par rapport au témoin.

Pour l'évaluation de la qualité microbiologique des saucisses avec additifs végétaux en membrane artificielle s'analysait l'ensemencement initial, à savoir semi-fabriqué jusqu'à traitement thermique-pasteurisation, inclus en figure 4. À la suite d'analyse microbiologique de l'échantillon de semi-fabriqué soumis à l'ensemencement du substrat de peptone-agar a été trouvée la présence de bactéries de genre *Streptococcus* en nombre total de germes – 7000. Les résultats obtenu montrent que le semi-fabriqué a été produit dans des conditions sanitaires favorables car selon les réglementations de viande hachée crue se permettent une charge microbiologique jusqu'à 10^4 UFC/g produit. On n'a pas détecté les genres de l'espèce: *Salmonella, Staphylococcus aureus, Escherichia coli, Listeria monocytogenes.*



a) b) c)

Fig. 4 Représentation photo de: a) et b) l'ensemencement microbiologique de semi-fabriqué témoin, c) présence de l'espèce *Streptococcus lactis*

Les indicateurs organoleptique des échantillons d'étude de saucisses (l'aspect, le goût, la consistance, la couleur, l'odeur, etc.) corresponde aux caractéristiques du produit fini tel que défini par la norme en plus de l'aspect commercial, extérieur, etc. Se fondant sur les conclusions dégustateurs reflétées en figure 5, ont révélé que les échantillons de contrôle ont prévalu après l'aspect commercial, la consistance et la texture.

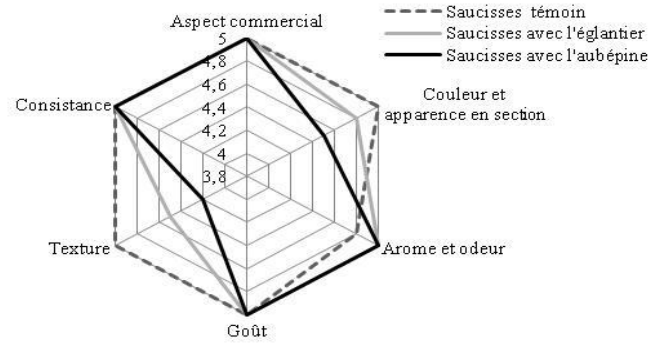


Fig. 5 La caractéristique sensorielle des échantillons de saucisse par le groupe de dégustateurs

Les échantillons avec l'églantier et l'aubépine ont été appréciés pour leur goût particulier, la saveur et l'arôme des matières végétales naturelles. Les dégustateursont pénalisés ces échantillons parce que l'églantier et l'aubépine n'ont pas été suffisamment broyés avant l'administration dans la composition.

De plus en plus, le consommateur exige des produits diversifiés et de bonne qualité. La satisfaction de cette demande variée, en matière de qualité des viandes, se traduit au niveau de la recherche par la nécessité d'identifier les caractéristiques des tissus favorables aux différentes composantes de la qualité, ainsi qu'une meilleure connaissance des facteurs de variation pouvant influencer cette qualité.

CONCLUSIONS

Les résultats obtenus ne relèvent que l'utilisation des fruits secs de l'églantier et d'aubépine dans le processus de fabrication des saucisses:

1) augmentent leurs valeurs nutritionnelles et biologiques;

2) conduit à une croissance insignifiante de l'activité d'eau, la poids et la forme de barres des échantillons de saucisses pendant le stockage à la température de 2 à 5 °C et l'humidité de l'air 75 ± 3 %;

3) il était possible d'amplifier la durée de stabilité microbiologique des échantillons de saucisse avec 2 jours et respectivement 3 jours par l'incorporation des fruits sec d'églantier et d'aubépine;

En base des données expérimentales on a élaboré la recette et la technologie de fabrication de saucisses avec des additifs végétaux horticoles (farine des fruits secs de l'églantier et l'aubépine) et présente un intérêt industriel pour les entreprises nationales ***Carmez*** et ***Mezellini***.

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THE IMPACT OF SWEET-BRIER AND HAWTHORN DRY FRUIT ON THE STABILITY AND QUALITY OF FUNCTIONAL SAUSAGES

Abstract: *The principles of incorporation in the sausages of products plant rich in antioxidants grain (sweet-brier and hawthorn) was study in bibliographic and experimental parts, in order to establish their impact on chemical, physico-chemicaltransformations and microbiological quality of the functional sausages. The dried fruit of sweet-brier and hawthorn berries have a high microbiological stability compared to the control sample increasing with 2 and 3 days, respectively. The composition and the technology for the production of the sausages with additions of vegetable horticultural plants (flour of dried fruit of sweet-brier and hawthorn) were elaborated.*

Key words: hawthorn, meat, sausage, sweet-brier

LE TRANSFERT DECOMPOSES D'AROME EN VIN A TRAVERS LE BOIS DE CHENE DANS UN SYSTEME DE MINI-FUT MODELE

TRANSFERUL COMPUŞILOR DE AROMĂ ÎN VIN DIN LEMNUL DE STEJAR ÎN SISTEM DE BARIC MODEL

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Résumé: *La modification du profil aromatique du vin durant l'élevage est une conséquence du transfert de composés d'arôme à l'interface bois/vin. On utilise des produits de bois de chêne (morceaux, planchettes, copeaux, etc.) pour accélérer le processus d'élevage des vins. Ces produits excluent les modifications non-souhaitées qui se produisent lors de l'élevage en fûts mais on ne maîtrise le processus d'extractions des molécules odorantes et volatiles du bois. En cas d'un système modèle, simulant les conditions d'élevage des vins en fûts de chêne, à la température de 10°C et avec l'espèce de chêne – Quercus robur on a étudié le mécanisme de transfert des composés d'arôme à l'interface bois/vin.L'étude a permis de mettre en évidence le comportement de sorption pour l'ensemble de molécules étudiées vis-à-vis du bois de chêne, avec toutefois une amplitude plus élevée pour le 4-vinylgaïacol. Le degré de sorption du composé 4-vinylgaïacol à l'équilibre était 3 fois plus important que pour le composé 4-éthylgaïacol à un temps de contact de 40 jours.L'incidence de la liaison entre le carbone 1 et 2 en chaîne carbonée de la position para sur le squelette gaïacol déterminait le rôle de hydrophobicité des molécules dans les mécanismes de sorption en système modèle mini-fût.*
Mots clés: 4-éthylgaïacol,4-vinylgaïacol, sorption, système modèle

Rezumat: *Modificarea profilului aromatic al vinului în timpul maturării în butoi este un efect al transferului compuşilor de aromă la interfaţa lemn / vin. Produsele pe bază de lemn de stejar (buşteni, plăci, talaş, etc.) sunt folosite pentru a accelera procesul de maturare a vinurilor. Aceste produse exclud schimbările nedorite care apar în timpul procesului de maturare în baric, însă procesul de extracţie a compuşilor odorante şi volatile nu este controlat. În condiţii de sistem model care simulează mediul de maturare a vinurilor în butoaie de stejar, la temperatura de 10 °C, cu specia de stejar – Quercus robur a fost studiat mecanismul de transfer a compuşilor de aromă la interfaţa lemn/vin. Studiul a permis stabilirea tipului de sorbţie pentru moleculele studiate provenite di lemnul de stejar, descriind o amplitudă mai mare pentru 4-vinilguaiacol. Gradul de sorbţie al compusului 4-vinilguaiacolla echilibru a fost de 3 ori mai mare faţă de compusul 4-etilguaiacol pentru un timp de contact de 40 de zile. Legătura dintre carbonul 1 şi 2 a structurii carbonice din poziţia para a structurii guiacolului a determinat în mecanismele de sorbţie rolul hidrofob al moleculelor studiate din sistemul model de baric.*
Cuvintecheie: 4-etilguaiacol, 4-vinil guaiacol, sorpţie, sistem model

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INTRODUCTION

Un des processus d'amélioration des qualités du vin est l'élevage en fûts de chêne car le bois possède une composition et une texture particulière. De plus le bois de chêne est un matériel complexe, à la fois très hétérogène qui présente une structure ligno-cellulosique organisée, cela confère au bois des propriétés mécaniques et physico-chimiques spécifiques (Bertrand *et al.,* 1995).

Lors de l'élevage du vin en présence de bois (fûts ou copeaux de chêne) s'extraitdes substances du bois comme: tanins hydrolysables, substances aromatiques (lactones, phénols volatiles, ellagitannins, etc.) (Jourdes *et al.,* 2011; Garcia-Estévez, *et al.,* 2015). Ces composés dissous ont une influence sur l'arôme, la saveur, l'aspect du vin (Tower et Waterhouse, 1996).

L'extraction des composés volatiles du bois de chêne lors de l'élevage du vin dépend principalement: de la quantité des substances qui sont potentiellement extractibles en bois, de la durée de contact du vin avec le bois, du degré alcoolique du vin et l'acceptabilité des pores du bois (Garde-Cerdan et Ancin-Azpilicueta, 2006). On sait que les zones de la surface du bois sont perméables au transfert des molécules peu solubles et volatiles du bois en vins (Feuillat *et al.,* 1993; Prida, 2004).

La modification du profil aromatique du vin durant l'élevage est une conséquence du transfert de composés d'arôme à l'interface bois/vin. Cesmécanismes de transfert à l'interface bois/vin ont été récemment étudiés. Feuillat F., 1996, Ramirez-Ramirez G., *et al.*, 2001 et Chassagne D., *et al.*, 2003 ont mis en évidence un phénomène de sorption de composés d'arôme vis-à-vis du bois de chêne, en simulant les conditions d'élevage. La quantité sorbée par le bois à l'équilibre semble être dépendante de la structure du composé. Actuellement, on utilise des produits de bois (morceaux, planchettes, copeaux, etc.) pour accélérer le processus d'élevage des vins. Ces produits excluent les modifications non-souhaitées qui pouvaientse produire lors de l'élevage en fûts mais on ne maîtrisait le processus d'extractions des molécules odorantes et volatiles du bois (Hernández-Orte *et al.,* 2014). Comme effet on peut mieux maîtriser le transfert des molécules peu solubles et volatiles du bois de chêne en vins élevés avec copeaux et autres produits de chêne, en influençant la porosité du bois. Cette modulation est plus souhaitable dans l'utilisation des produits de bois car en ce cas la partie transversale du bois qui est la plus poreuse est accessible au transfert des constituants aromatiques du bois vers les vins et on ne peut pas apprécier l'effet réalisé par ces produits (Oberholster *et al.,* 2015).

L'objectif de ce travail est d'étudier les mécanismes de transfert à l'interface bois/vin de deux homologues du gaïacol (4-éthylgaïacol et 4-vinylgaïacol) et autres composés d'arôme. Le comportement de ces composés volatils a été étudié dans les conditions d'un système modèle, simulant les conditions d'élevage des vins en fûts de chêne, à la température de 10 °C et avec une espèce de chêne utilisée en tonnellerie – *Quercus robur*.

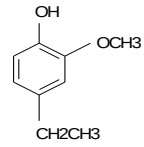
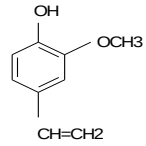
MATÉRIAUX ET MÉTHODES

L'étude a été menée sur l'espèce de chêne - *Quercus robur* ou chêne pédonculéen forme des planchettes. Les échantillons de merrains utilisés ont été fournis par l'Office National de Forêts (ONF) et sont originaires de la forêt de Cîteaux (Côte d'Or, France). Les planchettes de bois rectangulaire (2 x 10 x 20 mm) ont été pesés,les pores de la zone transversale (partie la plus poreuse) ont été bouchés avec une résine Araldite. La quantité de résine déposée sur une planchette a été 0,002 g.

Le milieuliquide a constitué le vin modèle qui représentait une solution hydro alcoolique à 12,5 % (v/v) d'éthanol, le pH de 3,5 unités, 3 g/l acide malique, 1 g/l acide acétique et sulfates de potassium/magnésium. Le vin modèle préalablement aromatisé en 4-éthylgaïacol (10 ppm) et 4-vinylgaïacol (40 ppm) est transversé dans les flacons étanches de 30 ml en quel on a placé les planchettes bouchées (tab. 1).

Tableau 1

Caractéristiquesphysico-chimiques des composés d'arôme

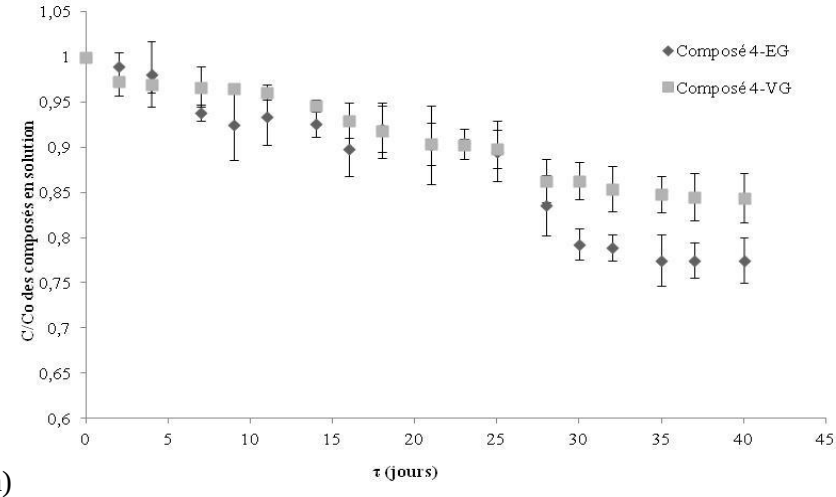
Composé d'arôme	Note aromatique	Formule moléculaire	Formule développée	Masse molaire (g/mol)	Présentation photo du système d'étude
4-éthyl gaïacol	épicé, girofle, fumée	$C_9H_{12}O_2$		152,19	
4-vinyl gaïacol	œillet, girofle, poivre	$C_9H_{10}O_2$		150,17	

On a préparé deux systèmes: le premier où les composés d'arôme (4-EG et 4VG) sont seuls en vin modèle et le deuxième système où le vin modèle est enrichi en plusieurs composés d'arôme mélangées (éthylgaïacol; vinylgaïacol, gaïacol, méthylgaïacol, 4-phenol, eugénol, isoeugénol). Ces deux systèmes sont conservés dans une étuve thermostable à la température de 10 °C tout au long de l'expérience. Les quantités des molécules volatiles restant dans la phase liquide sont déterminées par chromatographie en phase gazeuse (CG) (DelanoëD. *et al.,* 1996; Doneche B., 1993). Le chromatographe en phase gazeuse Trace GC Ultra (Thermo Electron Corporation), avec une colonne capillaire CP-WAX 57CB (Varian), l'épaisseur de la phase stationnaire était 0,2 µm, un détecteur FID et un injecteur Split/splittes. Le programme du four est un gradient de température allant de 130°C à 190°C où 3°C/min et avec un isotherme final de 21 minutes. Le gaz vecteur est l'hélium avec une pression en tête de colonne fixée à 100 KPa et le rapport du split réglé à 1/30. Le détecteur FID est alimenté avec l'hydrogène à un débit de 35 ml/min, l'air 350 ml/min et le maker up (N_2) de 30 ml/min.Le volume des échantillons injectés était de 2 µl réalisé en forme automatiquement avec un passeur d'échantillons AI 3000 (Thermo Electron). Les temps de rétention des molécules volatiles étudiées étaient: 10,02 minutes pour 4-EG et 14,1 minutes à 4-VG.

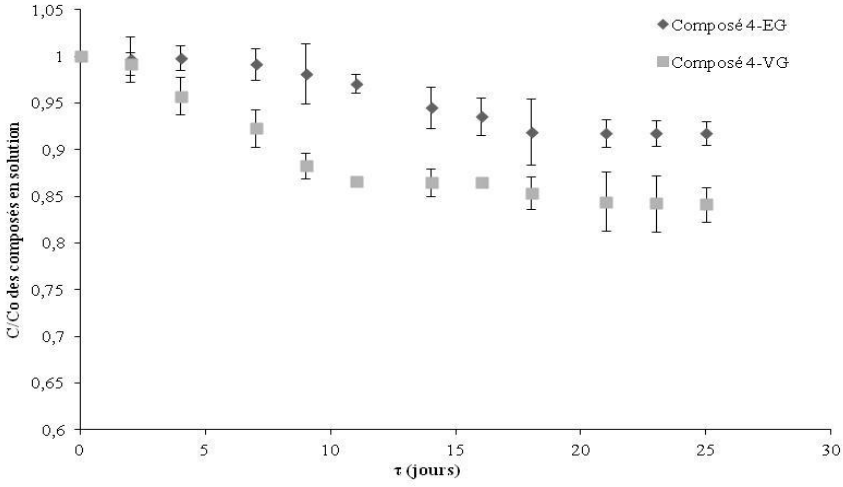
La quantité de composés d'arôme adsorbéea été calculée en tenant compte des différences de concentrations obtenues à l'équilibre avec celles des échantillons sans bois au premier jour (Ramirez-Ramirez *et al.,* 2001).

RÉSULTATS ET DISCUSSIONS

La sorption des substances d'arôme ajoutées en vin par le bois de chêne simulant les conditions d'élevage du vin en fûts de chêne est décrit par l'évolution des concentrations normalisées du 4-EG et 4-VG et le temps de mise à l'équilibre du système. Des données obtenues et incluses en figure 1, on observe tout d'abord que la concentration de ces composés diminuait légèrement en présence du bois.



a)



b)

Fig.1 Cinétique d'évolution de la concentration normalisée des composés d'arôme (4-EG et 4-VG) en système ″seul″ (a) et ″*mélange*″ (b) par le bois pédonculé conservé à 10 ºC

Pour un temps donné de 27 jours il semblerait que le phénomène de sorption des composés 4-EG et 4-VG est presque identique dans le système ***"seul"*** (figure 1 a) et le temps de mise à l'équilibre a été atteint à 40 jours de contact.

L'étude de Barrera-Garcia D. *et al.,* 2006 a montré un temps de mis à l'équilibre de 8 à 10 jours dans les mêmes conditions sauf que la partie poreuse des planchettes est „***libre***" à l'absorption. Apparemment le phénomène de sorption en ce cas se réalise plus lentement, car l'obstruction de la porosité transversale du bois diminue 4 fois l'absorption de phénols volatils par le bois. Les sites ***"actifs"*** de sorption sont étés inactivés par la barrière de résine. La teneur de diminution de la concentration normalisée est de 13 % pour 4-EG et respectivement de 20 % pour 4-VG.

L'évolution de la cinétique de deux phénols volatils 4-EG et 4-VG au contact avec les planchettes de bois en système ***"mélange"***(figure 1 b) montrait une diminution de la concentration de 10 % pour le composé 4-EG et de 17 % pour le composé 4-VG à une durée de contact de 25-28 jours.La diminution du processus de sorption est de 2 fois par rapport à lasorption établit par Barrera-Garcia D. *et al.*, 2006 en système***"mélange"***. Ça s'exprime par un temps de mise à l'équilibre de 25 jours de contact face à 12 jours de contact en système des pores ***"libres"***à la sorption des phénols volatils du vin (Barrera-Garcia *et al.,* 2006).

Pour comprendre mieux le processus de sorption des composés d'arôme 4-éthylgaïacol et 4-vinylgaïacol par le bois de chêneon a effectué des calculs qui pressente la quantité absorbée des composés d'arôme. Graphiquement les données obtenus concernant l'influence de la porosité des planchettes (pores bouchés) sur l'absorption des composés d'arôme dans les conditions de système ***"seul"***et ***"mélange"***est décrit en figure2. De ces donnes on voit que le composé 4-EG a une valeur de 0,034 mg absorbée à l'équilibre et respectivement de 0,095 mg pour 4-VG. Par des calculs on obtient une sorption de 3 fois plus importante du composé 4-VG que pour le composé 4-EG à un temps de contact de 40 jours. L'épaisseur de la zone d'échange est d'environ 10 x 20 mm et la sorption se réalise par diffusion, mais plutôt rapide au départ à cause des différences de concentration et puis plus lentement quand les concentrations en vin deviennent proches de celles de couche interne des planchettes de bois de chêne.

De la présentation en figure 2 (b) on observe que le composé 4-VG présente une quantité absorbée de 0,132 et de 0,07 pour le composé 4-EG comme résultat on obtient une diminution de la quantité absorbe pour 4-VG de 2 fois. Par comparaison aux valeurs obtenues en système ***"seul"*** on constate une absorption des composés d'arôme en système ***"mélange"***plus rapide de 50 % pour le composée 4-EG et de 25 % pour 4-VG. Cette différence d'absorption des composés volatiles (4-EG et 4-VG) peut être attribuée au phénomène de synergie entre les molécules volatiles introduites dans le vin modèle.

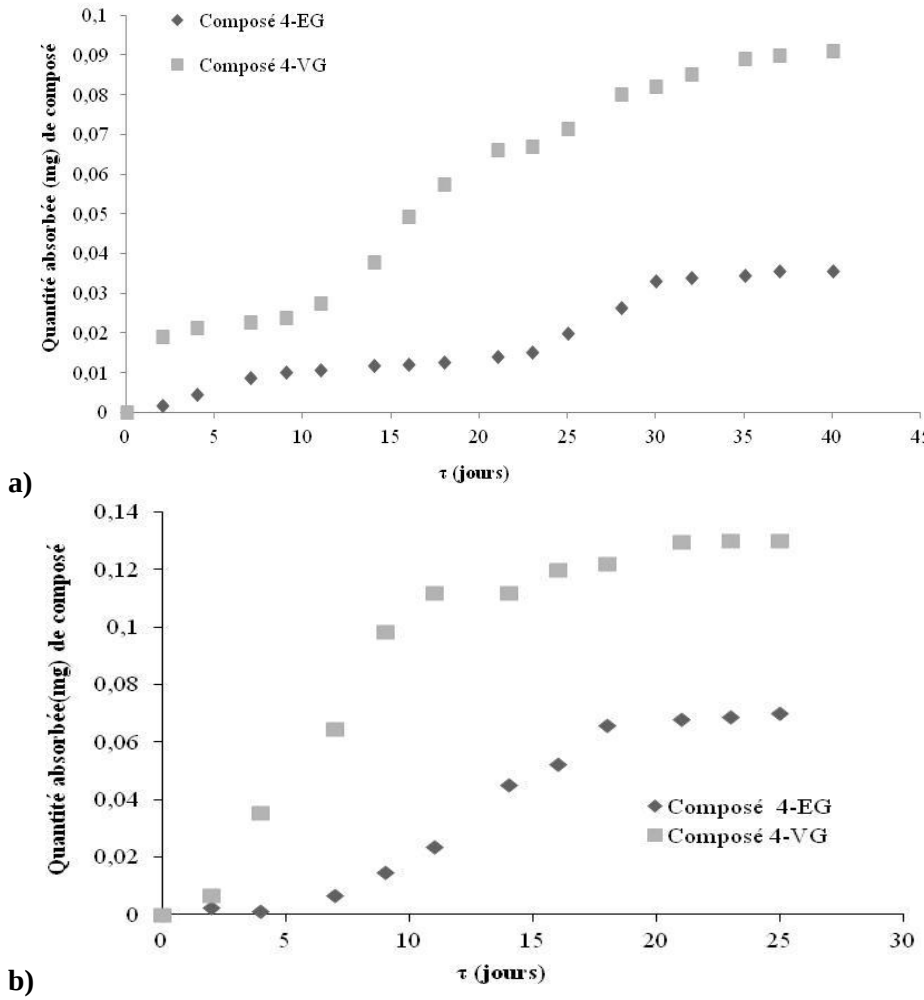


Fig. 2 Cinétique d'évolutionde la quantité absorbée (mg) des composés d'arôme (4-EG et 4-VG) en système ″seul″ (a) et ″*mélange*″ (b) par le bois pédonculé conservé à 10 ºC.

Si on compare le niveau de sorption du 4-éthylgaïacol avec celui du 4-vinylgaïacol, la quantité absorbée à l'équilibre est significativement plus grand pour ce dernier composé, il semblait que la présence de double liaison en squelette gaïacol soit à l'origine du niveau de sorption plus élevé. De plus, les sites potentiels de sorption des composés d'arôme se situeraient au niveau de la lignine en raison de sa nature hydrophobe.

Les études des phénomènes de sorption sont interprétées à l'aide d'isothermes des composés volatiles (4-EG et 4-VG) (Sing K., *et al.,* 1995). L'isothermes de sorption de 4-éthylgaïacol est de type III et pour 4-vinylgaïacol est de type I, sans arriver au palier de saturation caractéristique de ce type d'isotherme.L'isotherme de III type du 4-EG correspondait à la formation de

plusieurs monocouches sur la surface du solide. Ces molécules se posaient les unes sur les autres pour donner une zone inter-faciale qui peut contenir plusieurs épaisseurs de molécules absorbées. En ce qui concerne le composé volatile 4-VG, l'adsorption est limitée par un effet d'encombrement stérique du fait de la présence d'une ou deux couches de molécules au sein des micropores. Ceci on permet d'envisager que la sorption du 4-vinylgaïacol par le bois est réalisée au niveau des micropores.

CONCLUSIONS

L'étude a permis de mettre en évidence:

1) un comportement de sorption pour l'ensemble de molécules étudiées vis-à-vis du bois de chêne, avec toutefois une amplitude plus élevée pour le composé 4-vinylgaïacol;

2) l'obstruction des pores ***"actifs"*** de la partie transversale des planchettes diminuait 4 fois l'absorption des composés d'arôme par le bois;

3) le composé 4-vinylgaïacol à l'équilibre présente un degré de sorption plus grand que autres composés phénoliques présentés en vin modèle (4-éthylgaïacol, eugénol, vanilline etc.);

4) deux types d'isothermes de sorption: de type I pour le 4-vinylgaïacol et de type III pour le 4-éthylgaïacol, ont été observées.

5) l'influence de la structure chimique du sorbant sur le processus de sorption, et plus particulièrement, l'incidence d'une liaison entre les carbones 1 et 2 de la chaîne carbonée située en position *para*du squelette gaïacol (rôle de l'hydrophobicité des molécules dans les mécanismes de sorption).

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SORPTION BEHAVIOR OF VOLATILE PHENOLS AT THE OAK WOOD/WINE INTERFACE IN A MODEL SYSTEM

Abstract*: The Changes of wine aromatic profile duringageing in the wood barrel is an effect of the flavor compounds transfer at the wood / wine interface. The oak-products (pieces, plates, chips, etc.) are used to speed up the ageing process of wines. These products exclude undesirable changes that occur during the wine barrel maturation process, but the extraction of flavoring and volatile compounds is not controlled. Under laboratory conditions of a model system that simulates the wine oak ageing conditions at 10 °C and with oak species – Quercus robur was established the mechanism of aroma compounds transfer to the wood/wine interface. The study has determined the type of sorption for the studied molecules from oak wood, describing a higher amplitude for 4-vinylguaiacol. At the equilibrium, the sorption rate of the compound 4-vinylguaiacol was 3 times higher than the corresponding 4-ethylguaiacol for a 40 days contact time. The sorption 4-vinylguaiacol and the balance was 3 times higher than the.The bond between carbon 1 and 2 of the carbon in the para position of the guaiacol structure determined in the sorption mechanisms the hydrophobic role of the studied molecules in the oak barrel model system.*

Keywords: 4-ethylguaiacol, 4-vinylguaiacol, sorption, model system

CARACTÉRISTIQUES DE QUALITÉ DES CRAQUELINS FONCTIONNELS, ENRICHIS AVEC DE LA FARINE DE CÉLERI

CARACTERISTICI DE CALITATE A BISCUIȚILOR FUNCȚIONALI ÎMBOGĂȚIȚI CU FĂINĂ DE ȚELINĂ

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Résumé: *L'étude présente les résultats de l'analyse qualitative de craquelins fonctionnels innovatifs enrichis en farine de céleri dans le contexte d'une alimentation saine et des frais de transaction des producteurs. Le développement d'aliments fonctionnels innovatifs en enrichissant les craquelins de farine de céleri est efficace. Les craquelins enrichis en farine de céleri ont une teneur élevée en fibres. Ils sont également une source de protéines. Les caractéristiques chimiques et sensorielles des craquelins enrichis en farine de céleri déterminent leur pertinence pour une alimentation saine dans le cadre de la prévention et du traitement de grandes maladies à incidences sociales.*
Mots clés: farine de céleri, farine de riz, farine de pois chiche, craquelins, caractéristique de qualité, aliments sains, frais de transaction

Rezumat. *Studiul prezintă rezultatele analizei calitative a biscuiților funcționali inovativi îmbogățiti cu făină de țelină în contextul unei alimentații sănătoase şi a costurilor de tranzacție a producătorilor. Dezvoltarea de alimente funcționale inovatoare prin îmbogățirea biscuiților cu făină de țelină este eficientă. Biscuiții îmbogățiți cu făină de țelină au un conținut ridicat de fibre. Ele sunt, de asemenea, o sursă de proteine. Caracteristicile chimice şi senzoriale ale biscuiților îmbogățiți cu făină de țelină determină relevanța lor pentru o dietă sănătoasă în prevenirea şi tratarea unor boli majore din punct de vedere social.*
Cuvinte cheie: țelină de făină, făină de orez, făină de năut, biscuiți, caracteristică de calitate, alimente sănătoase, costuri de tranzacție

INTRODUCTION

Le développement des aliments fonctionnels est un processus innovant où l'intersection de la science et des affaires répond aux intérêts des consommateurs

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pour des aliments divers, sains, de qualité et de sécurité (Doyon *et al.,* 2005; Rastall *et al.,* 2000).

Le céleri (*Apium graveolens*) est largement utilisé dans le monde entier et il est présenté dans l'alimentation humaine. Les parties vertes de la plante sont principalement utilisées dans les soupes et les salades. La plante contient un certain nombre de substances biologiquement actives – fibres, propriétés antioxydantes, vitamines, carotène, protéines (Popovic *et al.,* 2006, Wen *et al.*, 2006, Winston, 2005; Ovodova *et al.,* 2009). Le céleri est riche en vitamines, carotène, protéines, cellulose et autres nutriments et constitue une bonne source de flavonoïdes, d'huiles volatiles et d'antioxydants (Li *et al.,* 2017). Les tubercules céphalorachidiens ont été évalués en tant qu'un source riche en pectine – 30 % en poids sec (Petrova *et al.,* 2014).

Cette étude présente les résultats de l'analyse qualitative de craquelins fonctionnels innovatifs enrichis en farine de céleri dans le contexte d'une alimentation saine, ainsi que les frais de transaction de l'entrepreneur pour leur production et livraison au consommateur.

Une petite partie de la recherche dans le domaine de la panification vise l'influence de différentes quantités de la farine de céleri sur les caractéristiques de qualité des craquelins à la farine de pois chiches et farine de riz. Pour cette raison, l'objectif principal de cette étude est de retracer l'influence de différentes quantités de farine de céleri sur les caractéristiques de qualité de craquelins de farine de pois chiches et farine de riz.

MATÉRIAUX ET MÉTHODES

La détermination de l'activité antioxydante, des sucres et des acides organiques de la farine de céleri est effectuée par la méthode HPLC.

L'analyse chimique montre que la farine de céleri a une teneur faible des lipides (1.04 g/ 100 g) et en sucres réducteurs. Il se caractérise par une teneur élevée en acide malique, acide citrique et acide citrique, respectivement de 250.93, 1681.20 et 419.15 mg/ 100 g.

Le céleri est également caractérisé par une bonne activité antioxydante. La consommation de flavonoïdes prévient le cancer, les maladies cardiovasculaires, l'ostéoporose et le diabète. La farine de céleri se distingue également par une bonne saturation en polyphénols. Une teneur moyenne en polyphénols n'inhibe pas l'absorption du fer par l'organisme (Mennen *et al.,* 2005). Ainsi, les produits finis contenant de la farine de céleri conviennent à la consommation des personnes atteintes d'anémie fébrile jaune, des femmes enceintes et des personnes ayant des besoins en fer accrus. L'incorporation de la farine de céleri dans des craquelins à la base de farine de chiche et la farine de riz confirme leur profil fonctionnel sain. Les craquelins enrichis en farine de céleri comprennent un mélange de la farine de chiche à 50 % et de la farine de riz. Les légumineuses sont une source de protéines, de glucides, de fibres et de minéraux. Les habitudes et les préférences alimentaires sont parmi les principales raisons de la prévalence de maladies à caractère social telles que le diabète de type 2, les maladies cardiovasculaires, l'obésité, l'hypertension, l'altération du métabolisme (Lecerf et *al., 2016*).

Le développement de craquelins par la farine de pois chiche et la farine de riz,

enrichis avec la farine de céleri, élargit leur profil santé et leurs caractéristiques fonctionnelles. Ils peuvent être consommés pour la prévention et comme l'addition vers le traitement de maladies métaboliques et cardiovasculaires (Manley, 2011).

RÉSULTATS ET DISCUSSIONS

Traitement technologique de craquelins innovatifs

Les pois de chiches sont une bonne source de protéines, d'oligo-éléments et de minéraux. Les légumineuses contiennent près de deux fois plus de protéines et de minéraux et environ trois fois plus de fibres que la farine de blé. Les protéines végétales contiennent de la lysine, qui est un acide aminé très important limité aux céréales (Muller, 1983).

L'ingrédient principal fonctionnel des craquelins c'est la farine de riz. Le riz est considéré comme un aliment hypoallergénique et est l'un des premiers aliments solides nourris au nés. Actuellement, la farine de riz est l'un des ingrédients le plus utilisé dans le pain et les produits boulangeries sans gluten.

Les craquelins, enrichis avec de la farine de céleri sont des biscuits de type non-sucré. Le poids unitaire de craquelins salés varie considérablement de 3 à 15 g. Leur surface est lisse, avec une couleur brune-jaune. Certains d'entre eux ont des ornements en relief sur la surface supérieure. Le mie est solide, presque dense, la mie en couches, une porosité uniforme avec des alvéoles très petite.

Analyse sensorielle de craquelins innovatifs

Analyse sensorielle des craquelins a été fait selon la norme ISO 8586-2:2008. Analyse sensorielle des craquelins a été fait avec les indices suivants: la couleur, le goût, l'odeur, la friabilité, la mastication, l'arrière-goût. Avant chaque test, les dégustateurs ont été préparés par la procédure de test. Les résultats arithmétiques sont graphiquement formés sur le système de coordonnées. Chaque propriété reçoit une valeur qui forme l'évaluation sensorielle des craquelins.

La figure 1 présente le profil sensoriel craquelins enrichis par différentes quantités de la farine de céleri.

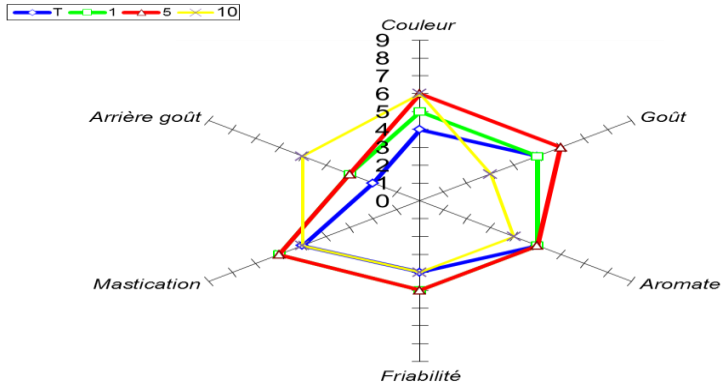

Fig 1 Analyse sensorielle de craquelins, enrichis avec de la farine de céleri

Il a été constaté que les résultats d'essais enrichis avec de la farine de goût, l'odeur, la friabilité, la mastication et l'arrière-goût. La différence la plus notable est dans le goût, la mastication et l'arrière-goût des échantillons. Avec l'addition de la plus grande quantité de la farine de céleri, les résultats sont plus faibles. La différence de goût entre 5 et 10 % de la farine de céleri est de 50 %. Selon les analystes, les résultats les plus élevés sur les indices de goût, d'odeur, de friabilité et de mastication sont obtenus avec l'addition de 5 % de la farine de céleri.

Après les résultats rapportés par les analystes, il a été constaté que les craquelins, enrichis à 5 % avec de la farine de céleri, possèdent les meilleures caractéristiques qualitatives. Par conséquent, des autres études chimiques ont été réalisées uniquement avec l'addition de 5 % de la farine de céleri.

Analyse chimique du produit fini innovatifs

Selon le règlement 1924/2006, l'analyse chimique du produit fonctionnel fini confirme que les craquelins enrichis avec de la farine de céleri constituent une bonne source de protéines, ne contiennent pas de sucres et ont une teneur élevée en fibres (8.42 %). Les craquelins sont sans sucre et ils se rapprochent également des normes des aliments d'allégation santé.

La composition chimique de craquelins fonctionnels innovants enrichis avec de la farine de céleri confirme leurs allégations saines. L'analyse montre sa pertinence pour une alimentation saine dans la prévention et le traitement du diabète de type 2, du syndrome métabolique et des maladies cardiovasculaires.

Frais de transaction pour la production de craquelins fonctionnels innovatifs avec de la farine de céleri

Chacune des phases du développement et de la vente de craquelins fonctionnels innovatifs enrichis en farine de céleri est chargée de divers frais de transaction. La conception, la production, le financement et la distribution des aliments fonctionnels sont liés à des nombreuses négociations, à des relations contractuelles et, par conséquent, à une asymétrie de l'information et à des incertitudes dans la mise en œuvre des engagements. La nécessité d'un degré accru de coordination augmente les frais de transaction engendrés par le processus de négociation. Une coordination inefficace peut entraîner une augmentation des frais de transaction négatifs. La garantie de l'efficacité, la qualité et la sécurité des aliments fonctionnels nécessite une surveillance plus stricte et augmente également les frais de transaction.

Les frais de transaction négatifs élevés aggravent les conditions du marché dans le secteur des aliments fonctionnels. Ainsi, l'élaboration, la production et la distribution d'aliments fonctionnels innovatifs sont impossibles pour les petites et moyennes entreprises.

CONCLUSIONS

Les résultats de l'étude de caractérisation qualitative montrent que l'enrichissement des craquelins en farine de céleri est efficace et approprié. Les craquelins enrichis à 5% de farine de céleri ont les meilleures caractéristiques

qualitatives. Il a été constaté que les produits finis sont caractérisés par une bonne teneur en protéines, teneur élevée en fibres et une faible teneur en sucres totaux. La composition chimique du produit fini détermine les allégations de santé des craquelins innovatifs enrichis en farine de céleri et permet de les définir comme fonctionnels.

Le développement des aliments fonctionnels innovants est un processus de recherche à long terme et leur production industrielle est associée à des frais de transaction élevés. Les résultats de cette étude montrent que l'enrichissement des craquelins à la base de la farine de chiches et la farine de riz, enrichies par la farine de céleri est efficace et approprié pour la production des aliments fonctionnels.

Remerciements: *Agence Universitaire de la Francophonie (AUF) - projet S0446 SAIN (2017-2019)*

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QUALITY CHARACTERISTICS OF CRACKERS ENRICHED WITH CELERY FLOUR

Abstract: *The study presents the results of the qualitative analysis of innovative functional crackers enriched with celery flour in the context of a healthy diet and the transaction costs of producers. The development of innovative functional foods by enriching crackers with celery flour is effective. Crackers enriched with celery flour have high fiber content. They are also a source of protein. The chemical and sensory characteristics of crackers enriched with celery flour determine their relevance to healthy diet in the prevention and treatment of major socially significant diseases.*

Keywords: celery flour, rise flour, chickpea flour, crackers, quality characteristic, healthy foods, transaction costs

ASSURANCE DE LA QUALITÉ ET DE LA DURÉE DE VALIDITÉ DE LA MARMELADE

ASIGURAREA CALITĂȚII ŞI TERMENULUI DE VALABILITATE A MARMELADEI

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Résumé. *L'objet d'étude de la présente recherche est d'assurer la qualité et la durée de conservation de la marmelade d'agar-agar. Les résultats expérimentaux sont présentés concernant: la caractérisation des principaux indicateurs de la qualité de la marmelade; les modifications résultant de l'influence d'additifs complexes et leur impact sur l'évolution des indicateurs de qualité de la marmelade; la mise en place des conditions optimales pour assurer sa stabilité lors de la conservation.Des résultats scientifiques ont été obtenus démontrant la possibilité de modifier régulièrement les propriétés de qualité et d'améliorer les qualités de consommation des produits gélifiés avec l'utilisation d'ajouts favorisant le processus de rétention d'eau dans le produit.*
Mots-clés: produits gélifiés, marmelade, humidité, propriétés texturales, qualité, sécurité alimentaire.

Rezumat. *Scopul studiului de cercetare constă în asigurarea calităţii şi termenului de valabilitate a marmeladei pe bază de agar-agar. Sunt prezentate rezultatele experimentale privind caracterizarea principalilor indicatori ai calităţii marmeladei, modificările care intervin în urma influenţei aditivilor complecşi şi impactul acestora asupra evoluţiei indicatorilor de calitate a marmeladei, stabilirea condiţiilor optimale de asigurare a stabilităţii acesteia în timpul păstrării. S-au obţinut rezultate ştiinţifice, care arată posibilitatea de modificare dirijată a proprietăţilor de calitate şi de ameliorare a calităţilor de consum a produselor gelifiate odată cu utilizarea adaosurilor care favorizează procesul de reţinere a apei în produs*.
Cuvinte-cheie: produse gelifiate, marmelada, umiditate, proprietăți texturale, calitate, siguranța alimentului.

INTRODUCTION

Les bonbons à la gelée (marmelade) sont devenus des friandises les plus populaires, présentant à la fois des produits savoureux et nécessaires au corps humain.

On sait que la marmelade a une valeur nutritionnelle inférieure à celle des autres produits de confiserie car elle ne contient pas de graisse. En outre, les substances gélifiantes utilisées, telles que l'agar-agar, à base d'algues marines rouges et brunes, améliorent la fonction hépatique, purifient le corps des

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toxines, sont des composants naturels des recettes de fabrication et ont un effet bénéfique sur le métabolisme humain (Chubenko, 1989).

Lors de l'évaluation de la qualité et de la durée de conservation des produits, le facteur déterminant est leur humidité. Toutefois, pour le développement de micro-organismes, il n'importe à la fois la valeur absolue de l'humidité, que la disponibilité de la teneur en eau dans le substrat pour le développement de micro-organismes („activité de l'eau"). Le contrôle de l'indice d'activité de l'eau permet de prévoir les processus se déroulant lors du stockage des produits de confiserie. La marmelade fait référence aux produits ayant une teneur en humidité comprise entre 75 et 80% d'eau, si l'activité de l'eau se situe à la limite de 0.65 à 0.9. À partir de l'activité de l'eau de 0.62, de nombreux types de moisissures, champignons et levures osmophiles peuvent se développer, alors que la plupart des micro-organismes (*Salmonella, Escherichia coli, Entérobactérie*) se développent à 0.94. L'activité de l'eau est également influencée par l'intensité des processus d'oxydation. La vitesse d'oxydation maximale des produits de confiserie se situe dans la plage d'activité de l'eau comprise entre 0.6 et 0.85 (Sarafanova, 2010).

Le but de cette recherche est d'étudier les modifications des caractéristiques de qualité des bonbons gélifiés (marmelade à base d'agar-agar) au cours du processus de conservation afin d'assurer la qualité et la durée de conservation.

Le sujet abordé n'a pas encore fait l'objet d'une étude. A partir de là, l'originalité du sujet étudié consiste à analyser les modifications intervenues après l'influence d'additifs complexes et leur impact sur l'évolution des indicateurs de qualité de la marmelade, la mise en place des conditions optimales pour assurer leur stabilité pendant la conservation, l'élaboration de la technologie de production de la marmelade avec ajout de glycérol et de la marmelade enrobée d'un film protecteur.

MATÉRIAUX ET MÉTHODES

Les matières premières et auxiliaires suivantes ont été utilisées pour obtenir des bonbons à la gelée (marmelade): eau potable, sucre granulé, mélasse d'amidon de maïs, gélifiant: CERO Agar-agar en poudre Type 8925 Q min.1000 g/cm², acide citrique, amidon de maïs, glycérol („Stanchemsp.z.o.o", Pologne), colorants et arômes, emballage en plastique, cartons.

Une méthodologie de recherche expérimentale a été mise au point, des procédures et techniques d'analyse classiques (indicateurs physico-chimiques, sensoriels et microbiologiques) ou modernes ont été identifiées. Afin d'obtenir des résultats valides, 5 déterminations ont été effectuées en parallèle avec l'identification d'erreurs des valeurs expérimentales.

L'analyse sensorielle a été réalisée selon la méthode d'évaluation sensorielle par score, en appliquant le système d'évaluation en 5 points (0 à 5 points pour chaque type de sensation) (Banu, 2002). L'aspect, le goût, l'odeur et la consistance des produits ont été appréciés après les analyses sensorielles. Suite aux résultats obtenus, a été élaboré le profil sensoriel des échantillons analysés.

Pour déterminer les caractéristiques microbiologiques (***, 2014), on a déterminé le nombre total de microorganismes mésophiles aérobies et éventuellement anaérobies; le nombre de levures et de moisissures, la présence de bactéries coliformes, bactéries pathogènes de *Salmonella*.

RÉSULTATS ET DISCUSSIONS

Pour la production de marmelade à base d'agar-agar, une technologie classique adaptée aux matières premières utilisées a été suivie et les paramètres technologiques optimaux ont été définis pour un produit fini, présentant les meilleures caractéristiques sensorielles. La technologie de fabrication comprend la préparation des matières premières pour la production, la préparation du sirop d'agar-sucre-mélasse, la filtration du sirop d'agar-sucre-mélasse, le filtrage du sirop de d'agar-sucre-mélasse, l'homogénéisation du sirop, le remplissage, le refroidissement - la structuration, le séchage et l'amballage du sirop (Dragilev *et al.*, 2004).

Les produits expérimentaux proposés à l'analyse sont les suivants: échantillon témoin - marmelade à gélifiant agar-agar, échantillon 1 - marmelade à gélifiant agar-agar enrobée d'un film protecteur, échantillon 2 - marmelade à gélifiant agar-agar avec ajout de glycérol de 2.7%, échantillon 3 - marmelade à gélifiant agar-agar avec ajout de glycérol de 4.5%.

Pour les échantillons avec ajout, le glycérol a été introduit dans le sirop d'agar-sucre-mélasse en une quantité de 2.7 à 4.5 g/kg de produit fini. Le glycérol/ la glycérine a un régulateur d'humidité et de remplissage, un agent épaississant et se réfère à un groupe d'alcools polyatomiques, utilisé comme complément alimentaire qui ne soulève pas d'objection de la part des autorités de la santé et dont l'utilisation est approuvée dans tous les pays (Buldakov, 2003).

En outre, le glycérol est une substance grasse de cire, ce qui explique pourquoi il est un bon plastifiant et un moyen d'encapsulation (Sarafanova, 2004;***, 2003).

Par conséquent, pour les spécimens expérimentaux recouverts d'un film, on a effectué l'enrobage (encapsulation) de la marmelade pour obtenir un film protecteur constitué de deux mélanges. Le deuxième jour après le traitement à la surface de la marmelade, une peau protectrice, brillante et antiadhésive s'est formée. Après un jour de séchage, a été réalisé le saupoudrage du sucre des échantillons revêtus du film protecteur.Les échantillons ont été emballés dans des boîtes en plastique, qui ont ensuite été stockées à 18.0 ± 2 °C et à une humidité relative de 75.0 ± 5% (***, 2009).

Les échantillons expérimentaux ont été analysés en fonction des indicateurs physiques et chimiques de qualité et les données obtenues, à partir des déterminations, sont présentées dans le tableau 1.

Tableau 1

Caractéristiques physico-chimiques de la marmelade à gélifiant agar-agar(échantillon témoin)

Nr.	Produit / Indicateurs de qualité	Valeurs admissibles pour la marmelade gélifiée (***, 2009)	Échantillontémoin - marmelade à gélifiant agar-agar
1.	Fraction massique d'humidité,%	15 - 23	17.0 ± 0.2
2.	Fraction massique de substances réductrices,%, maximum	20	16.8 ± 0.2
3.	Acidité totale titrable, degrés d'acidité	7.5 – 22.5	9.5 ± 0.01
4.	Cendres, par rapport à la matière sèche, %	0.05 – 0.1	0.05 ± 0.03

- **Évolution de la qualité des produits gélifiés lors de la conservation**
- **Évolution de l'humidité lors de la conservation**

La teneur en eau est d'une importance capitale car elle est présente dans tous les aliments.

L'humidité initiale de l'échantillon témoin est de 17.0%, c'est-à-dire la teneur en S.U. de 83.0 ± 0.2% (tab. 1).

Les variations d'humidité suivantes ont été surveillées lors de la conservation de l'échantillon.La figure 1 montre la modification de la teneur en humidité dans les produits gélifiés à l'agar-agar lors de la conservation.

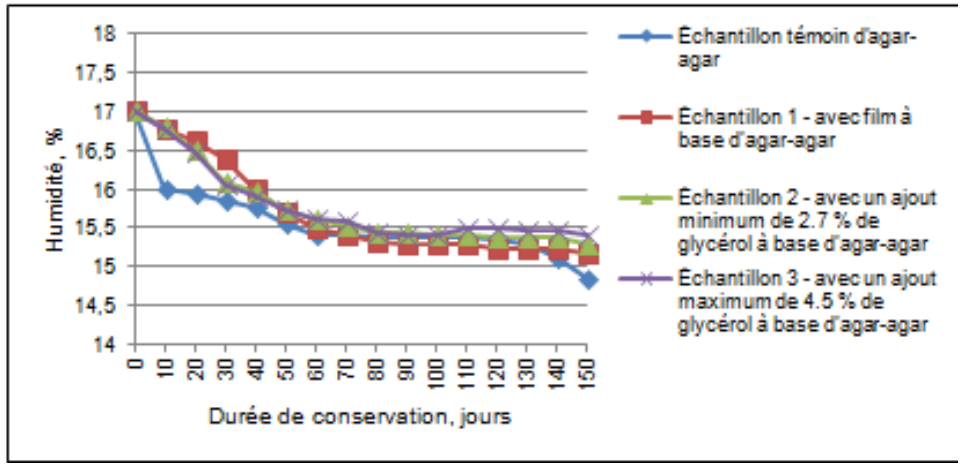

Fig. 1 Variation de l'humidité des échantillons de marmelade à l'agar-agar lors de la conservation

Dans les échantillons de produits gélifiés au cours des 30 premiers jours de conservation, on a observé une réduction soudaine de la teneur en humidité, la

période initiale étant caractérisée par une augmentation soudaine du gradient d'humidité et par sa migration des couches internes vers les couches externes avec évaporation intense de l'humidité capillaire de la surface du bonbon. Lorsque le produit est séché, le processus de diffusion interne s'intensifie dans le milieu dispersé (une solution aqueuse de sucre, mélasse et acides) du centre des produits vers les couches externes. Un grand nombre de molécules de saccharose se concentrent sur la surface déshydratée des produits, ce qui donne une croûte cristalline qui ralentit le processus de séchage (en particulier aux produits non enrobés).

Les processus décrits ci-dessus sont moins prononcés pour les produits gélifiés en film.

L'humidité finale dans les produits gélifiés à base d'agar-agar après 5 mois de conservation est indiquée dans le tableau 2.

Tableau 2

Teneur en humidité finale des échantillons d'agar-agar après 5 mois de conservation

Indicateurs de qualité	Échantillon témoin d'agar-agar	Échantillon 1 - avec film à base d'agar-agar	Échantillon 2 - avec un ajout minimum de 2.7% de glycérol à base d'agar-agar	Échantillon 3 - avec un ajout maximum de 4.5% de glycérol à base d'agar-agar
Fraction massique d'humidité,%	14.8±0.2	15.2±0.2	15.3±0.2	15.4±0.2
Fraction massique de la substance sèche, %	85.2±0.2	84.8±0.2	84.7±0.2	84.6±0.2

À la suite des études, on constate que divers ajouts ont eu une influence significative sur le taux de perte d'humidité des produits gélifiés (fig. 2).

Lorsque l'agar-agar est utilisé comme agent gélifiant (Tatarov, 2007), nous suivons: pour les échantillons filmés après cinq mois de conservation, la teneur en humidité est réduite de 1.96 %, avec un minimum d'ajout de glycérol de 2.72 %, avec un maximum d'ajout de glycérol 3.38 % envers l'échantillon témoin. Le glycérol/ glycérine a une grande capacité de liaison de l'eau, ce qui entraîne un séchage moins rapide des échantillons. D'après (Zubchenko, 1986), il est connu que si les produits gélifiés ont une texture plus dense, le processus de séchage est plus lent, ce qui est confirmé par les données expérimentales.

La réduction variée de l'humidité dans ces échantillons s'explique d'une part par les différentes capacités de rétention d'eau et d'autre part, par les différentes influences sur les propriétés structurelles-mécaniques de la gelée. Lors de l'utilisation du film protecteur, la principale substance active susceptible

d'influencer le processus de séchage est le glycérol, qui possède des propriétés de rétention d'eau.

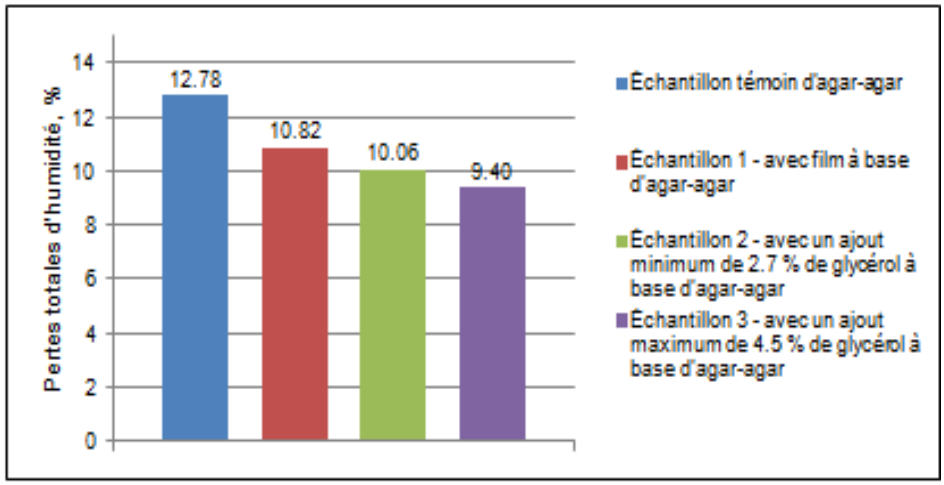

Fig. 2 Pertes totales d'humidité,%, par rapport à la teneur en humidité initiale du produit

À la suite de l'analyse de la variation d'humidité pendant la conservation et de la perte totale d'humidité, des résultats positifs ont été obtenus dans tous les cas, mais les meilleurs résultats sont présentés sur l'échantillon 3 - à base d'agar-agar, avec ajout maximal de glycérol.

• Évolution de l'activité de l'eau lors de la conservation

La valeur de l'activité de l'eau est un indice de base qui reflète la qualité et la sécurité des aliments et est standardisé dans tous les pays de l'Union Européenne et aux États-Unis (***, 1995).

Le monitorage de l'activitité de l'eau peut résoudre le problème de la stabilité des produits gélifiés pendant la conservation, car l'activité physiologique des micro-organismes dépend du contenu et de l'activité de l'eau dans les milieux nutritifs (Isengard, 2001).

Dans les produits analysés, l'activité de l'eau a été déterminée à l'aide du ROTRONIC HYGRO PALM. Les valeurs initiales et finales, après 5 mois de stockage, des échantillons analytiques à base d'agar-agar sont présentés dans le tableau 3 et la figure 3.

La marmelade est un produit d'humidité intermédiaire, au cas si l'activité de l'eau varie entre 0.65 et 0.9 (Sarafanova, 2004). Tous les échantillons analysés se situent dans ces limites (tab. 3).

Dans l'échantillon témoin à base d'agar-agar après cinq mois de conservation, la valeur de l'activité de l'eau est réduite de 22.6 % par rapport à la valeur initiale. Cela démontre que les produits fabriqués à base d'agar-agar présentent un risque minimal de dégradation microbiologique.

Si nous analysons l'échantillon 1 - avec film à base d'agar-agar, après cinq mois de conservation, nous observons une évolution moindre de l'activité de l'eau par rapport à l'échantillon témoin à base d'agar-agar de 5.3 %.

Tableau 3

Activité de l'eau dans les échantillons d'analyse

Échantillons expérimentaux	Valeur initiale	Valeurs, lors 5 mois	Évolution de l'activité de l'eau, AW	t, °C
Échantillons à base d'agar-agar				
Échantillon témoin d'agar-agar	0.72	0.557	- 0.163	18.80
Échantillon 1 - avec film à base d'agar-agar	0.710	0.624	- 0.086	18.60
Échantillon 2 - avec un ajout minimum de 2.7% de glycérol à base d'agar-agar	0.709	0.646	- 0.063	18.40
Échantillon 3 - avec un ajout maximum de 4.5% de glycérol à base d'agar-agar	0.72	0.664	- 0.056	18.40

Cela présente un avantage, car la couche protectrice (film) protège le produit des processus de séchage qui se produisent pendant la conservation.

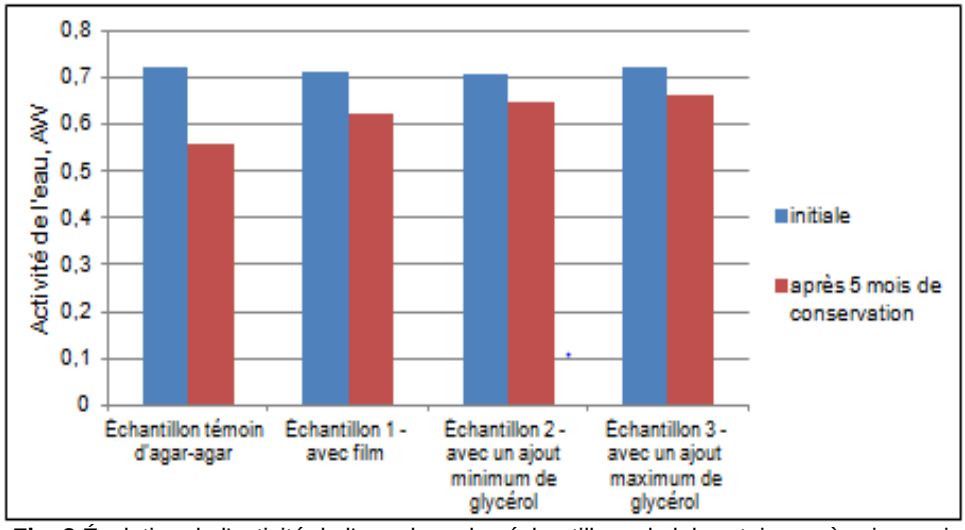

Fig. 3 Évolution de l'activité de l'eau dans des échantillons de laboratoire après cinq mois de conservation

Cependant, les meilleurs résultats ont été observés dans l'échantillon 3 - à base d'agar-agar avec ajout maximal de glycérol, où la différence entre la valeur initiale et finale de l'activité de l'eau est la plus faible, de 0.056 AW, ce qui correspond à une évolution de 34.3% par rapport à l'échantillon témoin.

- **Évolution de la qualité sensorielle**

Les caractéristiques sensorielles ont été analysées dans l'ordre suivant: aspect commercial, couleur et aspect dans la section, arôme, goût et odeur, surface, consistance, selon les documents normatifs et techniques.

Une autre caractéristique évaluée pour les échantillons expérimentaux était la variation des descripteurs en termes de temps, plus précisément, de la période de rétention. La limite de conservation a été établie selon les recommandations (***, 2009) d'après lesquelles le produit peut être conservé dans un emballage hermétique pendant une période de 5 mois.

Pour évaluer les caractéristiques de qualité, une réunion s'est tenue à laquelle ont participé des étudiants et des enseignants préalablement sélectionnés. Le groupe d'évaluateurs était composé de 7 personnes. Chaque évaluateur avait sa fiche d'analyse sensorielle individuelle. Un score de valeurs compris entre 0 et 5 a été attribué à chaque caractéristique des échantillons étudiés. En prenant en compte les scores moyens de l'évaluation sensorielle, on a élaboré une fiche centralisée de résultats. Sur la base des scores moyens pondérés, on a calculé le score moyen total (***,ISO 4121:2003; Banu, 2002).

Le diagramme de profil illustrent la représentation graphique des scores moyens, évaluant ainsi le profil du produit (fig. 4).

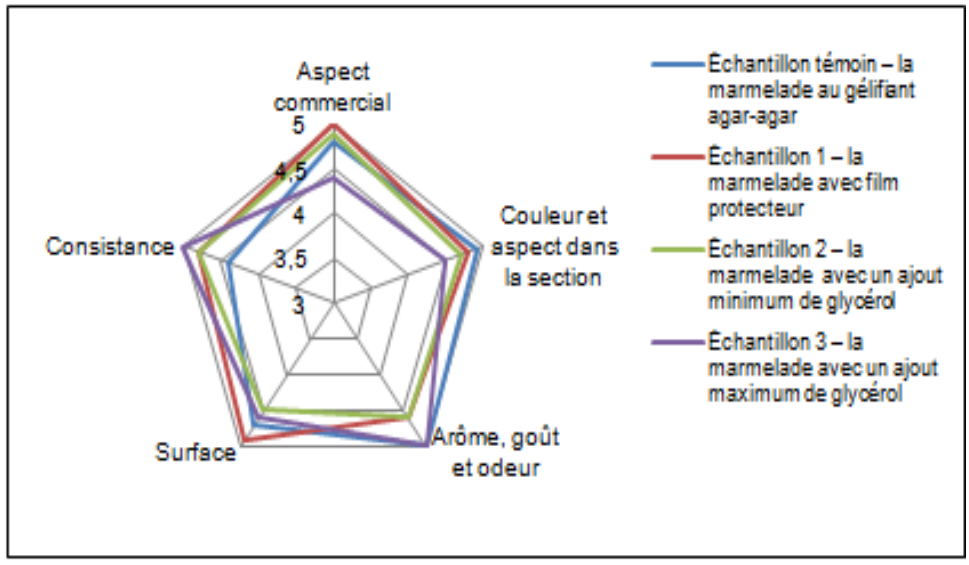

Fig. 4 Diagramme de profil de la marmelade à base d'agar-agar

L'évaluation sensorielle des échantillons expérimentaux a démontré la qualité et la stabilité les plus élevées au cours du temps. On a remarqué que la fixation du film se fait progressivement; par conséquent, dans la marmelade fraîche, à la rupture, le film est détaché de la surface du produit, mais il n'a pas

d'effet négatif sur les produits et, le produit en est classé pour un de très bonne qualité.

En suivant le diagramme de profil, généralement, on peut déterminer le produit présentant les caractéristiques sensorielles les plus optimales, à savoir l'échantillon 1 – la marmelade au gélifiant agar-agar avec film protecteur.

- **Évolution des indices microbiologiques**

L'analyse microbiologique du produit fini a confirmé l'innocuité des produits. La contamination microbiologique a été déterminée en semant sur le milieu Agar et le nombre total de levures et de moisissures sur le milieu Sabouraud. Le nombre total de germes dans l'échantillon analysé ne dépassait pas les exigences standard de 10^3 c/g de cellule formant des colonies. Dans les produits analysés on a confirmé l'absence de bactéries pathogènes et conditionné pathogènes, *Salmonella* et *Escherichia Coli*. Le nombre de levures et de micromycètes dans certains échantillons a été observé dans des cellules uniques de micro-organismes.

CONCLUSIONS

L'analyse de diverses compositions expérimentales a mis en évidence l'importance d'inclure des ajouts à base de glycérol dans la recette de marmelade au gélifiant d'agar-agar. Des études ont montré que ces ajouts peuvent être utilisées comme agents de rétention d'humidité: la couche protectrice (film) protège le produit des processus de séchage qui ont lieu pendant la conservation et le glycérol, en tant qu'agent humectant, retient l'eau dans le produit lors de la conservation.

Pour obtenir des indices de meilleure qualité pour la marmelade que ceux des produits classiques, il est important que la teneur en humidité de la marmelade atteigne 15.0%.

Les résultats finaux obtenus ont révélé la recette optimale, les plus efficaces étant les échantillons de marmelade enrobés de gélifiant d'agar-agar recouverts d'un film protecteur. Selon les indices organoleptiques, physico-chimiques et microbiologiques obtenus, les échantillons de marmelade peuvent être conservés plus longtemps que celui établi, avec de bonnes qualités pour la consommation et une durée de conservation supérieure à 5 mois.

Remerciements: *Agence Universitaire de la Francophonie (AUF) - projet S0446 SAIN (2017-2019)*

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QUALITY ASSURANCE AND TERM OF VALIDITY OF MARMELADE

Abstract*. The purpose of this research is to ensure the quality and shelf life of agar-agar marmalade. The experimental results are presented regarding the characterization of the main indicators of the quality of the marmalade, the changes that follow from the influence of the complex additives and their impact on the evolution of the quality indicators of the marmalade, the establishment of the optimal conditions for ensuring its stability during the preservation. Scientific results have been obtained demonstrating the possibility of routinely modifying the quality properties and improving the drinking qualities of gelling products with the use of additives that favor the water retention process in the product.*

Key words: jelly products, marmalade, moisture, texture properties, quality, food safety.

BIOCAPTEUR POUR LA DÉTECTION DE DÉRIVÉS PHÉNOLIQUES DES PRODUITS FUMÉS

BIOSENZOR PENTRU DETECȚIA DERIVAȚILOR FENOLICI IN PRODUSELEAFUMATE

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Résumé. *Une électrode enzymatique de type sérigraphie modifiée par la tyrosinase a été mis au point. Cette électrode a été optimisée pour fonctionner en mode FIA (Analyse par Injection en Flux). Le but de ce travail est la détermination quantitative des concentrations en composés phénoliques, pour le maintien de la qualité organoleptique de nombreux produits alimentaires fumés et le respect de législation visant l'innocuité des denrées.*
Mots clés:phénol, tyrosinase, produits fumés, biocapteur, sérigraphie

Rezumat. *Un electrod enzimatic de tip serigrafiat, modificat cu tirozinazaa fost elaboratpentru analiza anumitor compusi fenolici. Electrodul obținut a fost optimizat şi testat prin metoda de analiza în flux continuu.Obiectivul principal al acestei lucrări este determinarea cantitativă a unor compuşi fenolici pentru menținerea calității organoleptice aproduselor alimentare afumate şi respectarea legislației privind siguranța alimentară.*
Cuvinte cheie: fenol, tirozinaza, produse afumate, biosenzor, serigrafie

INTRODUCTION

Les polyphénols ou composés phénoliques, sont des molécules spécifiques du règne végétal. Le plus souvent, ils sont étudies en raison de leur propriétésantioxydantes et anticancérogènes. Les phénols sont probablement les composés organiques le plus souvent associés aux problèmes organoleptiques; ils provoquent des problèmes de gout et d'odeur a des concentrations aussi faibles que 1 μg/L（Onnerfjord *et al.,* 1995).

Lors du fumage, la fumée se dépose sur le produit. La composition chimique de la fumée est très variable selon la température et la quantité d'air présent lors de la pyrolyse. On y trouve des phénols, des alcools, des acides organiques, des composés carbonylés et des hydrocarbures. Certains composés sont cancérigènes, principalement les 3-4 benzopyrène (Knockaert, 1990). D'autres hydrocarbures aromatiques contenus dans la fumée sont également dangereux. Les composés phénoliques présent dans les aliments fumées font partie des produits apportés par le fumage.La détermination quantitative des concentrations

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en composés phénoliques est donc indispensable pour le maintien de la qualité organoleptique de nombreux produits alimentaires fumés et le respect de législation visant l'innocuité des denrées.

Le dosage des dérivés phénoliques est souvent réalisé par la chromatographie liquide d'haut performance (CLHP), chromatographie en phase gazeuse (CPG), spectrométrie de masse et calorimétrie. Cependant, malgré les performances reconnues pour ces méthodes, certains facteurs limitent leur utilisation en routine tels que le coût de l'analyse et la préparation des échantillons à analyser qui constitue toujours une phase très laborieuse (Rodriguez-Lopez *et al.,* 2001). A même temps ces techniques présentent l'inconvénient d'être difficilement "implantables" dans les sites de production. Les biocapteurs et les capteurs pourraient constituer donc une méthode alternative, rapide et très prometteuse pour les dosages en routine de composés phénoliques dans les produits fumés dans les sites industriels (Nikoleli *et al.,* 2018).

MATÉRIAUX ET MÉTHODES

Réactifs

Les produits chimiques utilises sont : phénol, glutaraldéhyde (SIGMA). p-crésol, m-crésol,gaïacol, crésol, eugénol, 4-ethylguaicol (ACROS), syringol, o-crésol (ALDRICH), isoeugénol (LANCASTER), 4-propylguiacol de SAFC, diclorophénol, tyrosinase (E.C.1.14.18.1, approximativement 3216 U/mg) de Fluka, poly (allylaminehydrochloride) de Alfa Aesar. Le stock des solutions standard de composésphénoliques a étépréparédansméthanol pour CLHP (PROLABO).

Méthodes et équipements

FIA -*l'analyse par injection en flux continu*

Le dispositif expérimental utilisé durant cette étude pour l'analyse par injection en fluxcontinu est constitué d'une pompe péristaltique multicanaux (Ismatec) permettant unréglage du débit volumique, d'une valve d'injection six voies (Rhéodyne) munie d'uneboucle d'injection de volume égal à 100 µL, d'un potentiomètre (BAS CV-1B), d'unenregistreur i=f(t) (Linseis L200E) et d'une cellule électrochimique de détection de typewall-jet fabriquée au laboratoire. L'analyse par injection en fluxcontinu a été utilisée pour tester le biocapteur en termes de sensibilité, stabilité,répétitivité et linéarité.

CPG -*chromatographie en phase gazeuse*

Le système chromatographique est représenté par un chromatograph en phasegazeuse Hewlett–Packard HP 6891, l'échantillon est injecté manuellement à l'aided'une microseringue à 1µl et d'un détecteur à ionisations de flamme (FID). Le moded'injection est un mode « splitless », la colonne utilisée est une colonne HP5. L'analyse a été effectué en chromatographie departage (gaz / liquide). La température du détecteur est 260°C, celle de l'injecteur: 290°C.La réponse du détecteur estenregistrée à l'aide du logiciel HP ChemStations.

RÉSULTATS ET DISCUSSIONS

Les travaux les plus récents se sont intéressés à la fabrication de biocapteurs de type sérigraphiées permettant d'effectuer le dosage des composés phénoliques.

Les biocapteurs ampérométriques basés sur l'immobilisation de la tyrosinase permettent la détection des dérivés monophénoliques et o-diphénoliques. Le fonctionnement du biocapteur modifié par la tyrosinase pour la détection de phénol est représenté dans fig.1.

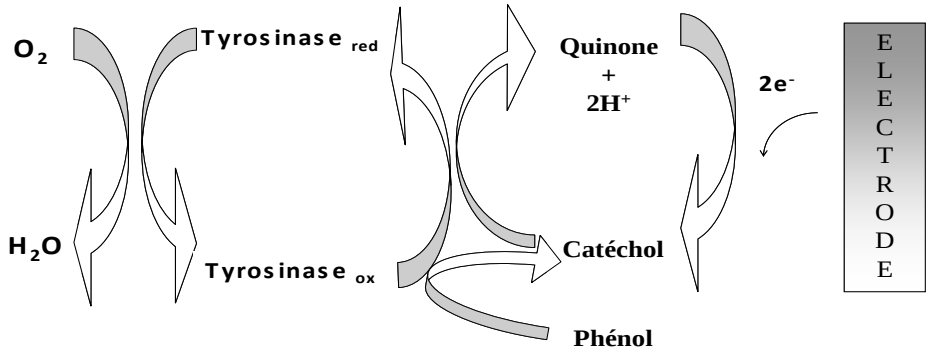

Fig. 1 Représentation schématique du fonctionnement du biocapteur modifié par la tyrosinase pour la détection des phénols

L'oxydation du phénol par la tyrosinase se fait dans deux étapes avec la formation du catéchol comme espèce intermédiaire, lors de cette oxydation la tyrosinase est réduite à la forme active de tyrosinase. La tyrosinase sous la forme oxydée est régénérée à son tour par l'oxygène présente dans la solution.

Ensuite l'o-quinone estélectrochimiquement réduite en catéchol qui génère un courant catalytique dont l'intensité est proportionnelle à la quantité de phénol présent dans la solution.

Les biocapteurs de type sérigraphie à base de tyrosinase sont obtenusdans le cadre de notre travail,après la fonctionnalisation de l'électrode sérigraphie par la modification de la surface de l'électrode de travail avec une membrane qui contient tyrosinase, poly (allylamine), et glutaraldéhyde.

Pour trouver une composition optimale de la membrane utilisée et augmenter les performances analytiques du biocapteur en termes de sensibilité et de stabilité opérationnelle, nous avons utilisé un plan d'expériences. Nous avons varié les facteurs suivant: la tyrosinase, la polyallylamine et la glutaraldéhyde, qui semblent en mesure d'avoir un effet sur la réponse du biocapteur (tab. 1).

Les niveaux bas noté par '-' et haut noté par ' +' choisis pourconstruire ce plan d'expérience s'appuient sur différents travaux préliminaires et sur les résultats obtenus précédemment pour des électrodes déjà testées dans le laboratoire.

Tableau 1

Choix des paramètres à étudier

No	Facteur	Niveau bas (-1)	Niveau haut (+1)
1	Tyrosinase (Tyr), mg/ml	2,5	5,0
2	Polyallylamine (Paa),%	0,025	0,05
3	Glutaraldehyde (Glut), %	0,0125	0,025

L'organisation des manipulations à réaliser pour un plan complet 2^3 est résumée dans le tableau 2.

Tableau 2

Matrice d'un plan factoriel complet à trois facteurs et deux niveaux

Expérience	Facteur 1	Facteur 2	Facteur 3	Réponse
1	-	-	-	y_1
2	+	-	-	y_2
3	-	+	-	y_3
4	+	+	-	y_4
5	-	-	+	y_5
6	+	-	+	y_6
7	-	+	+	y_7
8	+	+	+	y_8
Effet	E_1	E_2	E_3	

Pour résoudre le plan d'expériences, on procède au calcul des effets de chaque facteur et des interactions sur chaque réponse (sensibilité, stabilité opérationnelle).

Les valeurs des effets s'obtiennent par le calcul. Si l'effet calculé (ou l'interaction) est du même ordre de grandeur que son erreur, il peut influencer ou pas la réponse. Pour qu'un effet soit considéré significatif ou non, il est nécessaire de le comparer à l'écart type sur les effets, noté $\sigma_{E.}$

L'écart type sur les effets, σ_E, peut enfin être obtenu à partir de la formule suivante:

Ainsi huit types des électrodes sont prévus et testées. Selon les résultats obtenus, on a résumés les effets des facteurs choisi comme suit:

- l'augmentation de la quantité de tyrosinase utilisée influence de façon notable la sensibilité de l'électrode;
- l'augmentation du taux de Paa dans la membrane induit une augmentation de la stabilité opérationnelle du biocapteur;

- l'augmentation simultanée du taux de Paa et de celui de la tyrosinase permet d'améliorer la répétabilité des mesures;
- la diminution du taux de Glut permet d'améliorer la linéarité de l'électrode modifiée ainsi que la stabilité opérationnelle.

Compte tenu des résultats de plans d'expérience, nous avons choisi de modifier les électrodes à partir du mélange correspondant à l'essai 4 dans la matrice du plan d'expériences: la tyrosinase 5mg/ml (équivalent à 16 unités), la polyallylamine (Paa) 0,05%, la glutaraldéhyde (Glut) 0,0125%.

Cette composition donne un meilleur compromis entre la sensibilité et la stabilité opérationnelle. Les électrodes modifiées sont préparées en déposant manuellement sur l'électrode de travail une solution constituée de ces trois composés mélangés en volumes équivalents (50µL).

L'utilisation de l'électrode modifiée avec la tyrosinase pour la détection du phénol a nécessité la recherche des conditions optimales d'analyse. Nous avons étudié l'influence du potentiel, du pH et du solvant organique sur la réponse du biocapteur. La limite de détection est inférieure à 10 µmol.L^{-1}, la sensibilité est d'environ de 25 nA.µmol^{-1}.L et la réponse est linéaire sur une gamme de concentrations comprise entre 10 et 150 µmol.L^{-1}.Le biocapteur obtenu fonctionne en AIFC à 0 V vs. Ag/AgCl et présente des propriétés analytiques satisfaisantes.Ce travail a permis ensuite l'application du biocapteur à la détection des composés phénoliques dans des produits fumés.

En même temps, pour valider les résultats obtenus avec le biocapteur pour le dosage des composés phénoliques dans les produits fumés, nous avons analysé les enchantions avec la chromatographie en phase gazeuse. Dans le tableau 3, les résultats sont les moyennes de trois déterminations successives.

Tableau 3

Comparaison des teneurs en phénol et p-crésol obtenus avec le biocapteur en mode FIA et par chromatographie en phase gazeuse (CPG)

Produits analysés	FIA, C, µmol/ L	CPG C, µmol/ L
Jambon fumé	Phénol + p-crésol : **44.44 ± 1.09**	Phénol : 40.23 ± 1.38 p-crésol : 4.87 ± 0.42 Total : **45.10 ± 1.8**
Bacon fumé	Phénol + p-crésol : **39.10 ± 0.99**	Phénol : 36.68 ± 7.31 p-crésol : 2.32 ± 0.39 **total : 39.00 ±7.70**
Filet de poulet fumé	Phénol + p-crésol : **41.40 ± 2.35**	Phénol : 35.13 ± 1.12 p-crésol : 17.21 ± 1.73 **total : 52.34 ± 2.85**
Saumon fumé	Phénol + p-crésol : **37.07 ± 1.86**	Phénol : 30.76 ±0.86 p-crésol : 7.50 ± 1.34 **total : 38.26 ± 2.20**

Nous avons trouvé pour les taux de dérivés phénoliques dans les produits fumés une bonne corrélation entre les résultats obtenus enchromatographie en phase gazeuse et par le biocapteur en analyse en flux continu. On peut affirmer donc, que la méthode ampérométrique en utilisent le biocapteur à tyrosinase est juste.

CONCLUSIONS

1. Nous avons mis au point un biocapteur simple pour la détection du phénol.

2. On a optimisé la composition de l'électrode pour améliorer les performances analytiques (sensibilité et stabilité) du biocapteur final.

3. L'électrode Tyr/Paa/Glut peut être utilisée pour déterminer les faibles concentrations en phénol dans des échantillons réels, tels que le jambon; le bacon le poulet et le saumon fumé.

Remerciements: *Agence Universitaire de la Francophonie (AUF) - projet S0446 SAIN (2017 – 2019).*

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BIOSENSOR FOR THE DETECTION OF PHENOLIC COMPOUNDS OF SMOKED PRODUCTS

Abstract. *A tyrosinase modifiedserigraphy electrode has been developed. This electrode has been optimized to operate in FIA (Flux Injection Analysis) mode. The aim of this work is the quantitative determination of phenolic compounds concentrationof some smoked food products, on the frame of the maintenance of organoleptic quality and the respect of food safety legislation.*

Key words: phenol, tyrosinase, smoked products, biosensor, serigraphy

ÉTUDES SUR L'EXTRACTION DE COMPOSES PHÉNOLIQUES DE VIGNE BAGUETTES

STUDII PRIVIND EXTRACŢIA COMPUŞILOR FENOLICI DIN COARDELE DE VIŢĂ DE VIE

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Résumé. *Étant donné que la taille de la vigne produit chaque année une grande quantité de déchets inutilisables, le but de cette étude était d'évaluer le potentiel des baguettes de vigne à être utilisées comme source naturelle de composés bioactifs pour les industries alimentaire, pharmaceutique et cosmétique. Afin d'optimiser les procédures d'extraction phénoliques, les baguettes de vigne de raisin de Cabernet Sauvignon ont été extraites avec diverses concentrations d'éthanol (0, 50, 70, 90 et 96%) et d'hydroxyde de sodium 1N, dans un rapport matière végétale/solvant de 1:10. Pour purification ultérieure sur des cartouches C_{18} SPE préconditionnées, les surnageants ont été concentrés à sec dans un évaporateur rotatif sous vide. Après avoir déterminé la concentration optimale en solvant, le temps (<300 min) et la température (20, 40, 60 °C) nécessaires pour maximiser l'extraction des composés phénoliques ont été testés. La concentration la plus élevée en polyphénols a été obtenue lorsque l'extraction a été réalisée sur des baguettes de vigne broyées (particules <0,5 mm), avec une solution d'éthanol 70%, 4 heures à 60 °C. Après application de températures élevées, l'activité antioxydante et le pouvoir réducteur ferrique des extraits sont restés élevés (94,01% de DPPH nettoyé). Les résultats de la recherche indiquent que les baguettes de vigne sont sources durables de composés polyphénoliques avec fonction sanogène, actuellement inexploitées au potentiel technologique et économique réel.*
Mots-clés: vigne baguettes, composés polyphénoliques, Cabernet Sauvignon

Rezumat. *Deoarece tăierile anuale ale viţei de vie produc o mare cantitate de deşeuri inutilizabile, scopul acestui studiu a fost de a evalua potenţialul utilizării coardelor de viţă de vie ca sursă naturală de compuşi bioactivi pentru industria alimentară, farmaceutică şi cosmetică. Pentru a optimiza procedura de extracţie a compuşilor fenolici, coardele soiului Cabernet Sauvignon au fost supuse extracţiei cu etanol (0, 50, 70, 90 şi 96%) şi hidroxid de sodiu 1 N, în raport de 1:10 (m:v). Pentru purificarea ulterioară pe cartuşe C_{18} SPE precondiţionate, supernatantul a fost concentrat la sec prin evaporare în vid. După determinarea concentraţiei optime de solvent, au fost testate timpul (<300 min) şi temperatura (20, 40, 60 °C) necesare pentru maximizarea extracţiei compuşilor fenolici. Cea mai ridicată concentraţie de compuşi fenolici a fost obţinută atunci când extracţia a fost efectuată pe material vegetal mărunţit (particule <0,5 mm), cu etanol 70%, 4 ore la 60 °C. După aplicarea*

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temperaturilor ridicate, activitatea antioxidantă a extractelor a rămas ridicată (94,01% DPPH inhibat). Rezultatele obținute justifică utilizarea coardelor de viță de vie ca sursă sustenabilă de compuşi polifenolici cu potențial sanogen, neexploatată în prezent la potențialul tehnologic şi economic real.
Cuvinte cheie: coarde de viță de vie, compusi fenolici, Cabernet Sauvignon

INTRODUCTION

Les vignes baguettes sont des sarments qui ont environ un an. À ce stade, il y a développé une couche visible d'écorce et a perdu toutes ses feuilles (Çetin *et al.*, 2011). Parce que la taille de la vigne produit chaque année une grande quantité de déchets inutilisables, le but de cette étude était d'évaluer le potentiel des baguettes de vigne à être utilisées comme source naturelle de composés bioactifs pour les industries alimentaire, pharmaceutique et cosmétique. Les méthodes utilisées pour cette évaluation doivent répondre à trois critères de base: elles doivent être rapides, les résultats obtenus doivent être reproductibles, et inclure toutes les molécules de phénol (Rajha *et al.,* 2014).

Etant donné que différents systèmes d'extraction de composés phénoliques ont été utilisés et que les résultats diffèrent considérablement en fonction du solvant et du procédé choisi, il est indispensable d'identifier des procédés d'extraction unitaires exploitant le potentiel du matériel biologique.

MATÉRIAUX ET MÉTHODE

La recherche a été réalisée sur des baguettes de vigne âgées d'un an, récoltées lors de la taille du printemps 2018 (la dernière semaine de mars) apartenir du cultivar *Vitis vinifera* L. Cabernet Sauvignon, cultivé dans la collection ampélographique de la Station de Recherche et Développement pour Viticulture et Vinification Iasi, Roumanie (27° 53' E; 47° 20' N). Le porte-greffe utilisé était la Sélection Openheim 4 (*V. berlandieri* × *V. riparia*). Les opérations technologiques étaient spécifiques au vignoble industriel, sans irrigation ou fertilisation.

Pour optimiser les procédures d'extraction phénolique, les baguette de vigne ont été extraites avec diverses concentrations d'éthanol (0, 50, 70, 90 et 96%) et hydroxyde de sodium 1N, dans un rapport matière végétale/solvant 1:10. Pour purification sur des cartouches C_{18} SPE, les surnageant a été concentré à sec sous vide à 35 °C. Le sorbant contenant les polyphénols a été séché et dégraissé avec 10 mL d'hexane 99%. L'élution des polyphénols a été réalisée avec 20 mL d'éthanol à 96%. Les extraits polyphénoliques ont été évaporés à sec à 25 °C et remis en suspension dans l'éthanol à 96%, à une concentration de 100 µg/mL. Après avoir déterminé la concentration optimale du solvant, ont été testés le temps (<300 min) et la température (20, 40, 60 °C) nécessaires pour maximiser l'extraction des composés phénoliques. Teneur total en polyphénols (TPT) ont été déterminés avec le réactif Folin-Ciocalteu (OIV, 2012). Les résultats ont été exprimés en grammes d'équivalent acide gallique (EAG) par 100 g de poids sec (p.s.). Les flavonoïdes ont été précipités avec formaldéhyde à un pH <0,8 (Tibiri et collab., 2010). La teneur en glucides a été déterminée par extraction des hydrates de carbone (éthanol 80%) à partir de baguettes de vigne broyées séchées (65 °C), et mesure spectrophotométrique de la couleur intensité à 580 nm (% glucose).

L'activité de inhibation des radicaux libres comme 2,2-diphényl-1-picrylhydrazyle (DPPH) de chaque extrait a été mesurée selon la procédure de Brand-Williams et collab. (1995). Le pouvoir réducteur ferrique a été déterminé selon la méthode de Vijayalakshmi et Ruckmani (2016).

RÉSULTATS ET DISCUSSIONS

Le teneur en glucides totaux des baguettes de vigne sont indiquées dans le tableau 1. Dans le total des carbohydrates, l'amidon était environ 44%.

Tableau 1

Caractéristiques chimiques des baguettes de vigne

Cultivar	Humidité (%)	Amidon (%)	Glucides (%)	Carbohydrates total (%)
Cabernet Sauvignon	53,60	5,53	7,08	12,61

La concentration la plus élevée en polyphénols a été obtenue lorsque l'extraction sur des baguettes de vigne broyées a été effectuée avec éthanol 70% (7,96 mg/g p.s.), et par extraction alcaline avec NaOH 1 N (7,98 mg/g p.s.). Lorsque l'extraction a été réalisée avec éthanol 70%, la plus grande quantité de flavonoïdes (4,94 mg EAG/g p.s.) a été obtenue, tandis que l'extraction avec hydroxyde était plus efficace pour composés phénoliques non-flavonoïdes. Résultats similaires ont été rapportés par Delgado-Torre et collab. (2012).

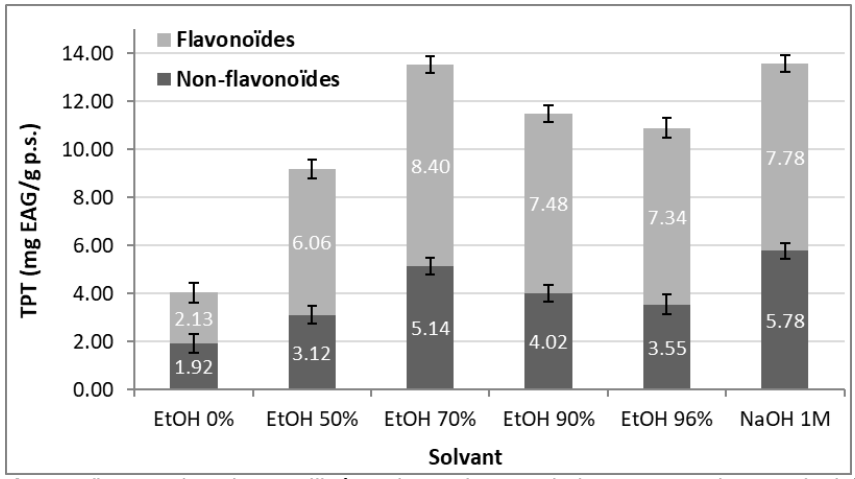

Fig. 1 Influence du solvant utilisé sur le rendement de la teneur totale en polyphénols (TPT) (Cabernet Sauvignon baguettes, particules <0,5 cm; 180 min; 20 °C)

L'activité antioxydante (AA) des extraits de baguettes de vigne était élevée à concentrations d'alcool élevées, atteignant 94% de DPPH inhibé à l'extraction avec éthanol 70% et 90%. De plus, le taux de FRC était élevé, présentant des valeurs comprises entre 0,66 (eau distillée/éthanol 0%) et 2,87 (éthanol 70%).

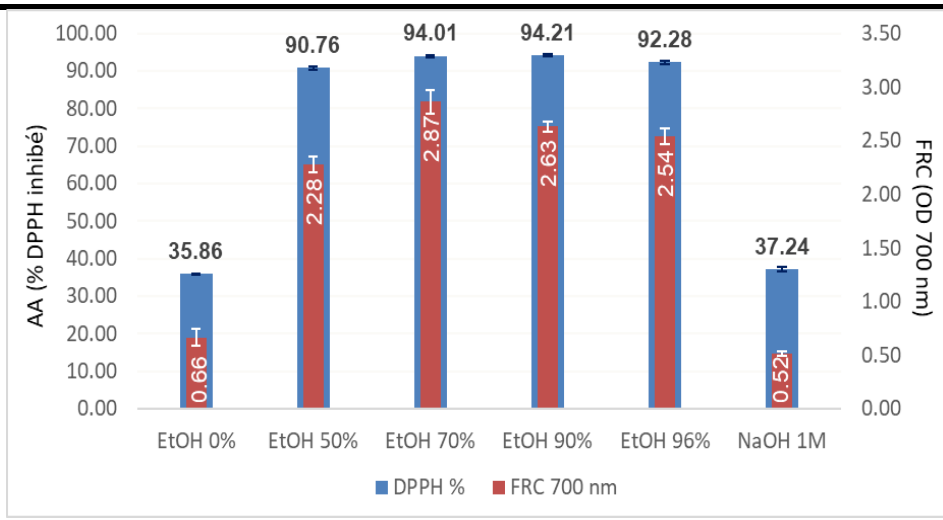

Fig. 2 Activité antioxydante (AA) et pouvoir réducteur ferrique (FRC) des baguettes

Bien que l'hydroxyde de sodium 1N ait extrait une quantité significative de composés phénoliques déterminée par le réactif Folin-Ciocalteu, l'activité antioxydante et le pouvoir réducteur ferrique ont été réduites. Une forte corrélation a été trouvée entre la teneur totale en polyphénols et l'activité antioxydante des extraits, montrant l'implication significative de ces composés dans l'activité biologique des extraits (fig. 3).

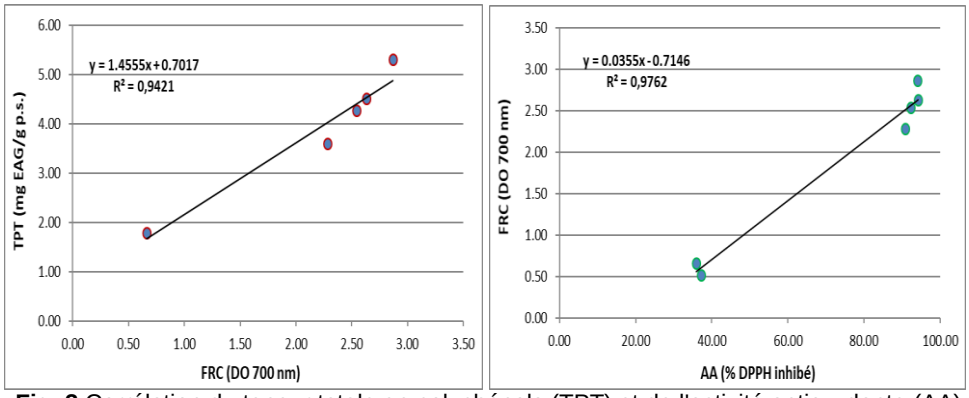

Fig. 3 Corrélation du teneur totale en polyphénols (TPT) et de l'activité antioxydante (AA)

Les concentrations des composés phénoliques extraits étaient plus élevées en temp la température montait. Ainsi, à 60 ° C, l'indice de polyphénol de l'extrait atteignait 85,20 en 4 heures, puis est entré dans la phase de plateau ou même tomber (fig. 4).

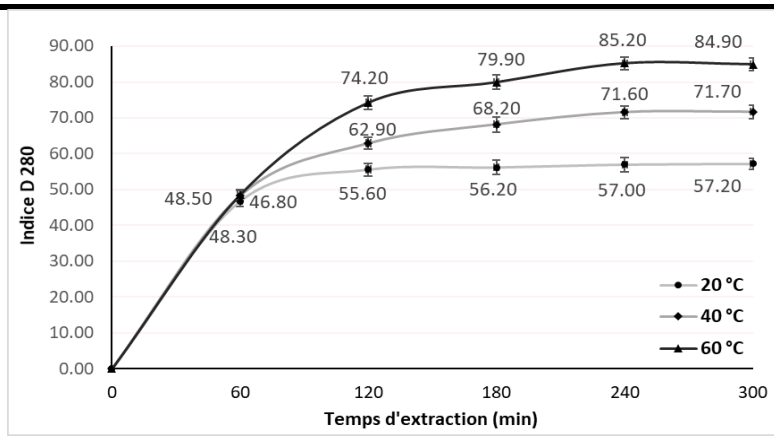

Fig. 4 Cinétique de l'extraction à l'éthanol à 70% de polyphénols de la baguette de Cabernet Sauvignon à 20, 40 et 60 °C. Indice D_{280}: densité optique à 280 nm × dilution.

Pour l'épuisement du matériel végétal, trois phases d'extraction ont été jugées suffisantes, dans la première phase être extrait plus de 78% du total des composés phénoliques (fig. 5).

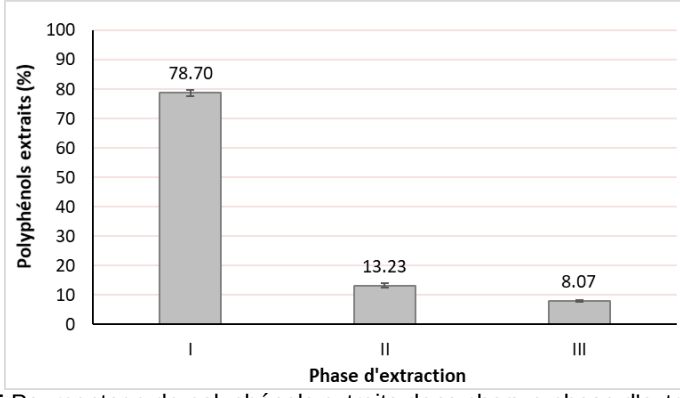

Fig. 5 Pourcentage de polyphénols extraits dans chaque phase d'extraction (70% d'éthanol, 60 °C, 240 min)

CONCLUSIONS

1. En raison de la purification sur les cartouches C_{18}, les extraits de baguettes de vigne contenaient quantités plus grandes de flavonoïdes.

2. La concentration plus élevée en polyphénols a été obtenue lorsque l'extraction a été effectuée avec éthanol 70%, 4 heures, 60 °C, sur des baguettes de vigne broyées (particules <0,5 mm).

3. L'activité antioxydante des extraits était élevé, en corrélation avec le contenu phénolique des extraits.

4. Les résultats de la recherche indiquent que les baguettes de *Vitis vinifera L.* sont sources durables de composés polyphénoliques à fonction sanogène, actuellement inexploitées au potentiel technologique et économique réel.

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STUDIES ON THE EXTRACTION OF PHENOLIC COMPOUNDS FROM GRAPEVINE CANES

Abstract: *Since a high amount of unusable waste is produced annually by grapevine pruning, the aim of this study was to evaluate the potential of vine canes to be used as a natural source of bioactive compounds for food, pharmaceutical and cosmetic industries. For the optimization of phenolic extraction procedures, grape canes of Cabernet Sauvignon were extracted with various concentrations of ethanol (0, 50, 70, 90 and 96 %) and 1N sodium hydroxide, in a plant material/solvent ratio of 1:10. For further purification on preconditioned C18 SPE cartridges, supernatants were concentrated to dry in a vacuum rotary evaporator. After determining the optimal solvent concentration, time (<300 min) and temperature (20, 40, 60 °C) required to maximize phenolic compounds extraction were tested. The highest polyphenol concentration was obtained when the extraction was performed on milled vine canes (<0.5 mm particle), with 70% ethanol, 4 hours at 60 °C. After applying high temperatures, antioxidant activity and the ferric reducing power of the extracts remained high (94.01% scavenged DPPH). The research results indicated that Vitis vinifera L. canes, are sustainable sources of polyphenolic compounds with sanogenous function, currently unexploited at the real technological and economic potential.*
Key words: vine canes, polyphenolic compounds, Cabernet Sauvignon

ÉTUDES SUR LA CORRELATION ENTRE L'ACTIVITE DE LA POLYPHENOLOXYDASE ET LA TENEUR PHENOLIQUE TOTALE DE CERTAINS CEPAGES AUTOCHTONES DE RAISIN DE TABLE

STUDII PRIVIND CORELAŢIA DINTRE ACTIVITATEA POLIFENOLOXIDAZEI ŞI CONŢINUTUL FENOLIC TOTAL AL UNOR SOIURI AUTOHTONE DE STRUGURI DE MASĂ

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Résumé. *La modification indésirable de la couleur, de la saveur et de la texture du raisin est associée aux enzyme polyphénoloxydase (PPO). Il est donc important de contrôler leur effet et d'établir leurs caractéristiques associées aux fruits. Raisins (peau, pulpe et pepines) de dix cépages roumains pour raisins de table (Splendid, Cetăţuia, Milcov, Transilvania, Someşan, Napoca, Gelu, Coarnă neagră selecţionată, Purpuriu et Radames), ont été analysés pour déterminer l'activité de la PPO, la teneur en composés phénoliques totaux (flavonoïdes et non-flavonoïdes) et en anthocyanes. La teneur totale en composés phénoliques était plus élevée dans les pepins, allant de 4,36 à 5,35 g équivalent acide gallique/100 g poids frais, dont les flavonoïdes se situaient entre 65 et 88%. L'activité PPO plus élevée a été déterminée dans l'extrait de raisin de la cépage Radames (7,91 U/g/min), tandis que la teneur en anthocyanes totales était plus importante dans les raisins de la cépage Napoca (343,86 mg équivalent cyanidine-3-glucoside/100 g poids frais). Des corrélations négatives plus fortes ont été trouvées entre l'activité PPO et le contenu en anthocyanes (r = -0,9180), ainsi qu'entre l'activité PPO et le contenu phénolique total des peaux de raisin (r = -0,9266) et de la pulpe de raisin (r = -0,9397), suggérant l'effet négative de l'enzyme sur cette classe de composés.*
Mots-clés: anthocyanes, composés phénoliques, polyphénoloxydase, raisins de table, *Vitis vinifera* L.

Rezumat. *Modificările nedorite ale culorii, aromei şi texturii strugurilor sunt direct asociate cu activitatea enzimei polifenoloxidaza (PFO). Prin urmare, este deosebit de important ca efectele acesteia asupra fructelor să fie bine cunoscute şi monitorizate. Astfel, a fost determinată activitatea PFO, concentraţia de polifenoli totali (flavonoizi şi non-flavonoizi) şi antociani din bacele (pieliţe, pulpă şi seminţe) provenind de la zece soiuri autohtone Vitis vinifera L. pentru struguri de masă (Splendid, Cetăţuia, Milcov, Transilvania, Someşan, Napoca, Gelu, Coarnă neagră selecţionată, Purpuriu şi Radames). Cel mai ridicat conţinut fenolic total a fost determinat în seminţe, între 4,36 şi 5,35 g echivalent acid galic/100 g masă proaspătă (m.p.), procentul de flavonoizi fiind între 65 şi*

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88%. Soiul Radames a prezentat cea mai intensă activitate a PFO (7,91 U/g/min), în timp ce conținutul în antociani a fost cel mai ridicat în pielița strugurilor soiului Napoca (343,86 mg echivalent cianidină-3-glucozid/100 g m.p.). Au fost înregistrate corelații negative între activitatea PFO şi conținutul de antociani (r = -0,9180), precum şi între activitatea PFO şi conținutul polifenolic total din pieliță (r = -0,9266) şi pulpă (r = -0,9397), evidențiind efectul distructiv al enzimei asupra acestei clase de compuşi.
Cuvinte cheie: antociani, compuşi fenolici, polifenoloxidaza, struguri de masă, *Vitis vinifera* L.

INTRODUCTION

La polyphénoloxydase (PPO), aussi connue sous le nom d'o-diphénoloxydase (EC 1.10.3.1), joue un rôle important dans la respiration, en catalysant l'oxydation des polyphénols et de leurs dérivés, afin de produire les quinones correspondantes (Rocha et De Morais, 2005). Appartient à la classe des oxydoréductases, PPO est responsable du changement indésirable de couleur (assombrissement enzymatique), de la saveur et de la texture des raisins. Dans les baies endommagées est possible de développer une saveur désagréable et une perte de couleur, qui vont affecter la qualité du raisins (De Pieri *et al*, 2003).

Les polyphénols sont métabolites secondaires de plantes généralement impliqués dans la défense contre les rayons ultraviolets ou l'agression d'agents pathogènes chez les plantes (Pandey et Rizvi, 2009). Dans les aliments, les polyphénols peuvent contribuer à l'amertume, astringence, couleur, saveur, stabilité olfactive et à la résistance à l'oxydation (Vermerris et Nicholson, 2006). Des études épidémiologiques récentes ont fortement suggéré que la consommation de polyphénols offrait une certaine protection contre le développement de cancers, de maladies cardiovasculaires et neurodégénératives (Cory *et al,* 2018).

Souvent, corrélations négatives ont été trouvées entre l'activité de PPO et la teneur totale en composés phénoliques de raisins (Orak, 2007), il est donc important de contrôler l'effet de l'enzyme et d'établir ses caractéristiques.

MATÉRIAUX ET MÉTHODES

Les recherches ont été effectuées sur des baies mûres de dix cépages de raisin de table *Vitis vinifera* L. (Gelu, Milcov, Cetățuia, Napoca, Someşan, Splendid, Transilvania, Coarnă neagră selecționată, Purpuriu et Radames), cultivés dans la collection ampélographique de l'Université des Sciences Agronomiques et de Médecine Vétérinaire de Iasi, Roumanie. Les baies congelées ont été séparées dans peau (pellicule), pulpe et pépins (5 g chacune), broyées séparément et extraites avec 100 ml de méthanol avec HCl 0,1% (v/v), pendant une nuit à la température ambiante.

Pour l'estimation des polyphénols totaux, on a utilisé la réactif Folin-Ciocâlteau (Singleton et Rossi, 1965). Les résultats ont été exprimés en grammes d'équivalent acide gallique (EAG) par 100 g de poids frais (p.f.). Les flavonoïdes ont été précipités par formaldéhyde à un pH <0,8 (Tibiri *et al*., 2010). La détermination des anthocyanes monomères a été effectuée par la méthode du pH différentiel et exprimée en équivalents de cyanidine-3-glucoside (EC) (Lee *et al*., 2005).

La polyphénoloxydase a été dosée par extraction avec un tampon phosphate (pH 7,4) (Ermakov, 1987). Une unité enzymatique (U) représente la quantité d'enzyme qui catalyse la conversion d'une micromole de catéchol en une minute, à 25 °C.

RÉSULTATS ET DISCUSSIONS

L'humidité, la matière sèche totale, les minéraux, le sucre et l'acidité des variétés roumaines à maturité technologique sont présentés dans le tableau 1. Le rapport sucre/acide variait de 23,17 (Purpuriu) à 42,50 (Radames), supérieur à la valeur minimale (20:1), requise par l'OIV (2008) pour les raisins de table mûrs.

Tableau 1

Caractéristiques chimiques des raisins

Cultivar	Humidité (%)	Minéraux (%)	Sucres (g/L)	Acidité totale (g/L acide tartrique)
Purpuriu	83,48 ± 1,02	0,29 ± 0,09	183,05 ± 3,49	7,90 ± 0,10
Splendid	83,67 ± 0,87	0,37 ± 0,12	182,67 ± 3,03	5,87 ± 0,42
Radames	79,19 ± 2,01	0,50 ± 0,08	235,85 ± 9,88	5,55 ± 0,41
Cetăţuia	80,91 ± 1,45	0,54 ± 0,14	180,41 ± 11,03	5,20 ± 0,06
Coarnă neagră select.	83,91 ± 0,98	0,38 ± 0,11	201,30 ± 10,82	6,70 ± 0,46
Transilvania	82,66 ± 1,11	0,39 ± 0,09	187,65 ± 9,28	6,50 ± 0,44
Someşan	84,84 ± 2,01	0,39 ± 0,07	175,08 ± 5,83	5,93 ± 0,12
Napoca	81,19 ± 1,16	0,40 ± 0,11	172,42 ± 3,40	6,50 ± 0,26
Gelu	80,94 ± 1,37	0,43 ± 0,18	192,33 ± 11,44	4,94 ± 0,08
Milcov	79,47 ± 2,11	0,49 ± 0,06	171,99 ± 14,90	7,37 ± 0,15

Les cultivars présentaient une teneur en anthocyanes comprise entre 103,70 et 343,86 mg CE/100 g p.f. (tab. 2). L'activité de la polyphénoloxydase dans les extraits de baies avait un maximum de 7,11 ± 0,13 U/g/min (Radames cv.).

Tableau 2

Teneur polyphénolique totale (TPT) et l'activité de polyphenoloxydase (PPO)

Cultivar	Anthocyanes (mg EC%)	Peau TPT (g EAG%)	Pulpe TPT (g EAG%)	Pépin TPT (g EAG%)	PPO (U/g/min)
Purpuriu	248,48 ± 0,21	1,66 ± 0,09	0,33 ± 0,02	4,38 ± 0,45	5,82 ± 0,12
Splendid	218,87 ± 1,54	1,70 ± 0,11	0,33 ± 0,01	4,45 ± 0,12	6,01 ± 0,08
Radames	103,70 ± 1,00	1,56 ± 0,08	0,32 ± 0,05	4,06 ± 0,30	7,11 ± 0,13
Cetăţuia	299,23 ± 2,29	1,77 ± 0,08	0,34 ± 0,01	4,58 ± 0,40	4,60 ± 0,06
Coarnă neagră select.	293,16 ± 2,16	1,81 ± 0,14	0,34 ± 0,02	5,07 ± 1,08	4,66 ± 0,11
Transilvania	274,68 ± 1,02	1,75 ± 0,24	0,34 ± 0,02	5,15 ± 1,21	4,41 ± 0,07
Someşan	318,92 ± 0,95	1,80 ± 0,07	0,34 ± 0,04	4,80 ± 0,68	4,68 ± 0,09
Napoca	343,86 ± 1,74	1,80 ± 0,11	0,34 ± 0,08	4,88 ± 1,14	4,32 ± 0,11
Gelu	198,33 ± 1,33	1,67 ± 0,08	0,33 ± 0,02	4,49 ± 0,98	6,30 ± 0,12
Milcov	303,84 ± 2,18	1,75 ± 0,06	0,34 ± 0,03	4,59 ± 1,27	5,40 ± 0,14

Les flavonoïdes constituent la classe la plus importante de composés phénoliques dans les peaux (fig. 1) et les pépins (fig. 2), tandis que dans la pulpe, les non-flavonoïdes étaient prédominants (fig. 3). Le pourcentage de flavonoïdes par rapport au TPT variait dans les peaux de 64,57% (Transilvania) à 71,05%

(Cetăţuia), dans les pépins de 65,28% (Milcov) à 86,35% (Splendid) et dans les pulpes de 9,35% (Gelu) à 27,27% (Purpuriu).

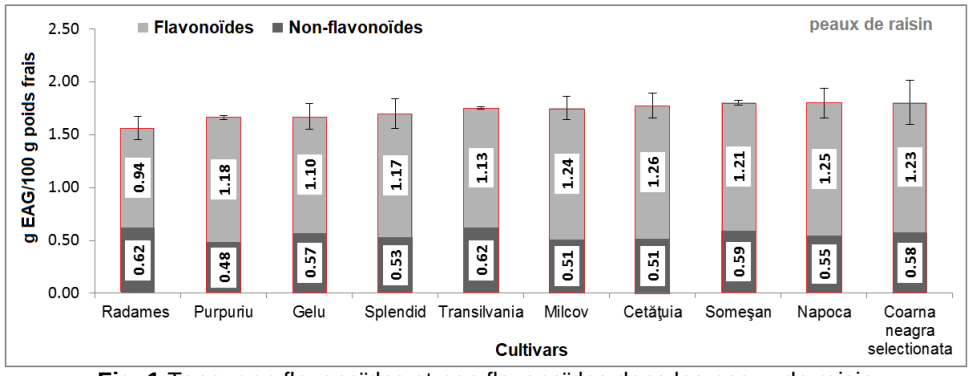

Fig. 1 Teneur en flavonoïdes et non flavonoïdes dans les peaux de raisin

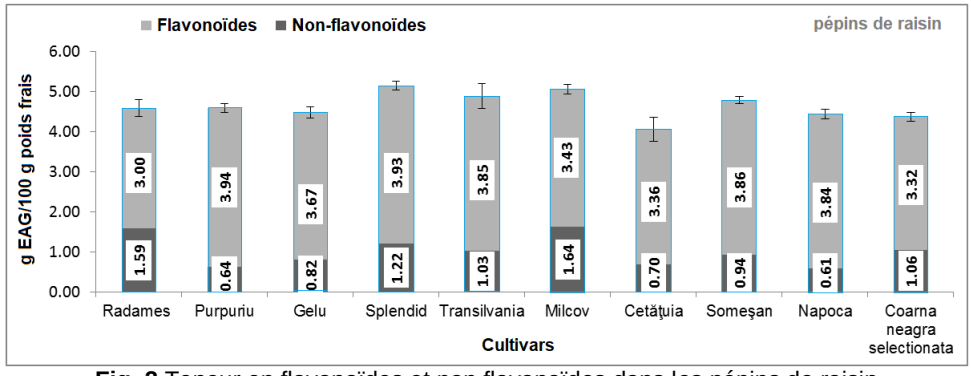

Fig. 2 Teneur en flavonoïdes et non flavonoïdes dans les pépins de raisin

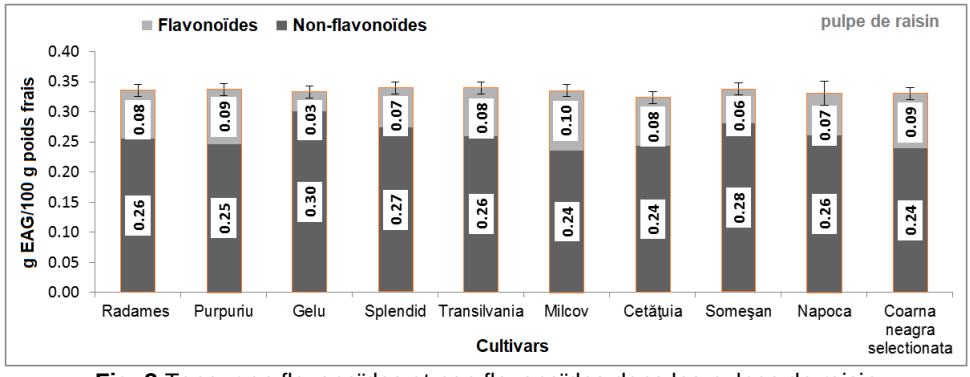

Fig. 3 Teneur en flavonoïdes et non flavonoïdes dans les pulpes de raisin

Le tableau 3 présente les coefficients de corrélation des relations identifiées entre les paramètres expérimentaux.

Tableau 3

Corrélation du teneur en polyphénols totale (TPT), anthocyanes (AC), flavonoïdes (Fl), non-flavonoïdes (NFl) et l'activité de polyphenoloxydase (PPO)

Paramètre	**PPO**	**AC**	**Peau TPT**	**Peau NFl**	**Peau F**	**Pulpe TPT**	**Pulpe NFl**	**Pulpe Fl**
AC	**-0,9180**	1						
Peau TPT	**-0,9266**	**0,9639**	1					
Peau NFl	0,0502	-0,2783	-0,1195	1				
Peau Fl	**-0,7772**	**0,9204**	0,8711	-0,5917	1			
Pulpe TPT	**-0,9397**	**0,8611**	0,9020	-0,0068	0,7358	1		
Pulpe NFl	**0,8132**	-0,8174	-0,7567	0,3980	-0,8113	-0,7015	1	
Pulpe Fl	**-0,8833**	**0,8698**	0,8280	-0,3343	0,8377	0,8029	-0,9880	1
Pépin TPT	**-0,8713**	0,7948	0,8401	0,2337	0,5666	0,8770	-0,6483	0,7319
Pépin NFl	-0,3872	0,5598	0,4509	-0,0263	0,3791	0,3592	-0,4568	0,4598
Pépin Fl	-0,4561	0,1824	0,3521	0,2695	0,1526	0,4936	-0,1485	0,2310

Une activité élevée de la PPO avait une influence négative sur la teneur en anthocyanes (AC) des raisins (r = –0,9180). Après Kader et collab. (1997), les phénolases sont communes enzymes de dégradation des anthocyanes, mais la destruction de pigment est plus efficace en présence d'autres composés phénoliques (catéchol, acide chlorogénique). Avec une augmentation de l'activité de PPO, composés phénoliques totaux de peaux ont suivi la même tendance que pour les anthocyanines, la fraction flavonoïde étant plus affectée (r = –0,7772).

CONCLUSIONS

1. La teneur en anthocyanes des peaux de raisin était fortement corrélée à leur teneur en flavonoïdes. La concentration en flavonoïdes était plus élevée dans les peaux et les pépins de raisin, tandis que les non-flavonoïdes prédominaient dans la pulpe de raisin.

2. Une activité élevée de la polyphénoloxydase dans les raisins était négativement corrélée à une teneur plus faible en anthocyanes et en composés phénoliques totale des peaux, de la pulpe et des pépines. Considérant l'effet destructeur possible de la polyphénoloxydase sur les anthocyanes, études complémentaires sont nécessaires pour évaluer l'influence de l'enzyme sur les paramètres chromatiques des peaux de baies.

3. Les données expérimentales obtenues sont utiles aux chercheurs, sélectionneurs et spécialistes de l'horticulture et de l'industrie alimentaire et peuvent servir de base de comparaison pour futures études.

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STUDIES REGARDING THE CORRELATION BETWEEN POLYPHENOLOXIDASE ACTIVITY AND TOTAL PHENOLIC CONTENT OF SOME AUTOCHTHONOUS CULTIVARS FOR TABLE GRAPES

Abstract. *The undesirable change in the grape color, flavor and texture is associated with the enzyme polyphenol oxidase (PPO), therefore it is important to control their effect, as well as to establish their characteristics associated to the fruits. Grapes (skin, pulp and seeds) of ten Romanian vine cultivars (cv.) for table grapes (Splendid, Cetățuia, Milcov, Transilvania, Someşan, Napoca, Gelu, Coarnă neagră selecționată, Purpuriu and Radames), grown in the Ampelographic collection of University of Agricultural Sciences and Veterinary Medicine Iaşi, Romania, were analyzed for determination of PPO activity, total phenolics (flavonoids and non-flavonoids) and total anthocyanin content. The highest phenolic content was found in seeds, ranging from 4.36 to 5.35 g gallic acid equivalent/100 g fresh weight, of which flavonoids were between 65 and 88%. The highest PPO activity was determined in the extract of Radames cv. grapes (7.91 U/g/min), while total anthocyanin content was the most important in Napoca cv. grape skins (343.86 mg cyanidin-3-glucoside equivalent/100 g fresh weight). Were found stronger negative correlations between PPO activity and anthocyanin content (r = -0,9180) as well as between PPO activity and total phenolic content of grape skins (r = -0,9266) and pulp (r = -0,9397), highlighting the destructive effect of the enzyme on this type of compounds.*

Key words: anthocyanins, phenolic compounds, polyphenol oxidase, table grapes, *Vitis vinifera* L.

ACTIVATION DES BOURGEONS LATENTS DE DIFFERENTS REJETS D'ANANAS (*Ananas comosus*) POUR LA PROPAGATION EN MASSE DE PLANTES EN CONDITIONS HORTICOLES *IN VIVO*

ACTIVAREA MUGURILOR LATENŢI AI DIFERIŢILOR LĂSTARI DE ANANAS (*Ananas comosus*) PENTRU PROPAGAREA ÎN MASĂ A PLANTELOR ÎN CONDIŢII HORTICOLE *IN VIVO*

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Résumé: *L'ananas est l'une des plus importantes espèces fruitières tropicales de culture intensive. Mais, en République Démocratique du Congo (RDC), la production est de plus en plus faible à cause de manque des matériels de plantation et de techniques appropriées pour sa multiplication. L'ananas dispose de plusieurs types d'organes qui peuvent être utilisés pour la multiplication. Cependant, il est considéré comme une plante dont la multiplication naturelle est particulièrement lente car la multiplication de l'ananas est obligatoirement végétative du fait que l'espèce est autostérile. Se référant au cas du cultivar Cayenne Lisse (PY 1979), montre qu'à la récolte du fruit, seule la couronne est disponible comme matériel pouvant être utilisé pour la replantation. De plus, selon la destination du fruit, même la couronne peut être indisponible. Quant aux cayeux, happas et bulbille, leur formation ne débutant souvent qu'après la phase reproductive de la plante, on n'arrive à récolter en moyenne qu'un seul rejet par pied planté trois à sept mois après la récolte du fruit, ce qui est très lent pour un cycle de culture de douze à vingt mois. C'est ainsi l'approvisionnement en rejets est souvent un facteur limitant pour l'extension et l'établissement de nouvelles plantations. C'est la raison pour laquelle une étude a été conduite au site du Mont-Amba en vue de déterminer le taux de multiplication de plants formés par les explants de l'ananas en fonction de leur origine et d'identifier le type de rejet approprié pour la prolifération des jeunes plants d'ananas. Suivant le dispositif complètement randomisé avec 4 répétitions et 4 traitements, les résultats obtenus ont montré que les explants issus de cayeu souterrain (E4) ont influencé de façon significative tous les paramètres de prolifération par rapport aux autres traitements. Le résultat le plus élevé obtenu avec le traitement E4 peut se justifier par sa richesse en bourgeons dormants sur ses fragments par rapport aux autres. Au regard des résultats obtenus, il apparaît de manière claire que les explants issus de cayeu souterrain peuvent être utilisés comme meilleurs explants pour la production des plantules d'ananas par la méthode de macro propagation ou la méthode de PIF (plante issus de fragment de tige).*

Mots clé: explant; bourgeons; ananas

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Rezumat. *Ananasul este una dintre cele mai importante specii de fructe tropicale de cultură intensivă. Dar, în Republica Democratică Congo (RDC), producția devine din ce în ce mai slabă din cauza lipsei materialului săditor şi a tehnicilor adecvate pentru multiplicarea acestuia. Ananasul are mai multe tipuri de organe care pot fi utilizate pentru înmulțire. Cu toate acestea, este considerată o plantă a cărei reproducere naturală este deosebit de lentă deoarece multiplicarea ananasului este obligatoriu vegetativă întrucât specia este auto-sterilă. Referitor la cazul soiului Cayenne Lisse, (PY 1979), atunci când se recoltează fructul, doar coroana este disponibilă ca material care poate fi utilizat pentru replantare. În plus, în funcție de destinația fructului, chiar coroana poate fi indisponibilă. În ceea ce privesc lăstarele subterane, formarea lor de multe ori nu începe decât după faza de reproducere a plantei; putem recolta, în medie, doar un singur lăstar pe plantă la trei până la şapte luni după recoltarea fructului, ceea ce este foarte lent pentru un ciclu de cultură de douăsprezece - douăzeci de luni. Acesta este motivul pentru care a fost realizat un studiu la situl Mont-Amba pentru a determina rata de multiplicare a răsadurilor formate din explante de ananas în funcție de originea lor şi pentru a identifica tipul de lăstar corespunzător pentru proliferarea răsadurilor de ananas. În urma unui experiment complet randomizat, cu 4 repetiții şi 4 tratamente, rezultatele obținute au arătat că explantele rezultate din lăstarele subterane (E4) au influențat în mod semnificativ toți parametrii de proliferare în comparație cu alte tratamente. Cel mai bun rezultat, obținut cu tratamentul cu E4 poate fi justificat prin multitudinea de muguri latenți, comparativ cu alte variante. Vizavi de rezultatele obținute, este evidențiat că explantele rezultate din muguri subterani pot fi utilizate ca fiind cele mai bune pentru producerea răsadurilor de ananas prin metoda macropropagării sau prin metoda PIF (plante rezultate din fragmente de tulpină).*

Cuvinte cheie: explantă; muguri; ananas.

INTRODUCTION

L'ananas (*Ananas comosus*) est connu principalement pour son fruit comestible et son importante potentialité nutritive, commerciale et industrielle. L'ananas peut être consommé frais, séché ou transformé en confitures, boissons ou vinaigre. On en extrait de l'acide citrique utilisé pour la fabrication de certains produits pharmaceutiques, notamment contre la bronchite. On peut aussi en extraire de l'amidon, des acides organiques, de la cire, des stérols etc. Les feuilles et couronnes hachées, voire la plante entière, peuvent être intégrées à l'alimentation du bétail. La tige d'ananas est utilisée pour ses propriétés anti-inflammatoires. La bromélaïne (enzyme) est employée pour favoriser le rétablissement après une opération ou des blessures et pour le traitement, notamment, des maladies veineuses, des contusions, de l'arthrite, et des dysménorrhées. Les fibres tirées des feuilles servent à la fabrication de cordages, de sacs et de papiers spéciaux. Il est cultivé dans presque la totalité des régions tropicales du monde (Leal et Ceppens, 1996).

Cette culture en Afrique en général, et en République Démocratique du Congo (RDC) en particulier, se caractérise essentiellement par sa faible productivité. Celle-ci est la résultante des nombreuses contraintes parmi

lesquelles, l'insuffisance et la difficulté d'acquisition de matériel de plantation. Cette contrainte est considérée comme la plus importante du fait qu'elle peut freiner l'expansion et l'amélioration de l'ananas.

Comme la propagation de l'ananas se fait par rejetonnage, elle présente des inconvénients, notamment: la lenteur (le nombre de rejet par plante étant limité), l'hétérogénéité du matériel de propagation et enfin le matériel de propagation est lourd et volumineux, son transport est par conséquent coûteux (Kwa, 2003).

Ainsi, la culture intensive de l'ananas est parfois confrontée à des difficultés d'ordre pratique: au moins 40 000 à 60 000 plants sont nécessaires pour un hectare. Il est remarqué que le problème est encore plus aigu dans le cas où on cherche à diffuser un nouveau cultivar (Fournier, 2011).

Cependant, ces rejets ont de différents comportements en champ selon l'endroit (le niveau) où ils ont été prélevés de la plante mère. Selon que l'on choisit l'un ou l'autre type de rejet lors de la plantation, on obtient les résultats différents concernant: la durée de la culture, la façon de croître de la plante et la qualité du fruit produit. Par conséquent, il faudra planter un seul type de rejets dans tout le champ pour avoir une récolte des fruits uniformes et moyennement homogènes dans tout son champ (Charrier *et al.,* 1997).

La technique de multiplication rapide des plants (macro propagation) par fragment des tiges permet d'obtenir plusieurs plants (rejets) à la fois sains, moyennement homogènes (clones) et conserverait entièrement les caractéristiques de la plante mère (meilleur rendement). Ainsi, cette technique appliquée à l'ananas constitue une voie nouvelle de production en masse de plants du fait qu'elle est rapide, adaptable et demande peu d'investissements.

L'objectif global suivi par cette étude est la détermination de taux de prolifération de plants à partir de différents fragments de rejets de l'ananas en fonction de leur endroit (le niveau) où ils ont été prélevés sur la plante mère.

Pour atteindre cet objectif global, les objectifs spécifiques suivants sont poursuivis :

- Identifier le type de rejet approprié pour la prolifération des jeunes plants d'ananas;
- Fournir les éléments et les pratiques facilement accessibles à tous ;
- Fournir un guide de production d'ananas chez les petits et moyens producteurs qu'aux vulgarisateurs de cette filière. Tout en prenant en compte la grande diversité agro-pédo-climatique des zones de production de l'ananas dans le monde.

La durée de production des rejets présente l'inconvénient d'être longue; trois à sept mois après la récolte des fruits. Ce travail peut, en effet, être nécessaire pour obtenir du matériel de plantation dans un laps de temps.

D'autre part, de nombreux bourgeons formés sur pied mère demeurent inexploités. C'est ainsi que la technique de macro propagation par plants issus de fragments de tige (PIF) permet d'activer les bourgeons latents pour régénérer des

quantités importantes de plants sains dans des délais relativement courts et ajustables aux périodes de plantation.

Dans le cas particulier du système PIF appliqué à l'ananas, il n'existe pas à notre connaissance de données relatives à la ville de Kinshasa. Ainsi, cette étude permettrait de disposer aux paysans exploitants une bonne technique culturale qui augmenterait leur rendement et leur revenu.

MATÉRIAUX ET MÉTHODES

Le matériel végétal ayant fait l'objet de notre étude était constitué d'un cultivar d'ananas (*Ananas comosus*): Cayenne lisse. Ce matériel est provenu de l'INERA-Mvuazi dans la province du Bas-Congo. Le choix a été porté sur ce cultivar à cause de son appréciation par les paysans cultivateurs de la contrée, par les commerçants acheteurs et pour ses qualités organoleptiques intéressantes, ainsi que pour son fruit de très gros calibre (plus de 2 kg).

Dispositif expérimental

L'essai a été conduit suivant un dispositif complètement randomisé avec 4 répétitions et 4 traitements, ayant comme variable aléatoire le type de matériel (rejet). Les 4 traitements sont répétés 2 fois dans chaque bac de propagation. Nous avons au total 16 parcelles (figure 1), pour les deux bacs comme l'indique la figure ci-dessous.

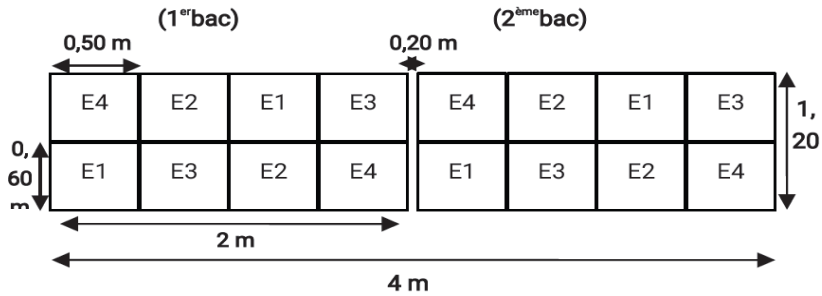

Fig. 1 Dispositif expérimental

Légende:

- **E1** : Explants issus de la Couronne
- **E2** : Explants issus de cayeu aérien
- **E3** : Explants issus de happa
- **E4** : Explants issus de cayeu souterrain

La surface totale de l'essai était de 4,8 m^2 soit 4 m de longueur et 1,20 m de largeur. Les répétitions étaient séparées par des séparateurs en bois mesurant 3 cm d'épaisseur et 0,20 m de largeur. La parcelle avait une superficie de 0,30 m², soit 0,6 m de long et 0,5 m de large et chacune d'elle comportait au total 30 explants, ce qui donne au total 480 explants pour l'ensemble de l'essai. L'ensemencement était fait aux écartements de 10 cm x 10 cm. L'essai était répété, une fois, dans le temps. Il est important de signaler que 10 échantillons sur 30 explants dans la parcelle ont été utilisés pour la récolte des données.

Opérations

Préparation des rejets et mise en châssis

La multiplication des rejets d'ananas sur tiges décortiquées est basée sur des plantes âgées ou pieds mères provenant d'une plantation déjà récoltée.

Les rejets étaient soumis aux opérations suivantes:

- **Parage**: à l'aide d'un couteau de cuisine, on débarrasse les rejets cayeux et happas, de toutes les racines desséchées, mais pour la couronne on ne fait que le décorticage. Le parage permet aux racines de se développer et résistes contre les symphiles (Begard, 2010). Après le parage on obtient une tige cylindrique.

- **Décorticage et fragmentation de tige:** Le décorticage consiste à enlever les feuilles l'une après l'autre. Les tiges sont coupées dans le sens de la longueur, de manière à obtenir plusieurs fragments (on les a aussi découpées en fragments de 3 à 4 cm) (fig.2).

-

Fig. 2 Tige décortiquée d'ananas

- **Désinfestation des fragments**: Nous avons trempé entièrement les fragments dans une solution avec un fongicide (microthion 40 g) et insecticide (cyperméthrine 40 cc) dans 10 litres d'eau. Les fragments ainsi traités sont disposés debout pendant 12 heures pour une bonne répartition du produit.

- **Mise en bac:** elle constitue la dernière étape. En effet, on recommande de fermer hermétiquement le bac avec le papier plastique. Ceci pour créer un micro climat spécifique. Les explants étaient ensemencés dans un bac de propagation comportant la sciure de bois comme substrat d'enracinement. Pour la mise en bac, la face sectionnée était orientée vers le substrat et celle comprenant les âmes emprisonnés vers le haut, ce qui facilite l'évolution des racines et des explants. On prenait alors soin de recouvrir les explants avec le substrat utilisé d'une épaisseur de 2 à 5 cm au-dessus de la surface des explants. Avant la mise en bac, le bac de propagation a été préalablement arrosé suffisamment pendant au moins trois heures.

La fréquence d'arrosage a été en fonction de gouttelettes d'eau trouvées sur le papier plastique c'est-à-dire, lorsque nous remarquons que les gouttelettes diminuent sur le papier plastique et surtout lorsque nous remarquons que les substrats ne renferment plus d'humidité. Cette fréquence a été de trois fois par semaine avant la reprise de bourgeon axillaire, mais cette fréquence devient quatre fois par semaine pendant la croissance des plantules.

La quantité d'eau apportée par fréquence était 4 arrosoirs de 15 litres soit 60 litres par bac c'est-à-dire chaque bac recevait 120 litres d'eau par semaine.

- **Sevrage des plants**: Au bout de 29 jours après la mise en bac, nous avons procédé au premier sevrage des plantules qui ont atteint plus de 2 cm de hauteur et présente plus de quatre feuilles vertes, l'opération consiste à détacher les plants du fragment ensemencé à l'aide d'un couteau très fin. Après sevrage, les plants sont repiqués dans des sachets polyéthylène d'une contenance d'environ 1Kg de terreau stérilisé (Il s'agit de la préparation des substrats destinés à accueillir les plantes après sevrage). La stérilisation était réalisée en plaçant le terreau dans une grande marmite au feu pendant 3 heures. Il faut noter que l'opération à lieu 2 jours avant sevrage,

pour éviter la réinstallation des germes microbiens déjà détruits), pour assurer le développement des jeunes plants d'ananas.

Paramètres observés

Pour évaluer la prolifération des plants, les observations ont été portées sur:

- **La durée de reprise**: Il correspond au nombre de jours qui s'écoule de la mise en bac des explants à la sortie de la tigelle.
- **Le Nombre de Plantules Sevrées (NPS) après 1 mois d'incubation**: a été obtenu par un comptage manuel direct du nombre des explants sevrés.
- **Le poids des plantules sevrés**: a été mesuré à l'aide d'une balance de précision.
- **La moyenne de nombre des plantules obtenues par explant**: a été déterminé par la sommation du nombre total des rejets sevrés durant les trois sevrages, divisée par dix explants étiquetés.
- **Le diamètre au collet des plants (cm) lors du sevrage**: a été mesuré à l'aide d'un pied à coulisse lors du sevrage.
- **La hauteur des plants (cm) lors du sevrage**: elle a été mesurée à l'aide du mètre ruban. Cette hauteur était prise de la base de rejet jusqu'au sommet de la dernière feuille.
- **Le nombre des feuilles formées lors du sevrage**: a été obtenu par un comptage manuel direct du nombre des feuilles formées.
- **Le nombre des racines formées**: a été obtenu par un comptage manuel direct du nombre des racines formées.

Analyse statistique

Pour chaque variable étudiée, les données collectées ont été analysées selon la méthode de l'analyse de variance ANOVA au seuil de probabilité de 5%. Lorsque des différences sont observées, l'analyse a été complétée par le test de la plus petite différence significative (PPDS ou LSD). Tous ces tests ont été effectués à l'aide du logiciel Statistix version 8.0.

RÉSULTATS ET DISCUSSIONS

Les résultats obtenus au cours de deux essais sont consignés dans les tableaux ci-dessous.

Résultats relatifs au premier essai

Les résultats relatifs aux paramètres végétatifs obtenus au cours du premier essai sont présentés dans le tableau 1.

Le résultat relatif à la durée de reprise de quatre traitements indique que tous les traitements utilisés sont de bonne qualité car leur durée de reprise est inférieure à 3 semaines. En outre, l'analyse statistique au seuil de probabilité 5% ne révèle aucune différence significative entre les traitements (LSD = 2,94).

Tableau 1.

Essai comparatif du taux de prolifération des plantules issues de différents rejets sur les paramètres végétatifs d'Ananas

Traitements	Durée de reprise (jour)	NPS après 1 mois d'incubation	Diamètre au collet (cm)	Hauteur des explants (cm)	Nbre de feuilles formées	Nbre de racines formées	Poids de plantules (g)	MPOE
Couronne	17a	3,4b	1,1e	7,4g	12,2j	6,2k	9,95n	4,6p
Cayeu A	19a	4,3c	0,8f	4,1h	10,1j	4,8lm	7,85no	9,5q
Happa	21a	3,5b	0,9f	5,4i	8,2j	3,8l	5,95o	6,7p
Cayeu S	19a	5,2d	0,8f	5,2i	10,3j	5,8km	8,65n	12,4r
Moyenne	**19**	**4,1**	**0,9**	**5,5**	**10**	**5,15**	**8,1**	**8,3**
CV	**6,51**	**14,8**	**18**	**9,21**	**20,7**	**20,7**	**21**	**13,15**

Les chiffres dans les colonnes suivis de mêmes lettres ne sont pas significativement différents selon le test de la Plus Petite Différence Significative (PPDS) à 5% de probabilité.

Légende: **Cayeu A**: cayeu aérien; **Cayeu S**: cayeu souterrain; **NPS** = Nombre des plantules sevrées et **MPOE** = Moyenne des plantules obtenues par explant.

Numériquement, la durée de reprise la plus courte a été enregistrée chez les explants issus de la Couronne (17 jours), suivi de cayeu aérien et cayeu souterrain (19 jours). Le happa a présenté une durée supérieure aux autres traitements mis en compétition (21 jours).

Concernant le nombre des plantules sevrées après un mois d'incubation, il ressort du tableau ci-dessus que la moyenne de nombre de plantules sevrées par fragment, la plus élevée a été observée chez les explants issus de cayeu souterrain (5,2 plantules formées) et la plus faible a été constatée chez les explants issus de la couronne (3,4 plantules formées). L'analyse statistique au seuil de probabilité 5% révèle de différences significatives entre les traitements (LSD = 0,79).

Quant au diamètre au collet, il ressort du tableau 1 que le diamètre au collet le plus élevé a été observé chez les couronne (1,1 cm), suivi de happa (0,9 cm). Le diamètre au collet le plus faible a été constaté chez les cayeux aériens (0,8 cm) et cayeu souterrain (0,8 cm).

L'analyse statistique au seuil de probabilité 5% a relevé qu'il y a des différences significatives entre les différents traitements (LSD= 0,18). Il existe une relation étroite entre le diamètre au collet et le nombre des plantules formées, plus il y a des plantules formées, moins sera leur diamètre au collet. Pour ce qui est de la hauteur, les plantules issues des explants de la couronne ont présenté une hauteur supérieure par rapport aux autres (7,4), cela peut être dû à leur temps de

reprise le plus rapide et la hauteur la plus faible a été constatée chez les cayeux aériens (4,1 cm).

En outre, l'analyse statistique au seuil de probabilité 5% révèle qu'il y a des différences significatives entre les différents traitements (LSD = 0,82) Par rapport au nombre de feuilles, il ressort du tableau ci–dessus qu'il n'existe aucune différence significative entre les quatre traitements (LSD = 6,81).

Numériquement, les couronnes ont le nombre des feuilles le plus élevé que les autres. Quant au nombre des racines formées, l'analyse statistique au seuil de probabilité 5% révèle qu'il y a des différences significatives entre les quatre traitements (LSD= 1,1).

Le nombre des racines le plus élevé a été constatée chez la couronne (6,2) cela peut être dû toujours à leur temps de reprise la plus rapide et le nombre des racines le plus faible été constatée chez happa (3,8) cela peut être dû à leur temps de reprise plus long.

Il ressort du tableau 1 que le poids des plantules sevrées variait entre 5,95 à 9,95 grammes. Les données numériques ont montré une nette différence entre les traitements dont les plantules issues des couronnes ont donné le poids supérieur par rapport aux autres traitements (9,95 g) et suivi des plantules issues cayeu souterrain (8,65 g). L'analyse statistique a montré des différences significatives entre les traitements (LSD = 2,25).

La moyenne des plantules obtenues par explant est de plantules 8,3 par explant et l'analyse statistique des données au seuil de 5% de probabilité indique des différences significatives entre les traitements (LSD = 2,75). La moyenne des plantules obtenues chez cayeux souterrains est de loin supérieure aux autres traitements (12,4 plantules) et la plus faible a été observée chez la couronne (4,6 plantules).

Résultats relatifs au deuxième essai

Le deuxième essai a consisté à répéter l'expérimentation dans le même bac afin de comparer ses résultats à ceux obtenus au premier essai. Les résultats obtenus au cours du deuxième essai sont consignés dans le tableau 2. La moyenne de la durée de l'essai est de 14,5 jours entre les différents traitements et la durée la plus longue est obtenue avec le happa (15,6 jours) et la durée la plus courte est obtenue avec les couronnes (13,5 jours), L'analyse statistique des données au seuil de 5% de probabilité indique des différences significatives entre les traitements (LSD= 1,22).

Par rapport au nombre des plantules sevrées après un mois d'incubation, le tableau ci-dessus révèle que la moyenne de nombre de plantules sevrées par fragment, la plus élevée a été observée chez le cayeux souterrains (6,1 plantules) et la plus faible a été constatée chez les explants de la couronne comme dans le premier essai (4,4 plantules) (LSD= 1,1).

Tableau 2

Essai comparatif du taux de prolifération des plantules issues de différents rejets sur les paramètres végétatifs d'Ananas

Traitements	Durée de reprise (jour)	NPS après 1 mois d'incubation	Diamètre au collet (cm)	Hauteur des explants (cm)	Nbre de feuilles formées	Nbre de racines formées	Poids de plantules (g)	MPOE
Couronne	13,5a	4,4c	0,9e	7,4g	10,9j	5,9m	11,96o	9,45r
Cayeu A	14,4ab	5,2cd	0,7f	4,8h	6,2k	4,1n	8,54p	16,40st
Happa	15,6b	4,8c	0,8ef	6,2gi	8,4l	3,6n	10,69oq	14,50s
Cayeu S	14,5ab	6,1d	0,7f	5,6hi	7,5l	5, 3m	9,24pq	19,75t
Moyenne	**14,5**	**5,13**	**0,8**	**5,88**	**8,25**	**4,75**	**10,11**	**15,03**
CV	**9,36**	**12,9**	**11,15**	**8,14**	**10,25**	**12,45**	**10,7**	**11,01**

Les chiffres dans les colonnes suivis de mêmes lettres ne sont pas significativement différents selon le test de la Plus Petite Différence Significative (PPDS) à 5% de probabilité
Légende: **Cayeu A**: cayeu aérien; **Cayeu S**: cayeu souterrain; **NPS** = Nombre des plantules sevrées et **MPOE** = Moyenne des plantules obtenues par explant.

Concernant le diamètre au collet, les plantules issues de la couronne, ont toujours montré un diamètre au collet supérieur que ceux des autres (LSD = 0,17). Quant à la hauteur, les plantules issues de la couronne ont présenté une hauteur supérieure que les autres, cela peut être dû à leur avantage par rapport à leur durée de reprise précoce. En outre, l'analyse statistique des données au seuil de 5% de probabilité indique des différences significatives entre les traitements (LSD = 1,31).

Concernant le nombre de feuilles, il ressort du tableau 2 ci–dessus qu'il existe des différences significatives entre les deux traitements (LSD = 1,27). Les explants de la couronne ont donné le nombre de feuilles le plus élevé que les autres. Par rapport au nombre des racines formées, les résultats de deuxième essai révèle qu'il existe des différences significatives entre les quatre traitements (LSD = 1,1).

Numériquement, le nombre des racines le plus élevé a été constaté chez les couronnes (5,9) cela peut être dû toujours à leur temps de reprise le plus rapide et le nombre des racines le plus faible été constaté chez happa (3,6) cela peut être dû à leur temps de reprise plus long.

En ce qui concerne le poids de plantules sevrées, les explants de la couronne ont toujours montré un poids supérieur que les autres. Il existe une relation étroite entre le nombre de feuilles et le poids des plantules formées, plus il y a des feuilles sur les plantules formées, plus le poids des plantules est plus

élevé. En plus, l'analyse statistique des données au seuil de 5% de probabilité indique des différences significatives entre les traitements (LSD = 1,7).

Par rapport au nombre total des plantules obtenues par traitement, le résultat du tableau 2 indique des différences significatives entre les traitements (LSD=2,54) et que le nombre des plantules le plus élevé a été enregistré chez les explants de cayeux souterrains, cela est dû peut-être au plus grand nombre des bourgeons chez les cayeux.

Parmi les 4 traitements utilisés au cours de l'essai, les résultats obtenus ont montré que les explants issus de cayeux souterrains ont donné les résultats les plus élevés au niveau du 1er et du 2ème essai par rapport aux autres, suivis par les explants issus de cayeux aériens et puis par explants issus de happa.

Les meilleurs résultats obtenus avec explants issus de cayeux souterrains en ce qui concerne les paramètres étudiés se justifient par une conséquence directe ou indirecte d'un facteur interne qu'est la richesse en bourgeons sur ses fragments.

Le taux de prolifération le plus faible a été enregistré chez les explants de la couronne pendant les 2 essais. Ce taux de prolifération le plus faible est dû à la pauvreté de ces explants en âmes emprisonnés.

Mais que ce soit chez les explants de la couronne, happa et les deux cayeux, le nombre des plantules a varié de façon croissante du premier sevrage au deuxième sevrage, et vers le troisième sevrage ce nombre a commencé à chuter. Nous considérons que cet effet serait dû au fait que les bourgeons tendent vers la fin de leur capacité maximum de rejetonnage.

Nous constatons ensuite une nette différence dans la majorité des paramètres observés entre le premier essai et le deuxième essai, ce dernier montre un résultat plus positif que le premier. Nous osons croire que cette différence pourrait être due aux facteurs climatiques notamment la température et l'humidité accentuées au cours de la période de deuxième essai.

Le premier essai était réalisé pendant la saison sèche, où la température dans le propagateur tournait autour de 27 à 30°C. Le taux d'humidité était plus élevé ce qui a favorisé la pourriture de certains fragments.

Le deuxième essai était mis en place pendant la saison de pluie, où la température dans le propagateur variait entre de 36 et 42 °C. L'humidité était plus faible, cela n'a pas permis d'enregistrer le cas de pourriture des fragments.

Par rapport aux résultats obtenus par Bidima, 2007, les résultats issus de notre essai (12,4 et 19,7 plantules issus de cayeux souterrains) sont de loin supérieurs à ceux qu'il avait trouvés en utilisant des cayeux souterrains avec une moyenne des plantules obtenues par explant de 10 plantules.

CONCLUSIONS

1. Partant des objectifs assignés à ce travail, les explants issus de cayeux souterrains ont influencé de façon significative tous les paramètres de prolifération par rapport aux autres traitements.

2. Le résultat le plus élevé obtenu avec le traitement de cayeux souterrains (12,4 et 19,75 plantules) peut se justifier par sa richesse en bourgeons dormants sur ses fragments par rapport aux autres.

3. Les explants issus des cayeux souterrains peuvent être utilisés comme meilleurs explants pour la production des plantules d'ananas par la méthode de PIF (plante issus de fragment de tige).

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ACTIVATION OF LATENT BURGEONS OF DIFFERENT PINEAPPLE SHOOTS (*Pineapple comosus*) FOR PLANT'S PROPAGATION IN MASS IN CONDITIONS HORTICOLES *IN VIVO*

Abstract: *Pineapple is one of the most important tropical fruit species of intensive cultivation. But in the Democratic Republic of Congo (DRC), production is becoming weaker because of lack of planting materials and appropriate techniques for its multiplication. Pineapple has several types of organs that can be used for multiplication. However, it is considered as a plant whose natural reproduction is particularly slow because the multiplication of the pineapple is compulsory vegetative as the species is self-sterile. Referring to the case of Cayenne Lisse, (PY 1979), when the fruit is harvested only the crown is available as material that can be used for replanting. More than that, depending on the destination of the fruit, even the crown may be unavailable. As for the cayeux, happas and bulbille, their formation often does not begin until after the reproductive phase of the plant, we can harvest on average only one discard per planted plant three to seven months after the harvest of the fruit, which is very slow for a twelve to twenty month crop cycle. Thus, the supply of discards is often a limiting factor for the extension and establishment of new plantations. This is why a study was conducted at the Mont-Amba site to determine the multiplication rate of seedlings formed by pineapple explants according to their origin and to identify the appropriate type for the proliferation of pineapple seedlings. Following the completely randomized experiment with 4 repetitions and 4*

treatments, the results obtained showed that the explants resulting from underground buds (E4) significantly influenced all proliferation parameters compared to other treatments. The highest result obtained with the E4 treatment can be justified by its rich dormant buds on its fragments compared to others. According to the obtained results, it is highlighted that the explants resulting from underground buds can be used as the best for the production of pineapple seedlings by macropropagation method or by the PIF method (plants derived from stem fragments).

Key words: explant; buds; ananas

MOUTS DE RAISINS SULFITES POUR LA PRODUCTION DE VINS MOUSSEUX À L'APPELLATION D'ORIGINE

MUST DE STRUGURI SULFITAT PENTRU PRODUCEREA VINURILOR CU INDICAȚII GEOGRAFICE

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Résumé: *L'article est consacré au développement et à la mise en œuvre de régimes technologiques pour la production, le stockage et l'utilisation de moûts de raisins sulfatés à des concentrations modérées en dioxyde de soufre pour la production de vins mousseux. En tant que critère assurant la stabilité, une concentration de dioxyde de soufre moléculaire ayant un effet bactériostatique vis-à-vis de la plupart des levures a été adoptée.*
Mots clés: moût de raisin sulfité, acidification, électrodialyse, cationisation

Rezumat: *Lucrarea este dedicată dezvoltării şi implementării regimurilor tehnologice de producere, depozitare şi utilizare a mustului de struguri sulfitat la concentraţii moderate de dioxid de sulf pentru producerea vinurilor spumante. Drept criteriu care asigură stabilitatea a fost selectată concentraţia de dioxid de sulf molecular, care are un efect bacteriostatic faţă de cele mai multe drojdii.*
Cuvinte cheie: must de struguri sulfitat, acidificare, electrodializă, tratare cu cationiți

INTRODUCTION

Au début des années 2000 il y avait une question de nouveaux types de produits à base de moût de raisin (vins mousseux naturels, vins tranquilles avec sucre résiduel et d'autres) (Delfini Claudio et Formica Joseph, 2001). Dans les compagnies vinicoles, le moût de raisin concentré importé est utilisé. Mais cela non seulement augmente considérablement le coût des vins, mais conduit également à leur dépersonnalisation des vins. En même temps, les méthodes recommandées préforment de moûts de raisins dans les entreprises (sulfitage avec des doses plus élevées d'anhydride sulfureux, avec l'ajout de l'acide sorbique, et conservé à basse température) ne sont pas justifiées non seulement à cause du coût élevé, mais aussi en raison de la formulation limitée. Dans la saison la production de moûts de raisins sulfité est une méthode commune de créer une réserve technologique de sucre de raisin naturel utilisé dans la production de différents vins (Zh. Ribero-Gajon, Pejno Je *et al.,* 1981). Ceci est un mout, tout en préservant le potentiel technologique du raisin, à un coût proche du coût du vin

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sec, ce qui crée des conditions pour améliorer la qualité des produits viti-vinicoles.

Dans le même temps, la technologie habituelle de production de moût sulfité nécessite l'utilisation de fortes doses de dioxyde de soufre (600-1200 mg / dm^3), ce qui nécessite des réservoirs de stockage spéciaux et limite son champ d'application.

Les informations ci-dessus ont servi de base au développement et à l'introduction de régimes technologiques pour la production, le stockage et l'utilisation des moûts de raisins sulfatés à des concentrations modérées en dioxyde de soufre, destines pour la production des vins mousseux a l'appellation d'origine « Cricova » (Prida *et al., RM 713)*.

MATÉRIAUX ET MÉTHODES

L'effet antiseptique du dioxyde de soufre sur les micro-organismes rencontrés en pratique œnologique a été étudié dans des solutions obtenues à partir d'eau distillée et de moût de raisin. Les solutions analysées étaient sulfitées avec du dioxyde de soufre concentré à des concentrations de 100-450 mg / dm3 et acidifiées avec de l'acide tartrique jusqu'à un pH de 2,4-3,6. Les concentrations en dioxyde de soufre libre ont été ensuite déterminées (Recueil des methodes internationales d'analise, *OIV, 1990*) et les concentrations en dioxyde de soufre moléculaire ont été calculées en fonction des relations décrites dans la littérature (Usseglio-Tomasset L., Tec&Doc, 1995).

Un mélange de micro-organismes œnologiques, préparé par fermentation spontanée de moûts, obtenu à partir de raisins blancs (maintenus longtemps au froid) atteints de moisissure, a été à l'origine de l'infection microbiologique. Dans la source d'infection (moût de fermentation spontanée), on a décelé des levures œnologiques à des concentrations de 120-150 mln/cm^3 (g. *Saccharomyces*), des levures contaminants (par exemple, *Brettanomyces, Saccharomycodes*), des bactéries (g. *Acetobacter*, g. *Streptocoques*) et des moisissures (g. *Aspergillus*, g. *Mucor*, g. *Penicillium*). Les observations sur le milieu de culture dans les éprouvettes ont été effectuées jusqu'aux premiers changements visuels (perturbation, dégagement de gaz, etc.), ce qui signifie le début du processus de développement du microorganisme. Si les modifications visuelles n'étaient pas détectées pendant 7 jours, l'échantillon était considéré comme acceptable et la solution de décontamination qui fournissait cet effet - correspondant aux critères de stérilité technologique.

RÉSULTATS ET DISCUSSIONS

La concentration de dioxyde de soufre moléculaire dans un moût ayant un effet bactériostatique par rapport à la plupart des levures a été acceptée comme critère pour lequel la stabilité est assurée (Prida *et al.,* 2014).

Dans la pratique, cela signifie que presque tous les cave, sous réserve des normes d'hygiène habituelles, peuvent produire pour le stockage à long terme et l'utilisation dans la fabrication de vins de moût de raisin sulfité modérément, sous réserve d'une augmentation artificielle de l'acidité. Lorsque le pH recommandé est de 2,7- 2,8, dans le moût la concentration totale de dioxyde de soufre est suffisante pour assurer sa stabilité microbiologique, située dans la plage de 200 à 250 mg / dm^3. Même avec des valeurs relativement élevées de la capacité de liaison du moût de dioxyde de soufre (55-65%), il permet de maintenir la concentration de dioxyde de soufre moléculaire dans celle-ci dans la plage de 5 à 10 mg /dm^3 (tab. 1).

Tableau 1

La teneur en dioxyde de soufre moléculaire* en moût (en% de dioxyde de soufre libre) en fonction de la température et du pH

pH	2,4	2,6	2,8	3,0	3,2	3,4	3,6
t, ^{0}C	10 ^{0} C						
$[SO_2]_{mol6}$ %	7.33	6.61	4.17	2,63	1,66	1.05	0.66
t, ^{0}C	20 ^{0} C						
$[SO_2]_{mol6}$ %	21.38	13.4 9	8.51	5.37	3.39	2.14	1.35
t, ^{0}C	30 ^{0}C						
$[SO_2]_{mol6}$ %	43,65	27.54	17.38	10.6	6.92	4.37	2,75

** La valeur moyenne de trois mesures parallèles; écart type: ±0,5%.*

L'augmentation de l'acidité active du moût peut être réalisée soit par acidification directe (en introduisant des acides alimentaires – acides tartrique, citrique, malique etc.), soit par cationisation ou par électrodialyse. Dans le même temps, avec une acidification directe du moût, afin d'abaisser le pH à 2,8, il est habituellement nécessaire d'ajouter 4 à 8 g/dm^3 d'acides (tartrique et citrique 1:1), c'est-à-dire acidité titrée du moût stable est 12 -14 g/dm^3. Avec la cationisation et l'électrodialyse, une diminution du pH à 2,8 s'accompagne d'une augmentation des acides titrés pas plus que 2-4 g /dm^3.

La technologie de production et de stockage du moût de raisin par échange d'ions (cations) est basée sur l'utilisation de la science connue concernant le rôle prédominant de l'anhydride sulfureux moléculaire dans l'action antiseptique (et conservateur) et sur l'utilisation de l'effet synergique d'une acidité active élevée pour augmenter sa concentration moléculaire dans le moût.

Ceci est nécessaire parce que le moût sulfité à haute acidité augmente la résistance microbiologique. Cette technologie permet une augmentation de l'acidité active (et en même temps une diminution du pH) dans le moût à des valeurs auxquelles il devient microbiologiquement stable aux concentrations habituelles d'anhydride sulfureux total acceptables dans la production du vin.

Ce moût sulfaté acidifié peut servir à différentes fins et peut être utilisé avec succès pour la production de vins mousseux. Dans le même temps, l'échange d'ions (cations) augmente la stabilité des vins à l'opacification des colloïdes, car la plupart des acides aminés sont éliminés (retirés sur colonne) par cette voie.

L'électrodialyse est une méthode d'extraction extrêmement efficace pour assurer la stabilité du vin, sans nécessiter l'ajout de produits chimiques. L'électrodialyse est conçue de manière à préserver toutes ses qualités naturelles et utiles dans le vin. Le processus passe à température ambiante en continu dans le flux à travers le module.

Sous l'action d'un champ électrique, l'excès d'ions potassium, calcium et tartrate est éliminé par des membranes spécialement adaptées au produit à traiter. Ces sels saturent la solution circulant parallèlement au produit dans le module d'électrodialyse. À la sortie de l'électrodialyse, le vin est absolument stable aux cristaux.

Le moût acidifié sulfité de raisin est un composant naturel contenant un mélange de sucres dans lequel la totalité de la réserve technologique d'extraits et de substances aromatiques des baies de raisin est préservée et peut être utilisé pour produire des vins mousseux ou tranquilles naturels.

Dans le processus de production, la sulfitation et l'acidification du moût peuvent être effectuées de manière à extraire des effets technologiques supplémentaires, en particulier la stérilisation, ce qui permet de réduire considérablement la charge microbienne due aux communications, équipements, réservoirs infectés [Prida *et al., RM 980*].

Les informations ci-dessus et le principe peuvent également être utilisés avec succès pour affiner les régimes technologiques de production de moûts de raisins sulfatés en utilisant un conservateur supplémentaire (acide sorbique), car leur utilisation, sans tenir compte de l'acidité active du moût avec le sucre élevé, caractérisé généralement par une faible acidité, permet d'améliorer sa stabilité.

Partant du fait bien connu que l'action antimicrobienne de l'acide sorbique est renforcée dans le moût à forte acidité active (avec un pH bas), il a été proposé de stocker le moût clarifié avec des concentrations de dioxyde de soufre 200-250 mg/dm^3 et d'acide sorbique 150-200 mg/dm^3 après acidification en ajustant le pH à des valeurs de 3,0 à 3,2. Parallèlement, l'augmentation de l'acidité active du moût peut être réalisée par acidification directe (en introduisant des acides alimentaires - citriques, tartriques, etc.) ou par cationisation ou électrodialyse.

Les concentrations ci-dessus de conservateurs aux valeurs indiquées d'acidité active (pH) garantissent la stabilité microbiologique des moûts de raisin clarifiés pour le stockage à long terme dans les conditions habituelles des établissements vinicoles. Un tel moût, utilisé comme édulcorant, peut non seulement réduire le coût des vins mousseux, mais aussi améliorer de manière significative leur qualité et authenticité des vins mousseux a appellation d'origine (DOC).

CONCLUSIONS

L'utilisation rationnelle des propriétés antiseptiques du dioxyde de soufre dans la vinification n'est possible que si l'acidité active est déterminée, enregistrée et fixée.

En tant que critère de l'activité antimicrobienne du dioxyde de soufre dans les environnements de vinification, l'utilisation de la valeur de concentration de sa forme "moléculaire" est recommandée.

L'augmentation de la proportion de « dioxyde de soufre moléculaire » par une augmentation de l'acidité peut réduire considérablement la concentration totale en dioxyde de soufre dans la production d'un moût de raisins sulfité microbiologiquement stable.

Le moût sulfité hautement acidifié a augmenté la résistance microbiologique. La technologie mise au point prévoit une augmentation de l'acidité active (et en même temps une diminution du pH) dans le moût à des valeurs auxquelles il devient microbiologiquement stable aux concentrations habituelles d'anhydride sulfureux total acceptables dans la production de vin.

Remerciements: *Agence Universitaire de la Francophonie (AUF) - projet S0446 SAIN (2017 – 2019)*

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SULFITATED GRAPE MOUSTS FOR PRODUCTION OF SPARKLING WINES WITH APPELLATION OF ORIGIN

Abstract: *The article is dedicated to the development and implementation of technological regimes for the production, storage and use of grape must at moderate concentrations of sulfur dioxide, for the production of sparkling wines. As a criterion ensuring stability, a molecular sulfur dioxide concentration having a bacteriostatic effect vis-à-vis most yeast has been adopted.*

Key words: sulfitated grape must, acidification, electrodialysis, cationization

IMPACT DE L'EXTRAIT DE FRUITS D'ARGOUSIER SUR LA QUALITÉ DU BEURRE

IMPACTUL EXTRACTULUI DE FRUCTE DE CĂTINĂ ASUPRA CALITĂTII UNTULUI

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Résumé. *Échantillons de beurre avec 2,5 %, 5 % et 7,5 % extrait liposoluble des fruits d'argousier ont été étudies. Les extraits utilisées présentaient une activité anti radicalaire élevée – 76.8±0.19 % et contiennent des composés bioactifs: β-carotène - 13.65±0.17 mg/100 g MS, lycopène - 17.02±0.15 mg/100 g MS et polyphénols – 0.36±0.03 mg GAE/100 g MS. Les extraits liposolubles d'argousier ont amélioré les caractéristiques sensorielles du beurre par rapport au témoin et ont réduit la croissance des microorganismes pendant le stockage suite aux leurs propriétés antimicrobiennes. Les recherches sur les caractéristiques de stabilité à l'oxydation pendant le stockage du beurre contenant d'extrait d'argousier indiquent que les extraits ont un effet inhibiteur sur l'intensité d'accumulation des produits primaires de l'oxydation lipidique et se manifestent par une diminution de l'indice de peroxyde par rapport au témoin. Il a été démontré que le beurre avec addition d'extrait d'argousier avait une activité anti radicalaire supérieure, le pourcentage d'inhibition des radicaux libres (DPPH) augmente pour un ajout de 7,5 % extrait d'argousier de 1,6 fois par rapport au témoin.*
Mots clés: beurre, extrait liposoluble d'argousier, antioxydant, valeur biologique, qualité.

Rezumat. *Au fost studiate probe de unt conținând adaos de extracte liposolubile din fructe de cătină în concentrații de 2,5 %, 5 %, 7,5 %. Extractele obținute au activitate antiradicalică mare – 76,8±0,19 % și conțin compuși bioactivi: β-caroten -13,65±0,17 mg/100g SU, lycopene – 17,02±0,15 mg/100g SU și polifenoli – 0,36±0,03 mg GAE/ 100g SU. Extractele de cătină au îmbunătățit caracteristicele senzoriale ale untului în raport cu proba-martor, au redus numărul total de germeni, datorită componentelor bioactive cu efect antimicrobian. S-a demonstrat scăderea valorilor indicelui de peroxid în probele de unt cu adaos de extract în timpul păstrării în raport cu proba-martor, determinată de efectului inhibitor al compușilor din extracte asupra intensității de acumulare a produșilor primari ai oxidării lipidice în unt. Probele de unt cu 7,5% adaos de extract de cătină au înregistrat o creștere procentului de inhibare a radicalilor liberi (DPPH) de 1,6 ori față de proba-martor.*
Cuvinte cheie: unt, extract liposolubil de cătină, antioxidant, valoare biologică, calitate.

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INTRODUCTION

Les substances biologiquement actives sont nécessaires pour le corps en quantités modérées pour un fonctionnement optimal, peu d'entre elles étant synthétisées dans le corps, il faut un approvisionnement continu en produits naturels pour répondre à ces besoins (Crăciun, 2011). La fabrication de produits fonctionnels avec des composés biologiquement actifs d'origine naturelle est plus qu'actuelle pour l'industrie alimentaire (Ghendov-Moşanu, 2018).

Selon le concept de l'alimentation rationnelle, l'un des axes principaux des recherches a été orienté vers l'élaboration de la technologie d'obtenir du beurre avec destination fonctionnelle, en utilisant comme élément de stabilisation vis-à-vis des oxydations (pendant la conservation) des extraits naturels de fruits d'argousier. L'argousier-blanc qui contient 190 principes bioactifs est une source de vitamine E, de vitamine C, de β-carotène, d'acides gras insaturés, d'acides aminés essentiels et de flavonoïdes, ayant une action bactéricide (Rösch *et al.*, 2003).

L'argousier est un réservoir naturel d'antioxydants et donc son efficacité pour protéger contre le stress oxydatif a été démontré par certains chercheurs. Les propriétés antioxydantes et immunomodulatrices de l'argousier ont été déterminées *in vitro* (Geetha *et al.,* 2002). Ainsi, l'utilisation d'extraits d'argousier pour la fabrication de produits laitiers fonctionnels est très prometteuse.

Actuellement, la production de beurre est une des principales directions d'industrialisation du lait (pour environ 49% du lait collecté). En raison de ses propriétés nutritionnelles et gustatives supérieures, de son utilisation universelle, le beurre est l'un des plus répandus produits laitiers concentrés. Le beurre contient une large gamme d'acides gras, très importants dans une alimentation rationnelle (Macovei, 2006). Il constitue une source importante de vitamines liposolubles, en particulier de vitamine A et de carotène (Guzun, 1996). Les stratégies actuelles utilisées dans l'industrie alimentaire pour inhiber le processus d'oxydation des graisses consistent à contrôler la qualité des matières premières, à limiter l'intervention de facteurs pro-oxydants sur les aliments et à utiliser des substances antioxydantes d'origine synthétique (Leonte et Florea, 1998). Les études effectuées sur des extraits obtenus à partir de fruits de l'argousier-blanc, riches en flavonoïdes, ont montré que ces extraits ont un potentiel antioxydant élevé et un effet positif sur la structure, la valeur physiologique et microbiologique et sur la durée de conservation (Kamenskih, 2008; Losev, 2006).

L'objectif de la présente recherche était d'étudier l'influence des extraits liposolubles de fruits de l'argousier sur les caractéristiques sensorielle, physicochimiques, microbiologiques et anti radicalaires du beurre.

MATÉRIAUX ET MÉTHODES

Les fruits de l'argousier. Ont été utilisés des fruits d'argousier (*Hippophae rhamnoides L.*) indigène, récolté en 2016. Ils ont été séchés naturellement jusqu'à une teneur en humidité de 8,0±0,25%, puis broyés jusqu'à l'état pulvérulent avec une granulation de 140 microns et tamisés.

L'extrait liposoluble. L'extraction de la fraction liposoluble a été effectuée dans un rapport solide-liquide de 1:12 dans un bain-marie à 45,0±0,1 °C pendant 1 heure. En qualité de solvant organique, a été utilisée l'huile de tournesol raffinée et désodorisée "Uniflor". Les extraits obtenus ont été filtrés et conservés dans des bouteilles brunes à 5,0±1,0 °C. Dans les extraits liposolubles des fruits de l'argousier a été déterminé la teneur en substances biologiquement actives, *β*-carotène et lycopène (Olives Barba et. al.,2005), polyphénols (Waterman et Mole, 1994) l'activité anti radicalaire (Brand - Williams *et. al.,*1995) et les indicateurs physico-chimiques: l'indice de peroxyde (AOCS, 2003), l'indice d'acide (AOCS, 1999), l'indice de *p*-anisidine (AOCS, 1997), la teneur en diène et en triène conjugués (AOCS, 1993).

L'obtention du beurre avec l'extrait liposoluble des fruits de l'argousier. Dans le beurre „Țărănesc" a été incorporé un extrait liposoluble des fruits de l'argousier obtenu à 45°C, en différentes concentrations: 2,5%, 5%, 7,5% rapporté à la quantité du beurre. L'incorporation uniforme des extraits dans le beurre a été réalisée en homogénéisant les échantillons pendant 20-30 minutes. Les échantillons de beurre obtenus ont été enveloppés dans une feuille d'aluminium et conservés à 4±1°C.

Les indicateurs de qualité (teneur en matière grasse, teneur en substance sèche totale, indice d'acidité et indice de peroxyde) ont été déterminés par des méthodes standardisées internationales (SM SR EN ISO 3727-3:2012, SM SR EN ISO 3727-1:2012). Dans les échantillons de beurre ont été déterminées les propriétés rhéologiques, la viscosité. A été aussi déterminée l'activité anti radicalaire (DPPH) *in vitro* (Brand - Williams *et. al.,* 1995). A été réalisée l'analyse sensorielle des produits (SM ISO 22935-3: 2015). Pour déterminer les caractéristiques microbiologiques des échantillons de beurre, le nombre total de germes a été déterminé (ORDIN nr.159 din 07.07.2006).

L'analyse statistique. L'analyse statistique des résultats a été réalisée par le programme Microsoft Office Excel, 2010 et ANOVA. Tous les tests ont été réalisés en triple à la température ambiante de 20±1 °C. Les résultats expérimentaux sont exprimés en valeur moyenne ± SD.

RÉSULTATS ET DISCUSSIONS

Caractérisation de l'extrait liposoluble des fruits d'argousier. Dans le Tableau 1 sont présentées les principales caractéristiques de l'extrait liposoluble des fruits d'argousier.

L'analyse des résultats montre que l'extrait obtenu est riche en composés biologiquement actifs. L'activité anti radicalaire de l'extrait est de 76.8±0.19 % DPPH inhibé, ce qui peut s'expliquer par la présence de composés polyphénoliques: 0.36±0.03 mg GAE/100g MS et par la teneur élevée en caroténoïdes: *β*-carotène - 13.65±0.17 mg/100g MS et lycopène – 17.02±0.15 mg/100g MS. L'indice d'acidité de l'extrait liposoluble de fruits d'argousier est

de 0.22±0.01 mg KOH/g d'huile en raison de la teneur en substances biologiquement actives, notamment les acides. L'indice de peroxyde atteint la valeur de 3,08±0,02 mmol oxygène actif/kg, qui démontre l'activité des composés antioxydants. L'un des indicateurs du degré d'oxydation des huiles végétales est la teneur en dièns et triènes conjugués. Ont été obtenues des valeurs de 15,06±0,18 µmol/g huile pour les dièns et une teneur en triène deux fois plus faible par rapport à la teneur en dièns conjugués. Ceci confirme l'action antioxydante des principes actifs contenus dans l'extrait liposoluble. Les produits d'oxydation secondaires, tels que les aldéhydes et les cétones, sont exprimés par l'indice de *p*-anisidine. Analysant la valeur d'indice de *p*-anisidine de 2,87±0,09 u.c. nous pouvons dire que la teneur en aldéhydes insaturés 2,4-diénaux et 2-alcényles est faible, de sorte que l'état oxydatif du substrat lipidique est également réduit.

Tableau 1

Teneur en substances biologiquement actives, l'activité anti radicalaire et les indicateurs physico-chimiques de l'extrait liposoluble d'argousier

Indicateur	Valeur
β- carotène, mg/100g MS	13,65±0,17
Lycopène, mg/100g MS	17,02±0,15
Teneur en composés polyphénoliques *, mg GAE/ 100g MS	0,36±0,03
Activité anti radicalaire (inhibition du radical DPPH), %**	76,8±0,19
Indice d'acidité, mg KOH/g huile	0,22±0,01
Indice de peroxyde, mmol oxygène actif/kg	3,08±0,02
Le contenu des dièns, µmol/g huile	15,06±0,18
Le contenu de triènes conjugués, µmol/g huile	7,59±0,03
Indice de *p*-anisidine, u.c.	2,87±0,09

* mg GAE/g de MS - mg d'équivalent acide gallique pour 100 g de matière sèche, ** - % d'inhibition des radicaux libres 2,2'-diphényl-1-picrylhydrazyle (DPPH).

Les caractéristiques du beurre additionné avec l'extrait liposoluble de fruits d'argousier. Pour déterminer l'effet de l'incorporation des extraits étudiés sur les processus d'oxydation, ont été déterminés les indicateurs de qualité du beurre, présentés dans le tableau 2.

Tableau 2

Les indicateurs de qualité du beurre avec différentes concentrations d'extrait d'argousier

Indicateur	échantillon			
	Beurre Control	Beurre additionné avec 2,5% extrait	Beurre additionné avec 5% extrait	Beurre additionné avec 7,5% extrait
Caractéristiques sensorielles				
Apparence (surface et section)	Brillance caractéristique, blanc-jaune, couleur uniforme. En section, de surface continue, pas de fentes d'air ou de gouttes d'eau visibles, pas d'impuretés.	Brillance caractéristique, blanc-jaune, couleur uniforme. En section, de surface continue, pas de fentes d'air ou de gouttes d'eau visibles, pas d'impuretés.	Brillance caractéristique, couleur jaune, specifique pour l'extrait utilisé, uniforme. En section, de surface continue, aucun entrefer ou gouttes d'eau visibles, aucune impureté.	Brillance caractéristique, couleur jaune, specifique pour l'extrait utilisé, uniforme. Dans la section, de surface continue, aucun entrefer ou gouttes d'eau visibles, aucune impureté.
Cohérence à (12±2)°C	Compact, plastique, homogène.	Compact, plastique, homogène.	Compact, plastique, homogène.	Compact, plastique, homogène.
Odeur et Goût	Crème douce agréable, sans odeur ni goût étranger.	Crème douce agréable, sans odeur ni goût étranger.	Crème sucrée agréable, avec une légère saveur de l'extrait utilisé, sans autre odeur ou goût étranger.	Crème sucrée agréable, avec une légère saveur de l'extrait utilisé, sans autre odeur ou goût étranger.
Caractéristiques physico-chimiques				
Indice d'acidité, mg KOH/g	0,14±0,01	0,22±0,01	0,22±0,01	0,3±0,01
Indice de peroxyde, mmol oxigen activ/kg	0,61±0,07	1,01±0,04	1,34±0,08	2,0±0,05
Viscosité, Pa·s	19,63±0,54	12,74±0,21	12,20±0,38	10,48±0,16
Teneur en graisse, %	72,5±0,07	79,02±0,01	79,03±0,01	79,04±0,01
Substances séchées, %	74,92±0,02	76,53±0,02	75,62±0,03	76,55±0,01

Au cours de la recherche, les propriétés sensorielles des échantillons de beurre ont été évaluées sur la base de l'échelle à cinq points comparée aux exigences de qualité sensorielle prédéfinies (HG nr. 611 du 05.07.2010. *„Reglementări tehnice „Lapte şi produse lactate"*). Tous les échantillons de beurre ont été évalués avec 5 points. Toutefois, l'échantillon de beurre additionné à 5% d'extrait était marqué par un tableau de brillance caractéristique de couleur légèrement jaunâtre par rapport à l'échantillon témoin, une saveur douce de l'extrait utilisé se mélangeant harmonieusement à celle du beurre.

L'analyse des données expérimentales montre qu'avec l'augmentation de la teneur en extrait introduit, augmente la valeur de l'indice d'acidité de 0,14±0,01 à 0,3±0,01 mg KOH/g control, il en va de même pour l'indice de peroxyde, ont été attestées des valeurs de 0,61 mmol oxygène actif/kg control pour l'échantillon témoin et de 2,0 mmol oxygène actif/kg control pour 7,5 % d'échantillon, qui, bien qu'en augmentation, à la suite de l'utilisation de l'extrait avec l'indice d'acidité de 0,22±0,01 mg KOH/g d'huile et l'indice de peroxyde 3,08±0,02 mmol oxygène actif/kg. L'ajout d'extrait d'argousier liposoluble a permis une légère augmentation de la teneur en matière grasse de 72,5±0,07 % dans l'échantillon de contrôle à 79,04±0,01 % dans le cas d'un échantillon de beurre à 7,5 % d'extrait et la teneur en matière sèche, respectivement, résultant de l'utilisation de l'extrait à 99,8 % de matières grasses. L'ajout d'extrait liposoluble de l'argousier au beurre s'accompagne de modifications rhéologiques telles que la viscosité. Le degré de changement de cet indice dépend de la quantité d'extrait inoculé. Avec un ajout d'extrait en proportion de 2,5 %, la viscosité passe de 19,63±0,54 Pa·s à 12,74±0,21 Pa·s, en augmentant ensuite la quantité d'extrait jusqu'à 7,5 %, la valeur de viscosité diminue non essentielle. La diminution de la viscosité n'est pas perçue sensorielle, mais la consistance du beurre est appréciée positivement.

A été étudiée l'influence des extraits liposolubles de l'argousier incorporé dans le beurre sur l'intensité de l'accumulation de produits d'oxydation et sur les micro-organismes au cours du processus de stockage (fig. 1 et fig. 2).

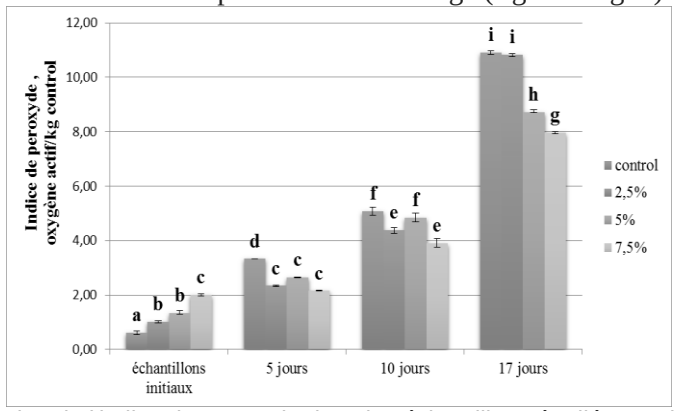

Fig.1 Modification de l'indice de peroxyde dans les échantillons étudiés pendant la période de stockage

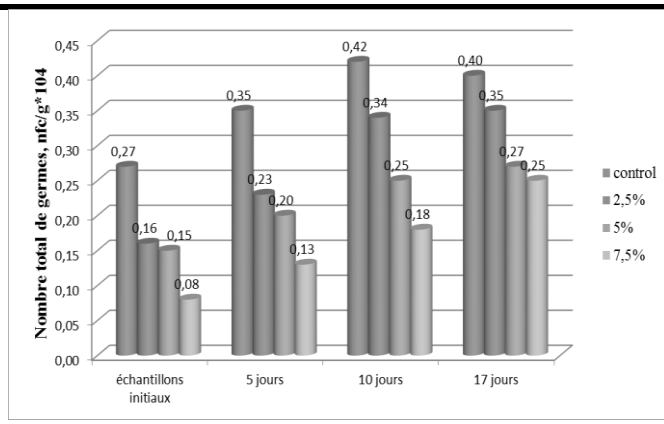

Fig. 2 Evolution du nombre total de microorganismes dans les échantillons étudiés pendant la période de stockage

La valeur de l'indice de peroxyde pour l'échantillon avec 5% d'extrait est de 1,34±0,08 à 8,72±0,08 mmol oxygène actif/kg control, respectivement pour l'échantillon avec 7,5% le premier jour de stockage est de 2,0±0,05 mmol oxygène actif/kg control, et après 17 jours de 7,97±0,08 mmol oxygène actif/kg control. Nous avons constaté que l'intensité de l'accumulation des produits d'oxydation est plus lente dans les échantillons additionnés avec 5% et 7,5% par rapport au témoin. L'évolution du nombre total de micro-organismes présents dans les échantillons de beurre montre que les extraits ont entraîné une diminution du nombre total de micro-organismes immédiatement après l'ajout et pendant toute la période de stockage, ce qui peut s'expliquer par le fait que l'extrait liposoluble d'argousier contient des composés bioactifs avec effet antimicrobien. Ainsi, l'utilisation de l'extrait liposoluble de l'argousier dans la fabrication du beurre assure la stabilité microbiologique élevée du beurre pendant le stockage.

L'analyse de la capacité anti radicalaire (méthode DPPH) du beurre contenant d'extrait d'argousier a démontré une augmentation du pourcentage d'inhibition des radicaux libres par rapport au témoin (le beurre blanc) (fig. 3).

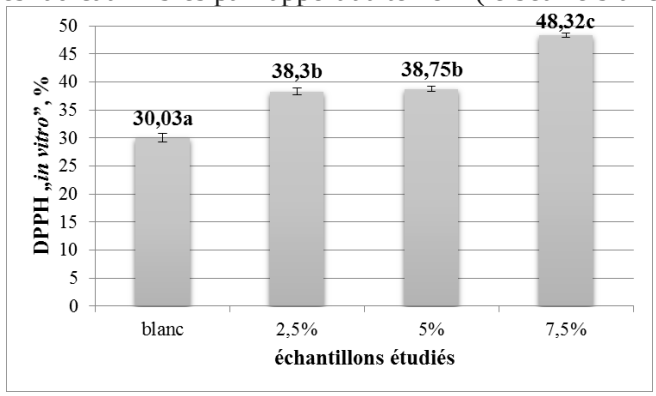

Fig. 3 Capacité anti radicalaire *in vitro* du beurre avec l'extrait des fruits d'argousier

La différence entre le pourcentage d'inhibition des radicaux libres dans l'échantillon de contrôle et les échantillons additionnés d'extrait d'argousier est significative. On remarque une augmentation de l'activité anti radicalaire de 1,6 fois, de 30,03±0,07 % (échantillon blanc) à 48,32±0,02 % (échantillon avec 7,5% d'extrait). L'augmentation de l'activité anti radicalaire du beurre est déterminée par les antioxydants présents dans les fruits d'argousier: vitamines E, K (Christaki, 2012), lycopène, β-carotène, les tocophérols, les polyphénols etc. (Cenkowski *et al.,* 2006; Kumar *et al.,* 2011; Leskinen *et al.,* 2010), qui sont appréciés pour leurs propriétés anti radicalaires (Suryakumar et Gupta 2011). Par conséquent, l'ajout d'extrait liposoluble dans la spread entraîne une augmentation de la valeur biologique du beurre.

CONCLUSIONS

L'extrait liposoluble de fruits d'argousier a un contenu important de substances biologiquement actives (β-carotène, lycopène) et une importante activité anti radicalaire.

L'ajout des extraits liposolubles d'argousier ont amélioré les caractéristiques sensorielles du beurre par rapport au contrôle et contribué à une diminution du nombre total de germes due aux composés bioactifs antimicrobiens.

L'étude des caractéristiques de stabilité oxydative pendant le stockage du beurre additionné avec extrait d'argousier indique que les extraits ont un effet inhibiteur sur l'accumulation des produits primaires d'oxydation lipidique et se traduisent par une diminution de l'indice de peroxyde, surtout pour le beurre avec 7,5% d'extrait.

La capacité anti radicalaire du beurre avec 7,5% extrait d'argousier a enregistré une augmentation de 1,6 fois par rapport au témoin.

Les résultats expérimentaux montrent que les extraits d'argousier peuvent être utilisés pour fabriquer du beurre de plus haute qualité, avec la prolongation de la durée de stockage.

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IMPACT OF SEA BUCKTHORN FRUITS EXTRACT ON BUTTER QUALITY

Abstract. *Samples of butter with 2.5 %, 5 % and 7.5 % liposoluble sea buckthorn extract were studied. The used extract had a high antiradical activity – 76.8±0.19 % and contain bioactive compounds: β-carotene - 13.65±0.17 mg/100g DM, lycopene - 17.02±0.15 mg/100g DM and polyphenols – 0.36±0.03 mg GAE/100g DM. The addition of sea buckthorn extracts improved the sensory characteristics of butter compared to the control and reduced the total number of germs due to the content of bioactive compounds with antimicrobial effect. During storage was registered a decrease of the peroxide index in butter samples with sea buckthorn extract, due to its inhibitory effect on the accumulation of the primary products of lipid oxidation. Butter samples with 7.5 % sea buckthorn extract proved an increase of the inhibition of free radicals (DPPH) by 1.6 times compared to the control.*

Key words: butter, liposoluble sea buckthorn extract, antioxidant, biological value, quality.

VARIABILITÈ DU CONTENU EN ARN DANS LES FEUILLES DE LA VARIÉTÉ DE VIGNE FRÂNCUŞĂ

VARIABILITATEA CONŢINUTULUI DE ARN ÎN FRUNZELE SOIULUI DE VIŢĂ DE VIE FRÂNCUŞĂ

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Résumé: *L'ARN est impliqué dans les principaux processus de synthèse des protéines. Le contenu en ARN/ mg de tissu reflète l'intensité des processus de synthèse des protéines. On a étudié le contenu total en ARN des feuilles de la variété de vigne Frâncuşă chez différentes phénophases: bourgeonné, floraison, début de la maturation des raisins, maturation complète des raisins. L'analyse en dynamique du contenu en ARN dans les feuilles montre que dans la phénophase de bourgeonné, la synthèse des protéines est à maximum.*
Mots clés: ARN, bourgeonné, floraison, début de la maturation des raisins, maturation complète des raisins

Rezumat. *ARN este implicat în principalele procese de sinteză ale proteinelor. Conținutul de ARN/mg de țesut reflectă intensitatea proceselor de sinteză a proteinelor. În prezenta lucrare s-a investigat conținutul total de ARN în frunzele soiului de viță de vie Frâncuşă, în diferite fenofaze: dezmugurire, înflorit, începutul maturării strugurilor (pârgă), maturarea completă a strugurilor. Analiza în dinamică a conținutului de ARN din frunze demonstrează că în fenofaza de dezmugurire, sinteza proteinelor este maximă.*
Cuvinte cheie: ARN, dezmugurire, înflorit, începutul maturării strugurilor (pârgă), maturare completă a strugurilor

INTRODUCTION

Les acides nucléiques (ADN et ARN) caractérisent l'intensité des processus de croissance, l'état général du métabolisme, la vitesse des réactions et leur intensité à chaque phase ontogénétique, avec une participation active des protéines et de la synthèse biochimique (chlorophylle, lipides complexes) et d'autre part dans la formation d'organites cellulaires (chloroplastes, mitochondries, peroxysomes et ainsi de suite) offrant ainsi la performance appropriée du cycle biologique des plantes.

L'ARN présent dans les cellules végétales et animales contribue à la synthèse des protéines. Les exons d'ADN sont transcrits en ARNm. Ce dernier est soumis à la traduction, ce qui donne des acides aminés qui, par polymérisation, forment des protéines.

Il existe quatre types d'ARN: ARNm, ARNt, ARNr, ARNs et trois types d'ARN polymérases. ARNm, ARNt, ARNr contribuent à la synthèse des protéines

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et à la synthèse des ribosomes (Leontis et Westhof, 2001; Shuman, 2002; Pădureanu, 2004).

ARN silencieux (ARNs) jouent un rôle dans la régulation des gènes, dans le monde naturel, présent chez les plantes, les animaux et de nombreux agents pathogènes. La régulation des molécules d'ARNs fournit un mode rapide pour modifier l'activité des gènes de plusieurs transcrits de gènes (Baulcombe, 2004; Sharp, 2009; Atkins, 2011; Rose *et al.,* 2019).

Dans la cellule, la plupart des ARN font partie de complexes ARN – protéine dans lesquels le ou les composants de la protéine aident la fonction de l'ARN et le protègent des risques de dégradation chimique ou enzymatique. La liaison intracellulaire des protéines commence de manière concomitante avec la transcription de l'ARN et est souvent ordonnée et entraînée de manière énergétique par la consommation d'ATP ou GTP. Les protéines de liaison à l'ARN se comportent comme les métabolites qui déclenchent les liens ARN, mais leur multivalence génère de l'énergie de liaison supplémentaire et peut donc conduire à un repliement plus profond d'un ARN. Les fonctions biologiques de l'ARN dépendent d'un assortiment éblouissant de changements structurels dynamiques qui se produisent à différentes échelles de temps (Al-Hashimi et Walter, 2008; Sharp, 2009).

Les processus cellulaires (le métabolisme des AND et ARN, l'expression des gènes, la réplication) pourraient être perturbés par interaction avec les herbicides complexes (Yupsanis *et al.,* 2010).

Dans la présent étude, ont concentrés sur la façon dont le contenu totale en ARN oscille dans les feuilles de la variété de vigne Frâncuşă au cours d'une période de végétation.

Frâncuşă est une variété de vigne noble (*Vitis vinifera*, spp. *vinifera*) vieille roumaine, cultivée depuis des siècles avant l'invasion filoxérique, dans toute la Moldavie. Cette variété de vigne donne un vin blanc supérieur, très réputé (Agerpres*:* Viticultură Românească: Frâncuşă, vinul cu o inconfundabilă notă de prospeţime şi fructuozitate, 2015; https://www.crameromania.ro/soiuri-de-struguri/francusa-329.html; http://www.horticultorul.ro/vita-de-vie/soiuri-de-vita-de-vie-pentru-vinuri-albe-superioare/; https://www.bautura-online.ro/blog/clasificarea-vinurilor/).

MATÉRIEL ET MÉTHODE

Le matériel biologique utilisé dans l'expérience a été représenté par la variété de vigne Frâncuşă cultivé dans la collection ampélographique de la Station Didactique Expérimentale "V.Adamachi" de l'Université des Sciences Agronomiques et de Médicine Vétérinaire "Ion Ionescu de la Brad" de Iasi.

De la variété Frâncuşă on a échantillonné des feuilles mûries parmi les pousses fertiles de les 30 vignes, réparties en 4 phénophases: bourgeonné, floraison, début de la maturation des raisins, maturation complète des raisins.

À partir des feuilles mûries, des échantillons de 50 mg de mésophilus localisés entre les nervures N1 et N2 ont été prélevés aussi près que possible du pétiole de la feuille. Pour chaque phénophase, ont été effectué 10 déterminations du contenu en ARN.

La méthode de détermination du contenu en ARN comprenait 5 opérations centrifuges successives et le surnageant de la dernière opération centrifuge était lu au spectrophotomètre Jenuay UV à deux longueurs d'onde: λ 270 nm et λ 290 nm par rapport à un échantillon aveugle représenté par 0,5 N d'acide perchlorique. Les lectures ont été introduites dans la formule de calcul suivante (Spirin, 1958; Toma et Pîrîianu, 2000; Ouyang *et al.,* 2014):

$$\text{mg ARN/g tissu frais} = \frac{5525 \times \Delta}{mgtissufrais} \times 0.25$$

où Δ = la différence entre l'extinction lue à 270 nm et 290 nm respectivement.

Les résultats obtenus pour chaque phénophase ont été analysés avec le test T student. À cet égard, les valeurs obtenues ont été calculées: $\bar{x}$ (la valeur moyenne), s (variance), s% (coefficient de variation), $s_{\bar{x}}$ (erreur moyenne de la moyenne arithmétique). Pour le calcul des assurances statistiques, a été appliqué la méthode des différences limites (DL) (Snedecor et Cochran, 1984; Oancea, 2007).

RÉSULTATS ET DISCUSSIONS

Les résultats sur la dynamique du contenu en ARN dans les feuilles de la variété de vigne Frâncuşă sont centralisés dans le tableau 1 et figure 1.

Tableau 1

Le contenu en ARN (mg/g) dans les feuilles de la variété de vigne Frâncuşă

Phenophase	La valeur moyenne ($\bar{x}$)	Déviation standard (s)	Coefficient de variabilité (s%)	Erreur moyenne de la moyenne arithmétique ($s_{\bar{x}}$)
bourgeonné	8.56	0.57	26.63	0.057
floraison	1.45	0.09	25.66	0.009
début de la maturation des raisins	2.08	0.08	15.29	0.008
maturation complète des raisins	1.73	0.13	29.91	0.013

Pendant toute la période de végétation, le contenu en ARN diminue progressivement. Au cours de bourgeonné, lorsque la vigne passe de l'état de repos à l'état de végétation, le métabolisme est intensifié, des processus de biosynthèse accélérés sont produits de manière à mettre en évidence une quantité accrue d'ARN présentant une variation située entre 7,74 et 10,37 mg/g avec une moyenne de 8.56 mg/g (tab. 1, fig. 1). Aussi, la quantité d'ADN est augmentée à

bourgeonné Il existe une similitude entre la dynamique du contenu en ARN et la dynamique du contenu en ADN dans les feuilles du Frâncuşă (Pădureanu, 2004).

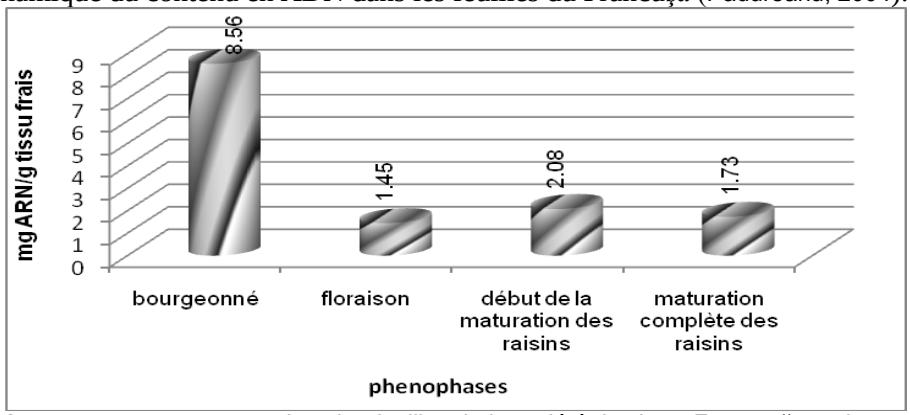

Fig. 1 Le contenu en ARN dans les feuilles de la variété de vigne *Frâncuşă* pendant un cycle de végétation

Une alimentation adéquate en azote entraîne une croissance normale ainsi qu'une coloration appropriée de la feuille, ce qui permet la photosynthèse efficace, tout en favorisant la différenciation des bourgeons florifères. Et pourtant, la quantité d'ARN est le plus bas dans floraison (1.45 mg/g). Au début de la maturation des raisins, le contenu en ARN a légèrement augmenté à 2.08 mg/g, puis a diminué à 1.73 mg/g au cours de la période de maturation complète du raisin.

La variation du contenu en ARN était modérée lors du début de la maturation des raisins, pendant que à bourgeonné, floraison et maturation complète des raisins, variation du contenu en ARN était élevée, supérieure à 20%.

En conclusion, le contenu en ARN à la bourgeonné est la plus élevée, statistiquement assurée (tab. 2).

Tableau 2

Assurance statistique du contenu en ARN pendant les phénophases de la période de végétation, dans les feuilles de la variété de vigne Frâncuşă

Phenophase	La valeur moyenne	Différence par comparaison avec témoin	Importance de la difference
Moyenne (témoin)	3.46	-	-
bourgeonné	8.56	+ 5.1	***
floraison	1.45	- 2.01	0
début de la maturation des raisins	2.08	- 1.38	-
maturation complète des raisins	1.73	- 1.73	-

DL 5% = 1.84; DL 1% = 2.64; DL 0.1% = 3.88

CONCLUSIONS

1. Le contenu en ARN dans les feuilles de la variété de vigne Frâncuşă est assez élevé dans la phénophase bourgeonné, lorsque le métabolisme est intensifié.

2. À partir de la floraison, la quantité d'ARN diminue rapidement. Ce phénomène est directement corrélé à l'intensité accrue des processus de biogenèse des organites cellulaires.

3. La variabilité du contenu d'ARN est modérée à début de la maturation des raisins et élevée à bourgeonné, floraison et maturation complète des raisins.

4. La dynamique du contenu en ARN est très similaire à la dynamique du contenu en ADN dans les feuilles de la variété de vigne Frâncuşă.

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19. *,** https://www.bautura-online.ro/blog/clasificarea-vinurilor/

VARIABILITY OF RNA CONTENT IN LEAVES OF FRÂNCUŞĂ VINE VARIETY

Abstract: *RNA is involved in the main processes of protein synthesis. The RNA content/mg of tissue reflects the intensity of protein synthesis processes. The total RNA content of the leaves of the Frâncuşă vine variety was investigated in different phenophases: unbudding, flowering, ripening, full maturation of grapes. Dynamic analysis of the RNA content in the leaves shows that in the unbudding phenophase, the protein synthesis is at maximum.*
Key words: RNA, unbudding, flowering, ripening, full maturation of grapes

LA STABILITÉ DU CONTENU EN ACIDE ASCORBIQUE PENDANT LE FLUX TECHNOLOGIQUE D'OBTENTION DU PRODUIT "CHOU-FLEUR AU VINAIGRE"

STABILITATEA CONȚINUTULUI ÎN ACID ASCORBIC PE PARCURSUL FLUXULUI TEHNOLOGIC DE OBȚINERE A PRODUSULUI „CONOPIDĂ ÎN OȚET”

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Résumé. *La teneur des produits horticoles en vitamine C est influencée par divers facteurs, tels que: les différences génotypiques, les conditions climatiques, les pratiques agricoles, les techniques de récolte et de stockage, ainsi que les technologies de fabrication et de conservation. L'objectif principal de la présente recherche est l'étude de la stabilité de l'acide ascorbique au cours des processus technologiques d'obtention du produit "Chou-fleur au vinaigre". L'échantillonnage pendant différentes étapes du flux technologique a eu lieu à l'unité de traitement des légumes et des fruits de S.C. Contec Foods S.R.L. Tecuci. Les échantillons ont été prélevés pendant deux années consécutives, au mois d'octobre, à partir de 4 points du flux technologique. Le produit fini "Chou-fleur au vinaigre" a été aussi analysé après une période de stockage de 3 mois à 10°C ou 25°C pour étudier la stabilité de l'acide ascorbique.*
Mots clés: vitamine C, chou-fleur, processus technologiques, traitement, conservation

Rezumat. *Conținutul produselor horticole în vitamina C este influențat de diverşi fatori, cum sunt: diferențele genotipice, condițiile climatice, practicile agricole, tehnicile de recoltare şi păstrare, precum şi tehnologiile de fabricare şi conservare. Obiectivul principal al prezentei cercetări este studierea stabilității acidului ascorbic pe parcursul proceselor tehnologice de obținere a produsului "Conopidă în oțet". Recoltarea probelor pe parcursul diferitelor etape ale fluxului tehnologic a avut loc la unitatea de prelucrare a legumelor şi fructelor S.C. Contec Foods S.R.L. Tecuci. Probele au fost recoltate pe parcursul a doi ani consecutivi, în luna octombrie, în 4 puncte ale fluxului tehnologic. Produsul finit „Conopidă în oțet" a fost de asemenea analizat după o perioadă de conservare de 3 luni la 10°C sau 25°C, în scopul studierii stabilității acidului ascorbic.*
Cuvinte cheie: vitamina C, conopidă, procese tehnologice, prelucrare, conservare

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INTRODUCTION

D'origine égyptienne, la culture du chou-fleur a commencée au XVIème siècle, d'abord dans le bassin méditerranéen, puis en Europe occidentale et enfin dans la plupart des pays du monde. C'est une légume très saine, du a son contenu riche en composés bioactifs antioxidants et anticancéreux, comme les polyphénols, l'acide ascorbique (vitamine C) et les glucosinolates (Patras *et al*., 2017). La teneur en vitamine C est influencée par divers facteurs, tels que: les différences entre les variétés de chou-fleur, les conditions climatiques, les pratiques agricoles, les techniques de récolte et de stockage, ainsi que les technologies de fabrication et de conservation. L'objectif de la présente recherche est d'étudier le contenu de chou-fleur en acide ascorbique pendant les processus technologiques d'obtention du produit "Chou-fleur au vinaigre" et son stabilité en temps pendant la conservation du produit finit à différentes températures.

MATÉRIAUX ET MÉTHODES

Le matériel étudié est représenté par le chou-fleur en 4 étapes du flux technologique d'obtention du produit "Chou-fleur au vinaigre" (fournis par la compagnie S.C. Contec Foods S.R.L. Tecuci): matière première, après lavage, après blanchissement a 85°C et produit fini obtenu après pasteurisation. Le liquide entourant le chou-fleur dans la conserve finale "Chou-fleur au vinaigre" (nommé aussi, liquide de revêtement) a été également analysé. Les échantillons ont été prélevés pendant deux années consécutives, au mois d'octobre, à partir des 4 points du flux technologique. Le produit fini "Chou-fleur au vinaigre" a été analysé aussi, après une période de stockage de 3 mois à 10°C ou 25°C pour étudier la stabilité de l'acide ascorbique.

L'analyse du contenu en acide ascorbique a été réalisée par deux méthodes différentes: la méthode titrimétrique utilisant le 2, 6-dichlorophénol indophénol (ISO 6557-1:1986, ISO 6557-2:1984) et une méthode réflectométrique utilisant le Reflectoquant RQFlex, Merck (Eberhardt *et al*., 2000).

RÉSULTATS ET DISCUSSIONS

Les deux méthodes d'analyse employées ont conduit aux résultats similaires. Dans toutes les échantillons de la première année, le contenu en acide ascorbique a été insignifiant plus élevé comparatif à la deuxième année, du a la qualité de la matière première. Dans toutes les étapes technologiques ont été remarques des baisses du contenu en vitamine C. La plus faible baisse a été enregistré après le lavage: environ 8 mg/100 g, représentant 11% dans le Ier année et 6 mg/100 g, représentant 8% dans la IIème année (fig. 1). Le blanchissement a réduit considérablement le contenu en acide ascorbique avec encore 19 mg/100 g (Ier année), et 20 mg/100 g (IIème année), représentant 29% et respective 32% du contenu après lavage. La pasteurisation a réduit beaucoup le contenu en acide ascorbique de toutes les échantillons, avec environ 29 mg/100 g (62 %) indifférent de l'année ou de la méthode d'analyse.

Par rapport à la matière première, le produit fini contienne environ 24-25% de l'acide ascorbique initial dans le Ier année (environ 18 mg/100 g), respectivement 22% dans le IIème année (environ 15,5 mg/100 g). Le liquide de revêtement a un contenu très faible de vitamine C (5,5-6,1 mg/100 g).

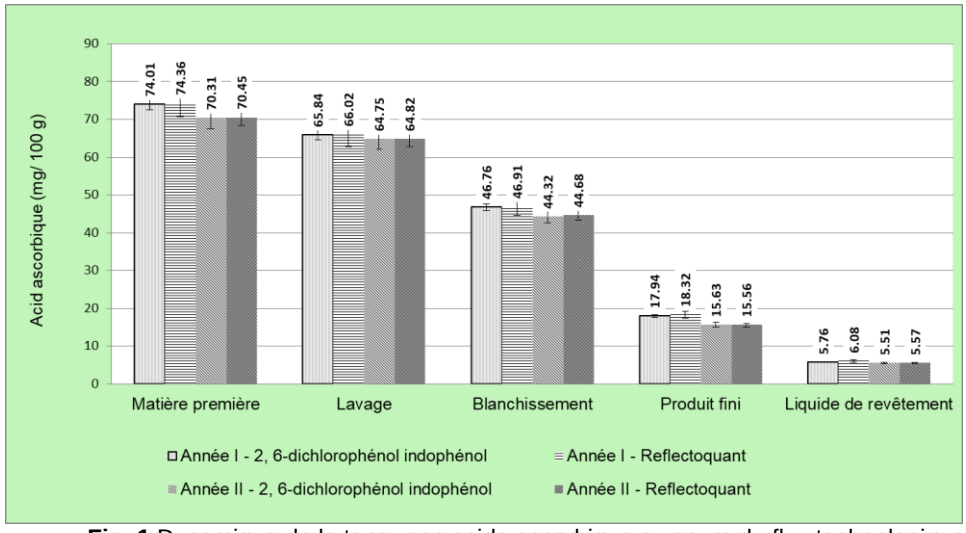

Fig. 1 Dynamique de la teneur en acide ascorbique au cours du flux technologique d'obtention du produit « Chou-fleur au vinaigre »

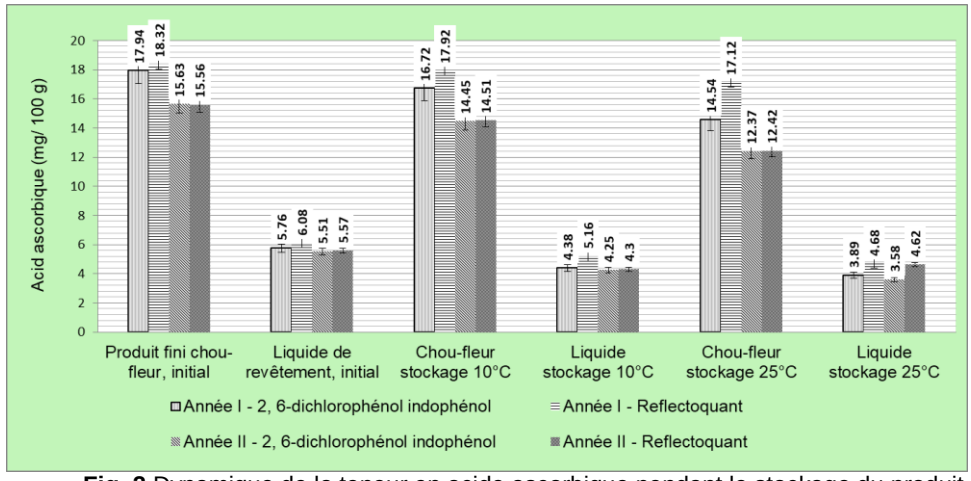

Fig. 2 Dynamique de la teneur en acide ascorbique pendant le stockage du produit „Chou-fleur au vinaigre"

Pendant les 3 mois de stockage, le contenu en vitamine C a enregistré une diminution dans le produit fini et aussi dans le liquide de stockage (fig. 2). Comme attendu, la plus importante diminution a été remarquée dans le cas du stockage à 25°C. Le chou-fleur conservé en vinaigre a perdu entre 0,4 - 1,2 mg

acide ascorbique/100g après 3 mois de stockage à 10°C et entre 1,2 - 3,4 mg acide ascorbique/100g après le stockage à 25°C.

CONCLUSIONS

1. Le produit « Chou-fleur au vinaigre » contienne moins de 25% de l'acide ascorbique de la chou-fleur initiale. Les traitements thermiques ont déterminé les plus importantes perdes pendant le flux technologique d'obtention du produit fini.

2. Les conditions de stockage ont influencé le contenu en acide ascorbique du produit fini « Chou-fleur au vinaigre », sa diminution étant plus importante dans le cas du stockage au température plus élevé.

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STABILITY OF THE ASCORBIC ACID CONTENT DURING THE TECHNOLOGICAL FLOW OF THE PRODUCT "CAULIFLOWER IN VINEGAR"

Abstract: *The vitamin C content of horticultural products is influenced by various factors, such as: genotypic differences, climatic conditions, agricultural practices, harvesting and storage techniques, as well as manufacturing and preservation technologies. The main objective of the present research is to study the stability of ascorbic acid during the technological processes of obtaining the product "Cauliflower in vinegar". The sampling during the different stages of the technological flow took place at S.C. Contec Foods S.R.L. Tecuci, a company for processing vegetables and fruits. The samples were collected during two consecutive years, in October, from 4 points of the technological flow. The finished product „Cauliflower in vinegar" was also analyzed after a 3-month storage period at 10°C or 25°C, in order to study the stability of ascorbic acid.*

Keywords: vitamin C, cauliflower, technological processes, processing, preservation

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