ISSN–L=1454-7376
(Print)-ISSN 1454-7376
(Online)=ISSN 2069-8275
(CD-ROM) = ISSN 2069 – 847X

UNIVERSITATEA PENTRU ȘTIINȚELE VIEȚII
"ION IONESCU DE LA BRAD" DIN IAŞI

USV 1842

LUCRĂRI ŞTIINŢIFICE

Vol. 67

NR. 2

SERIA HORTICULTURĂ

EDITURA "ION IONESCU DE LA BRAD"

IAŞI 2024

ISSN–L=1454-7376
(Print)-ISSN 1454-7376
(Online)=ISSN 2069-8275
(CD-ROM) = ISSN 2069 – 847X

Tehnoredactare și grafică computerizată
Asist. dr. Ana-Maria-Roxana ISTRATE

"Ion Ionescu de la Brad" Publishing House Iaşi
ISSN–L=1454-7376
(Print)-ISSN 1454-7376
(Online)=ISSN 2069-8275
(CD-ROM) = ISSN 2069 – 847X

Copywriting and computer graphics
Assist. Ana-Maria-Roxana ISTRATE, PhD

CUPRINS

EVALUATION OF THE MAIN CHARACTERISTICS OF SOME ROSE VARIETIES USING *ARTS*® (*AMERICAN ROSE TRIALS FOR SUSTAINABILITY*®) PROGRAM

EVALUAREA PRINCIPALELOR CARACTERISTICI ALE UNOR SOIURI DE TRANDAFIR PRIN UTILIZAREA PROGRAMULUI ARTS ® (*AMERICAN ROSE TRIALS FOR SUSTAINABILITY*®)

IUROAEA Gheorghe[1], APOSTOL Maria[1], CANTOR Maria[2], BERNARDIS Roberto Renato[1], DRAGHIA Lucia[1]

*Corresponding author e-mail: maria.apostol@iuls.ro

Abstract. *Diversification the assortment of roses, used in landscaping or as cut flowers, has as its main objectives both the improvement of ornamental characters and genetic resistance to biotic and abiotic factors. The decorative characters (habitus, flowering, foliage, etc.) of some new varieties of roses, belonging to the Iuroaea Gh. and homologated in 2021, were evaluated during three years (2019-2021), in the eco-pedological conditions of Vanatori locality, Galati county (Romania). The varieties 'Aris', 'Rodiana', 'Lilith' and 'Catalin' were evaluated, and the quantification of the analyzed characters was achieved by assigning grades, on a scale from 1 to 10, according to the American Rose Trials for Sustainability® program (ARTS®) The results indicated an excellent score for varieties 'Rodiana' (8.95 points) and 'Lilith' (8.65 points) and good behavior of the varieties 'Aris' (7.30 points) and 'Catalin' (7.60 points).*

Keyword: rose varieties, plant evaluation, ARTS program

Rezumat. *Diversificarea sortimentului de trandafiri, utilizați în amenajări peisagistice sau ca flori tăiate, are ca obiective principale atât îmbunătățirea caracterele ornamentale, cât și rezistenta genetică la factori biotici și abiotici. Caracterele decorative (habitus, înflorire, frunziș etc.) ale unor noi soiuri de trandafiri, autor Iuroaea Gh., și omologate în 2021, au fost evaluate pe parcursul a trei ani (2019-2021), în condițiile ecopedologice din localitatea Vânători, județul Galați (România). Au fost evaluate soiurile: 'Aris', 'Rodiana', 'Lilith' și 'Cătălin', iar cuantificarea caracterelor analizate s-a realizat prin acordarea de note, pe o scară de la 1 la 10, conform programului American Rose Trials for Sustainability (ARTS). Rezultatele au indicat un scor excelent pentru soiurilor `Rodiana` (8,95 puncte) și 'Lilith` (8,65 puncte) și un scor bun pentru soiurilor 'Aris' (7,30 puncte) și 'Cătălin' (7,60 puncte).*

Cuvinte cheie: soiuri trandafiri, evaluare, ARTS program

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania
[2] University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania

INTRODUCTION

The rose (*Rosa hybrida* L.) belongs to the Rosaceae family and originates, along with other species of the genus *Rosa*, in the northern hemisphere (Desta *et al.,* 2022). It has been cultivated since ancient times, but until today it has maintained a leading place in the hierarchy of the most appreciated and popular ornamental plants. Due to its special aesthetic qualities, some have called it "an aristocrat with class, color and fragrance" [Basu *et al.,* 2015]. As a cut flower it is among the favorites in the world trade, but it is equally appreciated in the design of gardens or as a potted plant. In addition, it also finds its use in medicine, food, cosmetics and perfumery, phytotherapy, art etc. [Cantor *et al.,* 2013; Desta *et al.,* 2022; Gaurav *et al.,* 2022; Hitter (Buru) *et al.,* 2020; Leus *et al.,* 2018; Shivaprasad *et al.,* 2016; Wasnik *et al.,* 2015].

Historical evidence points to the use of roses as garden plants for over 5000 years in regions of China, western Asia and northern Africa [Basu *et al.,* 2015; Leus *et al.,* 2018; Muthulakshmi *et al.,* 2022]. Primitive forms of roses had simple flowers and a reduced variety of colors, usually shades of pink [Cantor *et al.,* 2013], but through repeated selections, crosses and hybridizations, distinctive horticultural characters were obtained. Studies show that out of the 150-200 species of the genus *Rosa*, only 8-15 have contributed substantially to obtaining the modern varieties, currently over 25000-30000 [Cantor *et al.,* 2013; Gaurav *et al.,* 2022; Leus *et al.,* 2018; Van Huylenbroeck *et al.,* 2015].

Meeting the increasing demands of the market requires obtaining varieties with yield and quality performance, evaluated according to criteria related to the aesthetic potential (the appearance and architecture of the bush, the appearance of the leaves, the color, shape and fragrance of the flowers), tolerance to biotic and abiotic stress (diseases and pests), maximizing yield (minimal maintenance, good price) [Harp *et al.,* 2009; Hawke, 1997; Leus *et al.,* 2018; Muthulakshmi *et al.,* 2014; Santagostini *et al*., 2014]. The quality of rose production is directly influenced by climatic factors, especially light, temperature and humidity [Desta *et al.,* 2022], and the choice of varieties will take into account the reduction of water, fertilizer and phytosanitary products consumption [Adgi, 2017; Hurd *et al.,* 2006; Israel *et al.,* 1999; McLeod, 2002; Niu and Rodriguez, 2009; Pemberton, 2003; Spinti *et al.,* 2004]. Worldwide, there are numerous roses quality assessment programs, which differ according to the criteria analysed, but also the conditions under which the assessment is made (use of pesticides, nutrition management and water administration, planting distances, duration of testing etc.).

This paper presents the results obtained from the evaluation of four new varieties of roses, using the American Rose Trials for Sustainability® (ARTS®) program, a program initiated in 2012 in the USA, which evaluates: the quality of flowering throughout the growing season, the health and quality of the leaf apparatus and the mode of growth (Hammond *et al.,* 2019). The ARTS® philosophy is based on the premise of the possibility of having beautiful plants that tolerate harsh, low-maintenance environments (no fertilizers, pesticides and other agricultural chemicals, significantly reduced irrigation) [https://ucanr.edu/sites/SaratogaHort/files/266932.pdf].

MATERIAL AND METHOD

The research was carried out between 2019 and 2021, within the group represented by the author's rose collection, a group located in the area of Vanatori village, Galati county (latitude: 45°32'26.5" N; longitude: 27°59'59.1" E; altitude: 85 m). The average annual temperature in the research area was 10°C. The average summer temperature was 21.3°C. During the year there are approx. 210 days with temperatures above 10°C. The annual distribution of precipitation was uneven, the amount of precipitation during the vegetation period being 500 mm. The soil was represented by typical cambic chernozem, moderately eroded, with loam-clay texture (clay - 44.5%, sand - 32.25%, dust - 23.75%), formed on loessoid deposits, a reaction in layer 0-20 cm weakly acidic, with a medium content of humus and nitrogen (humus -3.56%, total nitrogen - 0.16%) and a medium insurance in mobile phosphorus (12 ppm P_2O_5) and very good in mobile potassium (169 ppm K_2O).

The vegetal material used in the present study was represented by four Romanian rose varieties (Iuroaea Gh.). The rootstock used was represented by *Rosa corymbifera* `Laxa`.

`Aris` - belongs to the *Thea hybrida* group, a budding variation (sport) from the `Artemis` variety homologated in 2022. The plants are vigorous, with a height of 100-150 cm and a horizontal development of 80-100 cm. The flowers are apricot color, with oval buds, with 20-25 petals. It blooms in 3-4 waves during the growing season. (fig. 1a).

`Rodiana` - homologated in 2022, belongs to the Floribunda group, obtained from artificial hybridization between `La Sevillina` x `Kimono`. The plants are vigorous, the bush have a height of 130-150 cm, diameter 100-120 cm with long erect branches. The leaves are dark green, glossy. The flowers are involute (35-40 petals), with buds located in corymb-shaped inflorescences, flower diameter 10-12 cm, pink petals with a medium intensity scent. It blooms in three waves (fig. 1b).

`Lilith`- belongs to the Floribunda group, was obtained from artificial hybridization between `Gebrüder Grimm` x `Airbrush`. The plants are vigorous, the bush reaches a height of 100-120 cm, a diameter of 80-100 cm, with long curved branches. The leaves are light green to dark green, glossy. The flowers, diameter 12-14 cm, are involute (40-45 petals), with round buds, white petals with salmon spots, and a medium intensity scent. It blooms in 3-4 waves (fig. 1c).

`Catalin`- belongs to the Hybrid Rugosa group, obtained from artificial hybridization between *Rosa rugosa* x `Cardinal de Richelieu`, homologated in 2022. The plants are medium to vigor, the bush grows to 130-170 cm in height and 110-150 cm in diameter, with long curved branches. The foliage is dark green, leathery. The flowers are involute (25-30 petals), with buds in umbel-like inflorescences, flower diameter of 10-12 cm, red petals, with a strong scent, similar to that of *Rosa damascena*. It blooms in three waves during the vegetation period (fig. 1d).

a) b) c) d)

Fig. 1. Rose varieties: a) `Aris`; b) `Rodiana`; c) `Lilith; d) `Catalin` (original)

At the PRO INVENT Exhibition 2021, `Aris` and `Rodiana` were awarded with the silver medal, and `Catalin` with the bronze medal.

The experiment was organized in randomized block design with three replications of 10 grafted plants for each cultivar. Planting was carried out in two rows, at a distance of 80 cm between plants per row and 100 cm between rows.

In the first year after planting, abundant amounts of water were provided to ensure the rooting and start of vegetation of the plants. To ensure the water needs of the plants in hot and dry periods, two liters of water were provided for each plant per week, either from natural rainfall or from additional irrigation. Additional irrigation was carried out by drip irrigation, ensuring a uniform distribution of water. No fungicides, insecticides, acaricides or other chemicals were applied during the growing season to control diseases and pests. The pruning were made outside the growing season as well as in the vegetation only to remove dead, diseased or broken branches or if a plant invades the adjacent plants. For winter protection the roses were additionally covered with soil (8-10 cm high) or mulched (with plants residue).

The character evaluation was done according to American Rose Trials for Sustainability® (ARTS®) (http://www.americanrosetrialsforsustainability.org/), which allows to calculate rose scores in any condition (inactive or not), on a scoring scale from zero to ten points (zero means that the plant is dead, and ten means that the plant is absolutely perfect). This program evaluates flower attractiveness, fragrance and bloom (42.5% of the score), leaf health and quality (45%), and growth habit (12.5%). Data collection was performed monthly from April to November before and after the 15th of the month.

The score obtained allows the quality of the variety to be determined (https://ucanr.edu/sites/SaratogaHort/files/266932.pdf):

- 10 points - superior variety (perfect foliage, absolutely covered with blossoms, outstanding growth habit, flawless in every respect);
- 9 - 8 points – excellent variety (very healthy/ healthy foliage, an abundance/ a significant of blossoms, really nice/ nice growth habit);
- 7 – 6 points – good variety (healthy foliage, only a few blossoms/ no blossoms, nice growth habit);
- 5 points – medium variety (10% leaf drop, no blossoms);
- 4 – 0 points – poor variety (no blossoms and 25%/ 50%/ 75%/ 90% leaf drop; dead plant).

RESULTS AND DISCUSSIONS

The main feature that an appraiser inspects was the foliage of the roses. If the leaves are healthy, the plant is healthy. The leaves are the most important part of the rose being responsible for producing all the energy needed to keep the plant alive and if the foliage is under stress, the plant is under stress. All roses should have healthy-looking green foliage, although some varieties have darker or lighter shades of green and higher or lower levels of brightness or luster, all should be completely green and not yellowed.

In the ARTS® program, this part of the criteria weighs the most in proportion to the total score given to each plant (45%). The criteria that were the basis of the foliage assessment refer to the ability of the plants to maintain their leaves (foliage retention), the degree of yellowing of the leaves (chlorosis), the degree of attack by pathogens

(spot - *Diplocarpon rosae*, powdery mildew - *Sphraerotheca pannosa* and rust - *Phragmidium mucronatum*), insects and mites (*Tetranichus urticae*).

In terms of foliage (tab. 1), the average for the four varieties in the three years was 3.94 points, the highest score being obtained by the `Rodiana` (4.20 points) and the lowest `Aris` (3.80 points) and `Catalin` (3.75 points). To criterion *the foliage retention*, none of the four varieties obtained the maximum score, but the lowest percentage of fallen leaves (up to 10%) and a score of 1.25 - 1.20 was registered at `Aris` and `Rodiana`. The other two varieties (`Catalin` and `Lilith`) received 1 point, the fallen leaves being 10-25%. On the other hand, the analyzed varieties proved to be resistant to yellowing of the leaves and were scored with the maximum score (1 point) – no yellowing leaves. Resistance to disease and pest attack shows differences between varieties. With very good resistance and with the maximum score (1 point) were the varieties `Rodiana` and `Lilith`. The variety `Catalin`, although it was very resistant to the attack of pathogens and received 1 point, showed a slight sensitivity to the attack of pests, with the foliage affected in a proportion of 1-10% (0.75 points). On the other hand, the `Aris` was affected in a proportion of approximately 10% by both diseases and pests, with each criterion obtaining 0.75-0.8 points.

Table 1

Varieties characteristics evaluated (average 2019-2021)

Criterias	Maxim points	Cultivars/ evaluation				Average
		`Aris`	`Rodiana`	`Lilith`	`Catalin`	
I. Foliage	**4.50**	**3.80**	**4.20**	**4.00**	**3.75**	**3.94**
Foliage retention	1.50	1.25	1.20	1.00	1.00	1.11
Chlorosis	1.00	1.00	1.00	1.00	1.00	1.00
Disease	1.00	0.75	1.00	1.00	1.00	0.94
Insects & mites	1.00	0.80	1.00	1.00	0.75	0.89
II. Form	**1.25**	**1.05**	**0.75**	**1.00**	**0.75**	**0.89**
Growth habit	1.00	0.80	0.75	1.00	0.75	0.83
Dead canes	0.25	0.25	0	0	0	0.06
III. Flowers	**4.25**	**2.45**	**4.00**	**3.65**	**3.10**	**3.30**
Bloom coverage	2.00	1.25	2.00	1.85	1.30	1.60
Bloom shape	0.50	0.30	0.50	0.50	0.25	0.39
Fragrance	1.00	0.50	0.75	0.80	1.00	0.76
Spent petals / calyces	0.50	0.25	0.50	0.25	0.30	0.33
Hip formation	0.25	0.15	0.25	0.25	0.25	0.22
TOTAL RATING	**10.00**	**7.30**	**8.95**	**8.65**	**7.60**	**8.13**

The term "nice" when used to describe growth habit (form) is not as subjective and this quality refers to an aesthetically attractive and uniform appearance to the form and shape the entire plant takes.

Of the four varieties studied in terms of form, the highest score was obtained by the variety `Aris` (1.05 points), followed by the cultivar `Lilith` with 1 point. The average for the four cultivars in the three years for the form criteria was 0.89 points (tab. 1). The criteria that contributed to the score received for form considered growth habit (maximum score 1 point) and dead canes (maximum score 0.25 points). With the most

beautiful growth (exceptionally robust and vigorous, pleasing to look at from every angle) and with the maximum score was variety `Lilith`. The other varieties were scored by 0.2 - 0.25 points due to the presence of weaker branches. The only one without dead branches or portions was the variety `Aris`, which received the maximum score (0.25 points). At `Rodiana`, `Lilith` and `Catalin` the presence of at least one dead or partially dead branch (if there were true leaves, those with at least 5 leaflets, above the point at which live tissue and dead tissue meet) determined scoring with 0 points.

The flowers themselves impact approximately 42.5% of the total score. The evaluation of the quality of the flowers, respectively of the flowering, was based on the following criteria: *bloom coverage* (the quantity of blooms), *bloom shape* (flower shape quality), *fragrance, spent petals or calyces* (petals or calyces remain after blooming) and *hip formation* (fruits which adds to the aesthetic quality of a rose, especially during the dormancy period).

The highest score was obtained by the variety `Rodiana` with 4.00 points, followed by the variety `Lilith` with 3.65 points. The average for the four varieties in the three years for the flower criteria was 3.30 points (tab. 1). From a quantitative point of view, variety `Rodiana` had the best coverage with flowers (75-100% of foliage masked by blooms) and maximum score. Variety `Lilith' had a close score (1.85 points), but varieties`Aris` and `Cătălin` dropped to 1.25 - 1.30 points due to a bloom that ensured coverage of approx. 50%. The quality of the flowers differentiated the varieties into two categories: `Rodiana` and `Lilith` with outstanding flowers (every petal is placed exactly where it should be and the overall appearance of the bloom is clean and well balanced), appreciated with maximum score (0.5 points); `Aris` and `Catalin` with beautiful flowers, but little loose or may have a few awkwardly placed petals, the score received being 0.25 – 0.30. The criterion related to the fragrance of flowers had scores between 1 and 0.5 points. With the most fragrant flowers (very fragrant), marked with the maximum, was `Catalin`, followed by `Rodiana` and `Lilith`, marked with 0.75 and 0.80, respectively, which indicates the presence of flowers with light to intense fragrance. The flowers from `Aris` had a weak perfume (0.5 points). Spent flowers represented the character that was penalized by almost 50% (0.25 – 0.30 points) in three of the four analyzed varieties, `Aris`, `Lilith` and `Catalin`, which indicates that they had a few petals remain on some of the calyces (newly forming hips), and paper petals appendages as brown. The only one rated to the maximum (no spent petals/calyces observed or the calyx tissue retains color and is obviously alive and healthy) was `Rodiana`. The ability to form fruiting bodies (roses) that complete the decorative appearance of the plants (attractive hips with a nice clean look) had all the varieties, except the variety `Aris`, with few hips or does not retain hips.

The final score is obtained by simply adding each point answer from the above criteria (table1). The overall result of the evaluation indicated an *excellent* behavior of the varieties `Rodiana` (8.95 points) and `Lilith` (8.65 points). The varieties `Aris` (7.30 points) and `Catalin` (7.60 points) and the evaluation result indicated a *good* behavior.

CONCLUSIONS

The ARTS® protocol involves evaluating the performance of the rose varieties on a no-maintenance, no-fertilizer, and minimal-irrigation regime (50% of what would be required to maintain a lawn during the cold season).

The `Aris' variety had a very good behavior regarding the *foliage retention, chlorosis, dead canes*, but a poor behavior in terms of the *flowers perfume*. It was considered a *very good variety* (7.30 points).

The `Rodiana' variety had a very good behavior in terms of the *chlorosis, disease, insects & mites, bloom coverage, bloom shape, spent petals/calyces, hip formation*. Poor results were recorded at criteria *dead canes*. With a total score of 8.95 points, it was considered *excellent variety.*

The `Lilith' variety had a very good behavior in terms of the *chlorosis, disease, insects & mites, growth habit, bloom coverage, hip formation*, and poor results at the *dead canes*. With a total of 8.65 points, it was rated as *excellent variety.*

The `Catalin' variety had a very good behavior in terms of the *chlorosis, disease, fragrance* and *hip formation*. A poor behavior in terms of the *dead canes*. It was considered a *very good variety* (7.60 points).

All four rose varieties evaluated by ARTS® presented valuable characteristics that recommend them to be grown in areas with similar conditions to the experimental field from Vânători village, Galați county, Romania.

REFERENCES

1. **Adgi T., 2017** - *Evaluation and assessment of rose health in the rose garden*. University of Pennsylvania (https://repository.upenn.edu/morrisarboretum_internreports /15/*).*
2. **Basu S.K., Zandi P., Cetzal W., Sengupta R., 2015 -** *The genus Rosa: An aristocrat from the plant family with class, color and fragrance.* Iranian Society of Environmentalists. IRSEN Newslatter, http://www.irsen.org/newse.html.
3. **Cantor Maria, Buta Erszebet, Conţiu Ioana, 2013** - *Behavior of some new Rosa varieties in pedoclimatical conditions at Cluj-Napoca*. Journal of Horticulture, Forestry and Biotechnology, 17(1):6-10, www.journal-hfb.usab-tm.ro.
4. **Desta B., Tena N., Amare G., 2022 -** *Response of rose (Rosa hybrida L.) plant to temperature*. Asian Journal of Plant and Soil Sciences, 7(1):93-101.
5. **Gaurav A.K., Namita Raju D.V.S., Ramkumar M.K., Singh M.K., Singh B., Krishnan S.G., Panwar S., Mithra S.V., 2022 -** *Genetic diversity analysis of wild and cultivated Rosa species of India using microsatellite markers and their comparison with morphology based diversity.* Journal of Plant Biochemistry and Biotechnology, 31(1):61–70.
6. **Harp D.A., Zlesak D.C., Hammond G., George S., Mackay W., 2009** - *Earth-Kind® rose trials-Identifying the world's strongest, most beautiful landscape roses Zlesak D.C. Roses.* Floriculture and Ornamental Biotech, 3(1): 166 -175.
7. **Hammond G., Zlesak D.C., Schwartz M., Kukielski P., George S., Chamblee M., Nelson R., Zuzek K., McLean K., Freedman D., Fink R., 2019** - *American Rose Trials for Sustainability® (ARTS®): a new United States rose trialing program for identifying and promoting regionally-adapted roses.* Acta Horticulturae, 1232:193-201, DOI 10.17660/ActaHortic.2019.1232.29.
8. **Hawke R.G., 1997** - *Plant Evaluation Notes. An Evaluation Report of Shrub Roses.* Chicago Botanic Garden, Issue 11.

9. Hitter (Buru) Timea, Szekely-Varga Z., Csiki I.L., Buta Erzsebet, Cantor Maria, 2020 - *Evaluation of some rosa cultivars under Transylvania climatic conditions*. Current Trends in Natural Sciences, 9(17):153-159.

10. Hurd B.H., Hilaire R.S., White J.M., 2006 - *Residential landscapes, homeowner attitudes, and water-wise choices in New Mexico. HortTechnology* 16(2): 241–246.

11. Israel G.D., Easton J.O., Knox G.W., 1999.-*Adoption of landscape management practices by Florida residents*. HortTechnology, 9(2): 262–266.

12. Leus L., Van Laere K., De Riek J., Van Huylenbroeck J., 2018 – *Rose* (chapter 27). In *Ornamental Crops*, Handbook of Plant Breeding 11, Springer International Publishing AG, pp 719-767, https://doi.org/10.1007/978-3-319-90698-0_27.

13. McLeod J., 2002 - *Botanica's Organic Gardening*. Random Hous Publishing, Sydney. ISBN1-74051-426-2.

14. Muthulakshmi R., Visalakshi M., Aruna P., Manikanda Boopathi N., 2022 - *Evaluation of field rose varieties for growth and yield parameters under open field condition*. The Pharma Innovation Journal, 11(7):1823-1826.

15. Niu G., Rodriguez D.S., 2009 - *Growth and physiological responses of four rose rootstocks drought stress.* J. Amer. Soc. Hort. Sci. 134(2): 202–209.

16. Pemberton H.B., 2003 - *Overview of roses and culture,* p. 570–573. In: A.V. Robert, T. Debener, and S. Gudin (eds.). Encyclopedia of rose science, Vol. 2. Elsevier Academic Press, San Diego.

17. Santagostini P., Demotes-Mainard S., Huché-Thélier L., Leduc N., Bertheloot J., Guérin V., Bourbeillon J., Sakr S., Boumaza R., 2014 - *Assessment of the visual quality of ornamental plants: Comparison ofthree methodologies in the case of the rosebush*. Scientia Horticulturae 168:17–26.

18. Shivaprasad, S.G., Nataraj S.K., Latha, S., Ravi C.H., Suryakant K.V., 2016 - *Evaluation and correlation studies of rose cultivars under naturally ventilated polyhouse*. Research in Environment and Life Sciences, 9(9):1097-1099.

19. Spinti J.E., Hilaire R.S., VanLeeuwen D., 2004 - *Balancing landscape preferences and water conservation in a desert community.* HortTechnology 14(1):72–77.

20. Van Huylenbroeck J., Smulders M.J.M., Debener T., Nybom H., Gudin S., Cox P., Crespel L., De Riek J., 2005 - *GENEROSE: Genetic Evaluation of European Rose Resources for Conservation and Horticultural Use***.** Acta Horticulturae, 690:119-123, DOI: 10.17660/ActaHortic.2005.690.17.

21. Wasnik P., Raut V.U., Bhande M.H., Shambhavkar V.B., 2015 - *Evaluation of scented rose varieties for yield and quality of flowers.* Plant Archives, 15(2):895-897.

22. **** https://ucanr.edu/sites/SaratogaHort/files/291184.pdf

23. **** https://ucanr.edu/sites/SaratogaHort/files/266932.pdf

24. *** http://www.americanrosetrialsforsustainability.org/

OBSERVATIONS ON ARTHROPOD SPECIES FROM SOME CHERRY ORCHARDS

OBSERVAȚII ASUPRA SPECIILOR DE ARTROPODE DIN UNELE PLANTATII POMICOLE DE CIREȘ

BALINT Romeo Ciprian [1]*, TĂLMACIU Nela[1], HEREA Monica[1], BALINT Răducu Ionuț[1], CROITORU Nichita [2], TĂLMACIU Mihai[1]

*Corresponding author e-mail: mihai.talmaciu@iuls.ro

Abstract.
The Barber-pitfall traps were used to capture the epigeus arthropod species from cherry plantations. The observations were carried out in a 15-year-old cherry plantation in the eastern part of Romania, in the locality of Raducaneni, Iasi county. The traps were installed in the plantation in 2022, the observations being made between May and September. A number of 7 collections of biological material were made, on the following dates: 25.05, 7.06, 19.06, 27.06, 18.07, 23.08, 5.09. The collected epigean arthropods belong to the order Arthropoda and to 3 classes: Insecta, Arachnida and Crustacea. The most numerous species belong to the class Insecta, order Coleoptera. The species of coleoptera collected belong to the families: Carabidae, Dermestidae, Elateridae, Cantharidae, Staphilinidae, Chrysomelidae and Coccinellidae.
Key words: cherry orchards, pitfall traps, artropods.

Rezumat.
Pentru capturarea speciilor de artropode epigee din plantatiile de cireş au fost utilizate capcane de sol de tip Barber. Observațiile au fost efectuate într-o plantație de cireș având vârsta de 15 ani din zona de est a României, în localitatea Răducăneni, Iași. Capcanele au fost instalate în plantație în anul 2022, observatiile făcându-se în perioada mai-septembrie. Au fost făcute un număr de 7 recoltari ale materialului biologic , la urmatoarele date: 25.05, 7.06, 19.06, 27.06,18.07, 23.08, 5.09. Artropodele epigee colectate aparțin încrengăturii Arthropoda și la 3 clase: Insecta, Arachnida si Crustacea. Speciile cele mai numeroase apartin clasei Insecta, ordinul Coleoptera. Speciile de coleoptere colectate aparțin familiilor: Carabidae, Dermestidae, Elateridae, Cantharidae, Staphilinidae, Chrysomelidae și Coccinellidae.
Cuvinte cheie: livada de cires, capcane de sol, artropode.

INTRODUCTION

Of many tree species which are cultivated in our country, cherry is one of the most valuable. It is a fruit growing species with great economic importance, given

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania
[2] Technical University of Moldova, Chișinău

the nutritional characteristics, technological and commercial fruits [Popescu and Ionescu, 2020].

Although the sweet cherry crop is present throughout the country, due to weather conditions, there is a higher concentration of them in Iasi, Botosani, Bacau, Vrancea, Buzau, Prahova, Arges and Valcea counties, namely Eastern Moldova region.

Like all sweet cherry and sour cherry, the species are affected by many diseases and pests which attack fruit, leaves, shoots, flowers, branches, stems and roots. Affected trees growing in poor condition, are wholly or partly damaged, the fruit quality deteriorates, and the longevity of the trees decreases [Cardei *et al*, 2001].

Obtaining high yields and fruit quality is correlated with a good health of trees. In our country, by neglecting pests and diseases, cherry harvest can diminish by 45-100% in mid and late maturing varieties [Nistor and Petrescu, 2016].

MATERIAL AND METHOD

Experience field was held for observation useful and harmful coleopteran species in sweet cherry orchards to SC Vinifruct from Raducaneni to Iasi country.

The research method consisted of using pitfalll traps type Barber, the six traps with salt solution 20% in concentration [Talmaciu *et al.,* 2003].

Throughout the period of observations from May and ending in August we made a number of 7 harvesting following:

- The first harvest on 25.05;
- The second collection on 07.06;
- The third harvest on 19.06;
- Fourth harvest on 27.06;
- Fifth harvest on 18.07;
- Sixth harvest on 23.08;
- Seventh harvest on 5.09.

After each harvest, the solution inside the trap was replaced, and the collected material, once cleaned of plant debris or other impurities, such as soil remnants, snails, mice, etc., was brought to the laboratory [Talmaciu *et al.,* 2000].

In the laboratory, the arthropods species were selected, which were then identified. The identification was carried out using identification keys books [Perju and Rogojanu, 1979] as well as specialized websites.

RESULTS AND DISCUSSIONS

Regarding the situation of arthropods in the samples collected, the results are as follows (Table 1):

First collection (28.05): A total of 146 arthropod specimens were collected, belonging to the following groups: mites, insects, arachnids, and miriapodes. The largest number of specimens and species were among the beetles.

Table 1

The species of collected arthropods in the pitfall trap

No.	Name of species	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	Total
1st Harvest 25.05.2022														
1	Mites	-	-	-	-	-	-	-	-	2	-	-	-	2
2	*Amara aenea*	-	2	-	-	2	-	-	-	-	-	-	-	4
3	*Amara eurinota*	-	-	-	-	-	1	-	-	-	-	-	-	1
4	*Amara familiaris*	-	1	-	3	-		-	-	-	-	-	-	4
5	*Anisodactylus binotatus*	6	1	3	3	2	4	7	-	1	1	-	2	30
6	Arahnids	2	8	10	-	1	3	9	1	4	1	-	1	40
7	*Armadilidium vulgare*	-	-	-	1	-	-	1	1	-	-	-	-	3
8	*Bombus terestris*	-	-	-	1	-	-	2	-	-	-	-	-	3
9	*Brachynus crepitans*	-	1	-	-	-	1	-	-	-	-	-	-	2
10	*Brachynus explodens*	-	-	1	-	-	-	-	-	-	-	-	-	1
11	*Calodera aethiops*	-	-	-	-	1	-	-	-	-	-	-	-	1
12	*Cantharis fusca*	-	-	-	-	-	-	-	1	-	-	-	-	1
13	*Cantharis violaceus*	-	-	2	-	-	-	-	-	-	-	-	-	2
14	*Coccinela septempunctata*	-	-	-	-	-	1	-	-	-	-	-	-	1
15	*Dermestes laniarius*	1	2	-	-	1	-	-	-	-	-	-	-	4
16	*Harpalus calceatus*	-	-	-	-	-	-	-	-	-	-	-	1	1
17	*Harpalus distinguendus*	6	8	1	3	2	3	2	-	2	2	-	-	29
18	*Harpalus tardus*	-	-	-	2	1	1	2	-	-	-	-	-	6
19	*Hister purpurascens*	-	-	-	-	-	-	-	1	-	-	-	-	1
20	Miriapods	-	-	-	-	-	1	-	-	1	-	-	1	3
21	*Ophonus azureus*	3	1	-	-	-	-	-	-	-	-	-	-	4
22	*Pseudophonus griseus*	1	-	-	1	-	-	-	-	-	-	-	-	2
23	*Tachyporus abdominalis*	-	-	1	-	-	-	-	-	-	-	-	-	1
Total 1st Harvest		**19**	**24**	**18**	**14**	**10**	**15**	**23**	**4**	**10**	**4**	**-**	**5**	**146**

2nd Harvest 07 .06.2022														
1	*Amara aenea*	-	-	-	1	-	-	2	-	-	-	-	-	3
2	*Amara apricaria*	-	-	-	1	6	-	-	2	-	-	-	-	9
3	*Anisodactylus binotatus*	-	-	4	8	-	-	2	-	-	7	-	-	21
4	*Anisodactylus signatus*	-	-	-	-	3	-	-	-	-	-	-	-	3
5	Arahnids	3	3	4	4	-	-	-	3	-	2	-	-	19
6	*Carabus coriaceus*	-	-	-	-	1	-	2	-	-	-	-	-	3
7	Dermapters	-	-	-	-	-	-	-	1	-	-	-	-	1
8	*Dermestes laniarius*	-	-	1	-	1	-	-	-	3	-	-	-	5
9	*Harpalus calceatus*	-	1	-	-	-	-	-	-	-	-	-	-	1
10	*Harpalus distinguendus*	3	1	2	3	2	-	3	2	-	2	-	-	18
11	*Harpalus tardus*	-	-	-	-	2	-	1	-	5	-	-	-	8
12	Miriapods	2	-	-	-	-	-	-	-	-	-	-	-	2
13	*Ophonus azureus*	-	-	-	-	1	-	1	-	-	-	-	-	2
14	*Pentodon idiota*	-	1	-	-	-	-	-	-	-	-	-	-	1
15	*Pseudophonus griseus*	-	1	-	-	-	-	-	-	-	-	-	-	1
Total 2nd Harvest		**8**	**7**	**11**	**17**	**16**	**-**	**11**	**8**	**8**	**11**	**-**	**-**	**97**
3rd Harvest 19.06.2022														
1	*Amara aenea*	1	-	-	-	-	-	-	-	-	-	-	1	2
2	*Amara similata*	1	1	-	-	-	-	-	-	-	-	-	-	2
3	*Anisodactylus binotatus*	1	-	-	-	1	1	-	2	-	-	2	2	9
4	Arahnids	5	-	3	-	-	2	-	3	-	-	5	6	24
5	*Cantharis violaceus*	-	-	-	-	-	-	1	-	-	-	-	-	1
6	*Carabus coriaceus*	-	-	-	-	1	1	-	-	-	-	-	-	2
7	Dermapters	2	1	-	-	-	-	-	-	-	-	-	-	3
8	*Dermestes laniarius*	-	-	-	-	1	-	1	-	-	-	-	-	2
9	*Harpalus distinguendus*	1	-	-	-	-	-	2	-	-	-	1	-	4
10	*Harpalus tardus*	-	-	-	-	1	-	-	-	-	-	-	1	2
11	*Lathrobium quadratum*	-	-	-	-	1	-	-	-	-	-	-	-	1

12	*Metcalfa pruinosa*	-	-	-	-	1	-	-	-	-	-	-	-	1
13	*Pterostichus cupreus*	-	-	-	-	-	-	1	-	-	-	-	-	1
14	*Sericus bruneus*	-	-	-	-	-	-	-	-	-	1	-	-	1
Total 3rd Harvest		**11**	**2**	**3**	**-**	**6**	**4**	**5**	**5**	**-**	**1**	**8**	**10**	**55**
						4th Harvest 27.06.2022								
	Amara crenata	-	-	-	-	-	1	-	-	-	-	-	-	1
1	*Anisodactylus binotatus*	-	-	-	-	3	4	-	-	8	-	-	-	15
2	Arahnids	-	-	-	-	5	3	1	-	-	-	-	-	9
3	*Blaps mortisaga*	-	-	-	-	-	-	-	1	-	-	-	-	1
4	*Calatus fuscipes*	-	-	-	-	-	-	-	-	1	-	-	-	1
5	*Carabus coriaceus*	-	-	-	-	-	2	-	-	-	-	-	-	2
6	*Dermestes laniarius*	-	-	-	-	-	-	-	-	1	-	-	-	1
7	*Halyzia 14-gutatta*	-	-	-	-	-	-	-	-	1	-	-	-	1
8	*Harpalus distinguendus*	-	-	-	-	3	2	2	-	2	-	-	-	9
9	*Leistus ferrugineus*	-	-	-	-	-	-	-	-	1	-	-	-	1
10	*Metabletus truncatellus*	-	-	-	-	-	-	-	-	3	-	-	-	3
11	*Ophonus puncticollis*	-	-	-	-	-	-	1	-	-	-	-	-	1
12	*Ophonus sabulicola*	-	-	-	-	-	-	1	-	-	-	-	-	1
Total 4th Harvest		**-**	**-**	**-**	**-**	**11**	**12**	**4**	**1**	**17**	**-**	**-**	**-**	**46**
						5th Harvest 18.07.2022								
1	*Amara aenea*	-	-	-	1	-	-	1	-	-	-	-	-	2
2	*Amara apricaria*	-	-	-	-	-	-	-	-	-	-	-	1	1
3	*Amara familiaris*	-	-	-	1	-	-	-	-	-	-	-	-	1
4	*Anisodactylus binotatus*	-	-	-	-	-	-	1	-	-	-	-	1	2
5	*Anisodactylus signatus*	-	-	-	3	1	-	-	1	-	4	-	-	9
6	Arahnids	3	1	2	3	1	-	2	2	2	1	1	2	20
7	*Balaninus glandium*	-	-	-	-	-	-	1	-	-	-	-	-	1
8	*Blaps mortisaga*	-	-	-	-	-	1	-	-	-	-	-	-	
9	*Coccinella spetempunctat*	-	-	-	-	-	-	-	-	-	-	-	3	3

10	*Crypticus quisquilius*	-	-	-	-	-	-	-	1	-	-	-	-	1
11	Dermapters	2	-	-	-	-	-	-	-	-	-	1	-	3
12	*Dermestes laniarius*	-	-	-	-	1	1	3	1	-	-	-	-	6
13	*Halyzia 14 gutatta*	-	-	-	-	-	-	-	-	-	-	-	1	1
14	*Harpalus distinguendus*	1	1	-	-	1	-	-	-	-	1	-	-	4
15	*Harpalus tardus*	-	-	-	-	-	-	-	-	-	-	1	-	1
16	*Metabletus truncatellus*	-	2	-	-	-	-	-	-	-	-	-	-	2
17	Miriapods	-	-	-	1	-	-	1	-	-	-	-	1	3
18	*Ontophagus ovatus*	-	-	-	-	-	-	-	-	-	-	-	1	1
19	*Opatrum sabulosum*	-	-	-	-	-	-	-	1	-	-	-	-	1
20	*Ophonus azureus*	-	-	-	-	-	-	1	-	-	-	-	-	1
21	*Panagaeus cruxmajor*	-	-	-	-	-	-	-	-	-	-	1	-	1
22	*Podagrica malvae*	1	-	-	-	-	2	-	-	-	-	-	-	3
23	*Pseudophonus pubescens*	-	1	-	1	-	-	-	-	-	-	-	-	2
24	*Staphylinius caesareus*	-	-	-	1	-	-	-	-	-	-	-	-	1
Total 5th Harvest		**7**	**5**	**2**	**11**	**4**	**4**	**10**	**6**	**2**	**6**	**4**	**10**	**70**
6th Harvest 23.08.2022														
1	*Amara apricaria*	-	-	-	-	-	-	1	-	-	-	-	-	1
2	*Amara similata*	1	-	-	-	-	-	-	-	-	-	-	-	1
3	*Anysodactylus signatus*	-	-	-	-	-	-	-	-	-	1	-	-	1
4	Arahnids	2	-	3	1	-	-	-	3	-	2	2	-	13
5	*Armadillidium vulgare*	-	-	1	-	-	-	-	-	-	-	-	-	1
6	*Cartodere elongatus*	-	-	-	-	-	-	-	-	-	-	-	1	1
7	*Dermestes laniarius*	-	-	-	-	-	-	-	-	-	-	1	-	1
8	*Harpalus autumnalis*	1	-	-	-	-	-	-	-	-	-	-	-	1
9	*Harpalus distinguendus*	1	-	-	-	-	-	-	-	-	-	-	-	1
10	*Harpalus rufus*	-	-	2	-	-	-	-	-	-	-	-	-	2
11	*Lathrobium multipunctum*	-	-	-	-	-	-	-	-	-	1	-	-	1
12	*Licinus cassideus*	1	1	-	2	-	-	-	1	-	-	1	-	6
13	*Ophonus azureus*	1	-	-	-	-	-	-	-	-	-	-	-	1

14	*Ophonus sabulicola*	-	-	-	-	-	-	-	-	-	-	-	1	1
15	*Otiorrhynchus pinastri*	-	1	1	-	-	-	-	-	-	-	-	-	2
16	*Pseudophonus pubescens*	-	-	3	1	-	-	-	-	-	-	-	-	4
Total 6th Harvest		**7**	**2**	**10**	**4**	**-**	**-**	**1**	**4**	**-**	**4**	**4**	**2**	**38**
						7th Harvest 05.10.2022								
1	Mites	-	-	-	-	-	-	2	-	-	-	-	-	2
2	*Amara crenata*	-	1	-	-	-	-	-	-	-	-	-	-	1
3	*Anisodactylus binotatus*	-	-	-	-	-	-	-	-	-	-	2	-	2
4	*Anthobium minutum*	1	-	-	-	-	-	-	-	-	-	-	-	1
5	Arahnids	2	2	1	-	-	-	3	-	5	1	-	-	14
6	*Armadilidium vulgare*	1	1	-	-	-	-	-	-	-	-	1	-	3
7	*Calathus melanocephalus*	-	-	-	-	-	-	1	-	-	-	-	--	1
8	*Carabus coriaceus*	-	-	-	-	-	2	1	-	-	-	-	-	3
9	*Cartodere elongata*	1	-	-	-	-		2	-	2	-	3	-	8
10	*Harpalus distinguendus*	-	-	-	-	-	1	-	-	-	-	-	-	1
11	*Harpalus rufus*	-	-	-	-	-	-	-	-	1	-	-	-	1
12	*Hister funestus*	-	-	-	-	-	1	-	-	-	-	-	-	1
13	*Hister purpurascens*	-	-	-	-	-	1	-	-	-	-	-	-	1
14	*Licinus cassideus*	1	3	1	1	-	1	-	-	-	-	-	-	7
15	*Pseudophonus pubescens*	1	-	-	-	-	1	1	-	-	-	-	-	3
16	*Pterostichus nigrita*	-	-	-	-	-	1	-	-	-	-	-	-	1
17	*Quedus cinctus*	-	2	-	-	-	-	-	-	-	-	-	-	2
18	*Triplax lepida*	-	1	-	-	-	-	-	-	-	-	-	-	1
Total 7th Harvest		**7**	**10**	**2**	**1**	**-**	**8**	**10**	**-**	**-**	**1**	**6**	**-**	**53**

Second collection (7.06): A total of 97 arthropod specimens were collected, belonging to the following groups: insects, arachnids, and millipedes. Insects were the most numerous, both in terms of specimen count and species diversity.

Third collection (19.06): A total of 55 arthropod specimens were collected, belonging to the classes *Arachnida* and *Insecta*. Insects were the most numerous in both species and number of specimens.

Fourth collection (27.06): A total of 46 arthropod specimens were collected, belonging to the following groups: arachnids and insects. Only beetle species were collected among the insects.

Fifth collection: A total of 70 arthropod specimens were collected, belonging to the following two categories: arachnids and insects. Again, only beetle species were collected among the insects.

Sixth collection (23.08): A total of 38 arthropod specimens were collected, represented by arachnids and insects. The insects belonged only to the order *Coleoptera*, which dominated in terms of both specimen and species count.

Seventh and final collection (5.10): A total of 53 arthropod specimens were collected, belonging to the following groups: mites, arachnids, and insects. The insects were represented by the order *Coleoptera*, having the highest number of collected specimens and species.

Arthropoda species collection overview (table2).

Table 2

The centralized situation of arthropod species collection in the cherry plantation in 2022

Dates of harvest	25.05	7.06	19.06	27.06	18.07	23.08	5.09	**Total of 8th harvests**
Number of samples	146	97	55	46	70	38	53	505

Regarding the dynamics, abundance, and species of beetles collected throughout the observation period, the situation is as follows (Table 3):

A total of 347 beetle specimens were collected, representing 56 different species.

The species with the highest number of specimens collected were: *Anisodactylus binotatus*, with 74 specimens, representing 22,77% of the total, *Harpalus distinguendus*, with 66 specimens, representing 19,02% of the total, *Dermestes laniariu*s, with 19 specimens, representing 5,48% of the total, *Harpalus tardus*, with 17 specimens, representing 4.9%, *Anisodactylus signatus* and *Licius cassid*eus, with 13 specimens each, representing 3,75%, *Amara aenea* and *Amara apricaria*, with 11 specimens each, representing 3,17%.

A total of 25 species were represented by a single specimen each, while the remaining species had between 2 and 10 specimens collected.

Table 3

Structure, dynamics, and abundance of beetle species

No.	Name of species	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	Total
1.	*Amara aenea*	1	2	-	2	2	-	3	-	-	-	-	1	11
2.	*Amara apricaria*	-	-	-	1	6	-	1	2	-	-	-	1	11
3.	*Amara crenata*	-	1	-	-	-	1	-	-	-	-	-	-	2
4.	*Amara eurinota*	-	-	-	-	-	1	-	-	-	-	-	-	1
5.	*Amara familiaris*	-	1	-	4	-		-	-	-	-	-	-	5
6.	*Amara similata*	2	1	-	-	-	-	-	-	-	-	-	-	3
7.	*Anisodactylus binotatus*	7	1	7	11	6	9	10	2	9	8	4	5	79
8.	*Anisodactylus signatus*	-	-	-	3	4	-	-	1	-	5	-	-	13
9.	*Anthobium minutum*	1	-	-	-	-	-	-	-	-	-	-	-	1
10.	*Armadilidium vulgare*	1	1	1	1	-	-	1	1	-	-	1	-	7
11.	*Balaninus glandium*	-	-	-	-	-	-	1	-	-	-	-	-	1
12.	*Blaps mortisaga*	-	-	-	-	-	1	-	1	-	-	-	-	2
13.	*Bombus terestris*	-	-	-	1	-	-	2	-	-	-	-	-	3
14.	*Brachynus crepitans*	-	1	-	-	-	1	-	-	-	-	-	-	2
15.	*Brachynus explodens*	-	-	1	-	-	-	-	-	-	-	-	-	1
16.	*Calathus melanocephalus*	-	-	-	-	-	-	1	-	-	-	-	--	1
17.	*Calatus fuscipes*	-	-	-	-	-	-	-	-	1	-	-	-	1
18.	*Calodera aethiops*	-	-	-	-	1	-	-	-	-	-	-	-	1
19.	*Cantharis fusca*	-	-	-	-	-	-	-	1	-	-	-	-	1
20.	*Cantharis violaceus*	-	-	2	-	-	-	1	-	-	-	-	-	3
21.	*Carabus coriaceus*	-	-	-	-	2	5	3	-	-	-	-	-	10
22.	*Cartodere elongata*	1	-	-	-	-		2	-	2	-	3	1	9
23.	*Coccinela septempunctata*	-	-	-	-	-	1	-	-	-	-	-	3	4
24.	*Crypticus quisquilius*	-	-	-	-	-	-	-	1	-	-	-	-	1
25.	*Dermestes laniarius*	1	2	1	-	4	1	4	1	4	-	1	-	19
26.	*Halyzia 14-gutata*	-	-	-	-	-	-	-	-	1	-	-	1	2
27.	*Harpalus autumnalis*	1	-	-	-	-	-	-	-	-	-	-	-	1
28.	*Harpalus calceatus*	-	1	-	-	-	-	-	-	-	-	-	1	2

29.	*Harpalus distinguendus*	12	10	3	6	8	6	9	2	4	5	1	-	66
30.	*Harpalus rufus*	-	-	2	-	-	-	-	-	1	-	-	-	3
31.	*Harpalus tardus*	-	-	-	2	4	1	3	-	5	-	1	1	17
32.	*Hister funestus*	-	-	-	-	-	1	-	-	-	-	-	-	1
33.	*Hister purpurascens*	-	-	-	-	-	1	-	1	-	-	-	-	2
34.	*Lathrobium multipunctum*	-	-	-	-	-	-	-	-	-	1	-	-	1
35.	*Lathrobium quadratum*	-	-	-	-	1	-	-	-	-	-	-	-	1
36.	*Leistus ferrugineus*	-	-	-	-	-	-	-	-	1	-	-	-	1
37.	*Licinus cassideus*	2	4	1	3	-	1	-	1	-	-	1	-	13
38.	*Metabletus truncatellus*	-	2	-	-	-	-	-	-	3	-	-	-	5
39.	*Ontophagus ovatus*	-	-	-	-	-	-	-	-	-	-	-	1	1
40.	*Opatrum sabulosum*	-	-	-	-	-	-	-	1	-	-	-	-	1
41.	*Ophonus azureus*	4	1	-	-	1	-	2	-	-	-	-	-	8
42.	*Ophonus puncticollis*	-	-	-	-	-	-	1	-	-	-	-	-	1
43.	*Ophonus sabulicola*	-	-	-	-	-	-	1	-	-	-	-	1	2
44.	*Otiorrhynchus pinastri*	-	1	1	-	-	-	-	-	-	-	-	-	2
45.	*Panagaeus cruxmajor*	-	-	-	-	-	-	-	-	-	-	1	-	1
46.	*Pentodon idiota*	-	1	-	-	-	-	-	-	-	-	-	-	1
47.	*Podagrica malvae*	1	-	-	-	-	2	-	-	-	-	-	-	3
48.	*Pseudophonus griseus*	1	1	-	1	-	-	-	-	-	-	-	-	3
49.	*Pseudophonus pubescens*	1	1	3	2	-	1	1	-	-	-	-	-	9
50.	*Pterostichus cupreus*	-	-	-	-	-	-	1	-	-	-	-	-	1
51.	*Pterostichus nigrita*	-	-	-	-	-	1	-	-	-	-	-	-	1
52.	*Quedus cinctus*	-	2	-	-	-	-	-	-	-	-	-	-	2
53.	*Sericus bruneus*	-	-	-	-	-	-	-	-	-	1	-	-	1
54.	*Staphylinius caesareus*	-	-	-	1	-	-	-	-	-	-	-	-	1
55.	*Tachyporus abdominalis*	-	-	1	-	-	-	-	-	-	-	-	-	1
56.	*Triplax lepida*	-	1	-	-	-	-	-	-	-	-	-	-	1
Total		**36**	**35**	**23**	**38**	**39**	**34**	**47**	**15**	**31**	**20**	**13**	**16**	**347**

CONCLUSIONS

A total of 505 arthropod specimens were collected during several sampling sessions. Insects, particularly beetles, were the most dominant group in terms of both specimen count and species diversity in the majority of the collections.

Regarding beetles, 347 specimens were collected, making them the dominant group in the samples. Beetles were frequently encountered in all collections, represented by a large number of species (56), with some species such as *Anisodactylus binotatus* and *Harpalus distinguendus* having the highest numbers of specimens.

Among the collected beetles, many species were represented by a small number of specimens. Twenty-five species were represented by a single specimen each, while other species had between 2 and 10 specimens collected.

Throughout the seven collections, the number of specimens varied, showing a gradual decrease in the number of arthropods towards the end of the observation period. Insects remained predominant at each stage; however, the total number of specimens decreased starting from the third collection (55 specimens) and continued to decline in subsequent collections.

Among beetles, the species *Anisodactylus binotatus* (22.77%) and *Harpalus distinguendus* (19.02%) were the most abundant, together representing almost half of the total specimens collected. Other species, such as *Dermestes laniarius* and *Harpalus tardus*, had a lower but significant presence.

REFERENCES

1. **Cardei E., Beşleagă Ramona, Corneanu G. 2010 -** *The prevention and control of major pathogens and pests in cherry species*, Scientific Papers of the R.I.F.G. Pitesti, Vol. XXV, p.106-108
2. **Nistor A., and Petrescu M., 2016** - *Study of the arthropod fauna in cherry plantations from the Moldova region*. Journal of Applied Biology and Ecology 15(3), p.55-69.
3. **Popescu, D. and Ionescu, V., 2020** - The impact of arthropod pests on cherry plantations: Species structure and diversity. Bulletin of the Romanian Entomological Society, 28(4), p.210-222.
4. **Rogojanu V., Perju T., 1979** - *Key for recognizing pests of cultivated plants*. Editura Ceres, Bucharest.
5. **Talmaciu M., Talmaciu Nela, Georgescu T., Mitrea I., Filipescu C., 2000** - *Contributions to the knowledge of the structure and dynamics of beetle communities in vineyards*, Scientific Papers, Annals of the University of Craiova, 4, p. 168-174.
6. **Talmaciu Nela, Talmaciu M., Filipescu C., Georgescu T., 2003 -** *Observations about the structure and dynamics of the Carabidae (Coleoptera-Carabidae) population from the plum tree plantation under the conditions of the Iasi* Didactic research station, Annals of the University of Craiova, p. 170-175.

OBSERVATIONS ON THE DYNAMICS AND ABUNDANCE OF ARTHROPOD SPECIES COLLECTED FROM SOME CHERRY ORCHARDS USING DECIS TRAPS

OBSERVAȚII PRIVIND DINAMICA ȘI ABUNDENȚA SPECIILOR DE ARTROPODE COLECTATE DIN UNELE PLANTAȚII POMICOLE DE CIREȘ LA CAPCANELE DE TIP DECIS TRAP

BALINT Romeo Ciprian [1]***, HEREA Monica*** [1]****, TĂLMACIU Nela*** [1]***, BALINT Răducu Ionuț*** [1]***, PĂNUȚA Sergiu*** [2]***, TĂLMACIU Mihai*** [1]

*Corresponding author e-mail: monica.herea@iuls.ro

Abstract.
Romania, Răducăneni locality, Iași county, using the Decis trap method. In carrying out the research, 3 experimental variants were used, with three traps for each variant. The readings were performed periodically, at intervals of 10-14 days. The three variants are represented as follows: V1 - Rivan early cherry plantation; V2 - cherry plantation with the Stela variety; V3 - Cherry plantation with the Regina variety; The traps were installed in the plantation on May 15, the readings being done periodically, during the vegetation period, the last reading being done on September 2, 2023. The species collected at these traps belong to the following groups of arthropods: Diptera, Hymenoptera, Chrysopods, Orthoptera, Lepidoptera and Dermaptera.
Key words: Sweet cherry orchards, Decis trap, arthropods, *Rhagoletis cerasi*.

Rezumat.
Observațiile au fost făcute în anul 2023 într-o plantație pomicolă de cireș situată în zona de Est a Romaniei, localitatea Răducăneni, județul Iași utilizând metoda capturării cu ajutorul capcanelor de tip Decis. Au fost utilizate 3 variante, câte trei capcane pentru fiecare varianta. Citirile au fost efectuate periodic, la intervale de 10-14 zile. Cele trei variante sunt reprezentate astfel: V1 - plantația de cireș timpuriu Rivan; V2 - plantație de cireș cu soiul Stela; V3 - plantație de cireș cu soiul Regina; Capcanele au fost instalate în plantație pe data de 15 mai, citirile făcându-se periodic, pe parcursul perioadei de vegetație, ultima citire făcându-se pe data de 2 septembrie 2023. Speciile colectate la aceste capcane aparțin la următoarele grupe de artropode: diptere, himenoptere, crisopode, ortoptere, lepidoptere și dermaptere.
Cuvinte cheie: plantații de cireș, capcana Decis trap, artropode, *Rhagoletis cerasi*.

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania
[2] Technical University of Moldova, Chișinău

INTRODUCTION

Different pests can cause damage in both quantitative and qualitative terms more crops at any stage of vegetation. They are pests whose development cycle is carried out entirely in straw cereal crops or an fruit tree orchards.

The increase of agricultural production is possible through the technologies that presupposes the use of the varieties with big capacity of production, the fertilization of the soils, according to their necessities, complete mecanisation of the works and through measures of prevention and struggle the weeds and specific pests.

Regardind the pests from the cereal crops, these can produce annual damage of 13.8 against 11.6% produced by the pathogenic agents and against 9.5% due to the weeds [Herea *et al*., 2019].

The biological control, that is the diminution of pest populations as influenced by agro-biocenosis, is due, on the one hand, to unfavorable factors and, on the other hand, to biotic factors [Seranno *et al*., 2016].

A series of internal factors of the population, entomophagues, predators and parasites, and entomopathogenic agents belong to the category of biotic factors [Minoiu and Lefter, 1987].

MATERIAL AND METHOD

For the collection of arthropods from the cherry orchard in 2022, were used Decis Traps.

In the case of cherry orchards, the use of traps based on the "Attract and Kill" biotechnology becomes a very good alternative for controlling the cherry fruit fly/worm - *Rhagoletis cerasi*. These traps were arranged in the orchard according to a specific pattern that ensured mass capture of fruit flies before they could cause damage [Serrano, 2011].

The Decis Trap traps are equipped with olfactory and food attractants based on protein substances and are impregnated with insecticide inside the lid, destroying the harmful flies that are caught.

The traps are placed in the cherry trees at the beginning of the growing season, before the cherry flies' breeding period [Herea *et al*., 2019] Farmers regularly inspect the traps to assess the population density of the flies and to decide if additional treatment is necessary.

In addition to the monitoring function, Decis Trap can also be used to reduce pest populations by capturing adult flies, thus preventing them from laying eggs in the cherries [Talmaciu *et al*., 2016].

The traps should be placed evenly in the orchard, usually a few traps per hectare, to ensure effective monitoring and capture of the flies.

A total of 9 traps were used for this purpose, distributed as 3 traps for each variant as follows:

- V1 - Rivan early cherry plantation;
- V2 - Cherry plantation with the Stela variety;
- V3 - Cherry plantation with the Regina variety as can be seen in fig. 1.

The traps were placed in the plantation on May 14, 2022, and remained until August 23, 2022.

Fig. 1. Placement and collection of material from Decis Trap traps

The collections were made periodically on the following dates: May 17, May 25, June 7, June 19, June 27, July 18, August 2, and August 23, for a total of eight readings.

During each collection, all captured insects were removed from the traps and preserved in 70% rubbing alcohol. The collected material was brought to the laboratory, where it was sorted and grouped by order, and then identified by species.

This method reduces the need for chemical treatments, thereby eliminating negative effects related to fruit and environmental pollution, and contributes to maintaining a proper balance in the orchard ecosystem.

RESULTS AND DISCUSSIONS

Observations made in the early cherry plantation, Rivan variety (V1):

During the seven collections, a total of 493 arthropod specimens were collected (Table 1). The highest number of specimens, 170, were collected during the third collection on July 7, followed by the fifth collection with 153 specimens, and the sixth collection with 87 specimens.

In the other collections, between 12 and 37 specimens were collected.

Except for a single collection on August 23, *Rhagoletis cerasi* was the predominant species.

Table 1

The situation of collections using Decis Traps for variant 1, Rivan variety in 2022

No	Nme of species	C1	C2	C3	TOTAL samples
1st Harvest - 17.05.2022					
1.	Rhagoletis cerasi	6	-	-	9
2.	Chrysopa sp.	-	-	2	3
Total		6	1	5	12
2nd Harvest - 25.05.2022					

1.	Rhagoletis cerasi	1	2	11	14
Total		1	2	11	14
3rd Harvest - 07.06.2022					
1.	Rhagoletis cerasi	45	53	72	170
Total		45	53	72	170
4th Harvest - 19.06.2022					
1.	Rhagoletis cerasi	6	4	3	13
Total		6	4	3	13
5th Harvest - 27.06.2022					
1.	Rhagoletis cerasi	50	25	15	90
2.	Chrysopa sp.	6	11		17
3.	Other dipters	20	15	10	45
4.	Coccinella 7 punctata	-	-	1	1
Total		76	51	26	153
6th Harvest - 18.07.2022					
1.	Rhagoletis cerasi	21	23	6	50
2.	Chrysopa sp.	8	-	-	8
3.	Other dipters	10	10	-	20
4.	Wasp	-	7	-	7
5.	Ortopteres	-	1	-	
6.	Coccinella 7 punctata	-		1	1
Total		39	41	7	87
7th Harvest - 02.08.2022					
1.	Diptere	9	3		12
2.	Chrysopa sp.	3	-	-	3
3.	Lepidopters	1	-	-	1
4.	Wasp	-	-	1	1
Total		13	4	0	17
8th Harvest - 23.08.2022					
1.	Rhagoletis cerasi	2	-	-	2
2.	Wasp	10	6	-	16
3.	Heteropters	1	2	-	3
4.	Lepidopters	1	1	-	2
5.	Chrysopa sp.	3	1	-	4
Total		7	10	0	67
Total		493			

In total, 493 specimens belonging to 8 taxa were collected in variant 1. The predominant species was *Rhagoletis cerasi*, which had 348 specimens, representing 70.59% of the total arthropods collected in this variant.

Table 2

Structure, dynamics, and abundance of arthropod species collected in 1st variant

No.	Name of species	Dates of harvest and number of samples								Total
		17.05	25.05	7.06	19.06	27.06	18.07	2.08	23.08	

1.	*Rhagoletis cerasi*	9	14	170	13	90	50		2	348
2.	*Chrysopa* sp.	3				17	8	3	4	35
3.	Other *Diptera*					45	20	12		77
4.	*Coccinella 7 punctata*					1	1			2
5.	Wasps						7	1	16	24
6.	Ortopters						1			1
7.	Lepidopters							1	2	3
8.	Heteropters								3	3
Total arthropods		12	14	170	13	153	87	17	27	493

Regarding the dynamics of the *Rhagoletis cerasi* species in 1st variant, it can be observed in Fig. 2, based on the data recorded during each collection in the cherry plantation with the Rivan variety.

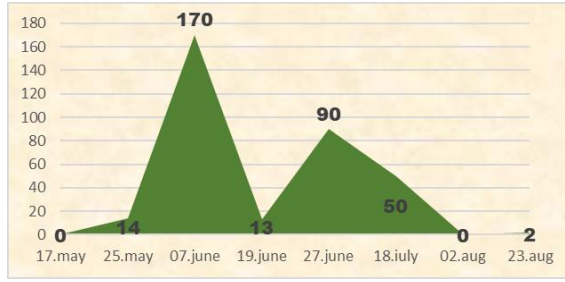

Fig. 2. Dynamics of *Rhagoletis cerasi* specimen collection in 2022, for the *Rivan* variety

Observations made in the cherry plantation with the Stela variety (V2).

During the seven collection sessions for this variant, a total of 181 arthropod specimens were collected.

The highest number of specimens was collected during the sixth session, with 52 specimens, followed by the fifth session on June 27th, when 43 specimens were collected.

During the fourth collection, as well as the last one, 31 and 24 specimens were collected, respectively (Table 3).

Table 3

Overview of collections using Decis Traps in 2nd variant, Stela variety in the year 2022

No	Name of species	C1	C2	C3	TOTAL samples
1st Harvest 17.05.2022					
Total specimens collected		No specimens were collected			
2nd Harvest 25.05.2022					
1.	*Rhagoletis cerasi*	1	3		4
Total		1	3	0	4

3rd Harvest 07.06.2022					
1.	*Rhagoletis cerasi*	4	3	3	10
2.	*Chrysopa* sp.	1			1
3.	Other *Diptera*	4			4
Total		9	3	3	15
4th Harvest 19.06.2022					
1.	*Rhagoletis cerasi*	7	4	20	31
Total		7	4	20	31
5th Harvest 27.06.2022					
1.	*Rhagoletis cerasi*	30			30
2.	*Coccinella 7 punctata*	1			1
3.	*Chrysopa* sp.	6			6
4.	Other *Diptera*	6			6
Total		43	0	0	43
6th Harvest 18.07.2022					
1.	*Rhagoletis cerasi*	5	2		7
2.	Lepidopters	2			2
3.	*Chrysopa* sp.	5	2		7
4.	bees	1			1
5.	Other *Diptera*	19	16		35
Total		32	20	0	52
7th Harvest 02.08.2022					
1.	*Rhagoletis cerasi*		2	1	3
2.	Dipters	2	1		3
3.	*Chrysopa* sp.	3	2		5
4.	*Coccinella 7 punctata*			1	1
Total		5	5	2	12
8th Harvest 23.08.2022					
1.	Ants		23		23
2.	Other *Diptera*			1	1
Total		0	23	1	24
Total		181			

The species *Rhagoletis cerasi* was the most frequently collected, being absent only from two collections: the first collection on May 17 and the last collection on August 23.

Regarding the structure, dynamics, and abundance of the species collected (Table 4), arthropods belonging to 7 species/taxa were collected in this variant, with a total of 181 specimens.

Table 4

Structure, dynamics, and abundance of arthropod species collected in 2nd variant

No.	Name of species	Dates of harvest and number of samples								Total
		17.05	25.05	7.06	19.06	27.06	18.07	2.08	23.08	
1.	*Rhagoletis cerasi*		4	10	31	30	7	3		85
2.	*Chrysopa* sp.			1		6	7	5		19
3.	Other *Dipters*			4		6	35	3	1	49

4.	Lepidopters						2			2
5.	Bee						1			1
6.	*Coccinella 7 punctata*					1		1		1
7.	Ants								23	23
Total arthropods		0	4	15	31	43	52	12	24	181

The dominant species, as in the case of the first variant, was *Rhagoletis cerasi*, with 85 specimens, representing 86.97% of the total specimens collected in this variant.

This was followed by taxa belonging to the order *Diptera* with 49 specimens, and the species *Chrysopa* sp. with 19 specimens.

The flight curve of the species *Rhagoletis cerasi* in this variant followed the dynamics of collections using Decis Traps.

Observations made in the cherry plantation with the *Regina* variety (V3).

During the 7 collections (Table 5), a total of 458 arthropod specimens were collected. The highest number, 148 specimens, was collected on July 18, 2022, followed by the collections on June 27, when 77 specimens were collected. On August 2, no specimens were collected, while in the other collections, the number of specimens varied between 13 and 63.

The species *Rhagoletis cerasi* was collected in 6 out of the 8 collections conducted.

The graph (fig. 3) highlights the dynamics of Rhagoletis cerasi (European cherry fruit fly) specimens captured in 2022 for the Stela variety. The number of individuals was low in May, then increased rapidly, reaching a peak around June 27, with approximately 31 specimens. This peak corresponds to the height of adult flight activity. Subsequently, the number of captures gradually decreased during July and August, suggesting the end of the activity period.

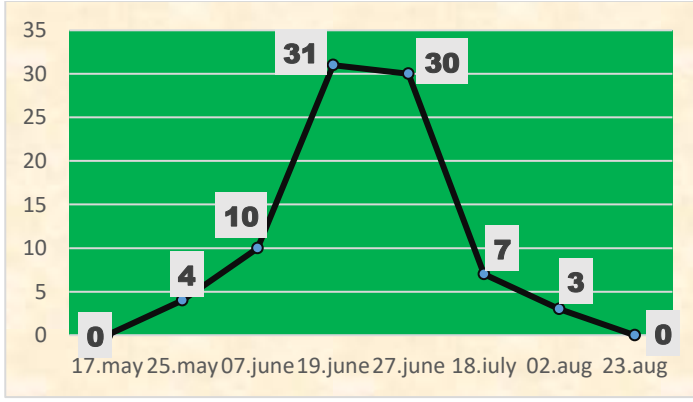

Fig. 3. Dynamics of *Rhagoletis cerasi* specimen collection in 2022,

for the Stela variety

Table 5

Overview of collections using Decis Traps in 3rd variant, Regina variety in the year 2022

NO	Name of species	C1	C2	C3	TOTAL
1st Harvest 17.05.2022					
1.	*Rhagoletis cerasi*	5	4	8	17
2.	Wasp	1			1
3.	Other *Diptera*	2	1	2	5
Total		**8**	**5**	**10**	**23**
2nd Harvest 25.05.2022					
1.	*Rhagoletis cerasi*	25	9	29	63
Total		**25**	**9**	**29**	**63**
3rd Harvest 07.06.2022					
1.	*Rhagoletis cerasi*	58	46		104
Total		**58**	**46**	**0**	**104**
4th Harvest 19.06.2022					
1.	*Rhagoletis cerasi*	6	4	3	13
Total		**6**	**4**	**3**	**13**
5th Harvest 27.06.2022					
1.	*Rhagoletis cerasi*	60			60
2.	*Chrysopa* sp.	6			6
3.	Other *Diptera*	10			10
4.	Lepidopters	1			1
Total		**77**	**0**	**0**	**77**
6th Harvest 18.07.2022					
1.	*Rhagoletis cerasi*	27	24	22	73
2.	*Chrysopa* sp.	11	7	11	29
3.	Lepidopters	1			1
4.	Other *Diptera*	13	14	13	40
5.	Orthopters		1		1
6.	*Coccinella 7 punctata*			1	1
7.	Cicads			2	2
8.	Wasp			1	1
Total		**52**	**46**	**50**	**148**
7th Harvest 02.08.2022					
Total		No specimens were collected.			
23.08.2022					
1.	Other Diptera	8	6		14
2.	Lepidopters	2			2
3.	*Chrysopa* sp.	3	6		9
4.	wasp		2	3	5
Total		**13**	**14**	**3**	**30**
Total		**458**			

Regarding the structure, dynamics, and abundance of the collected species/taxa, they are presented as follows (Table 6).

The highest number of specimens was recorded for the species *Rhagoletis cerasi* with 330 specimens, followed by other *Diptera* with 69 specimens and *Chrysopa* sp. with 44 specimens. The other species had between 1 and 7 specimens collected.

Table 6

Structure, dynamics, and abundance of arthropod species collected in 3rd variant

No.	Name of species	Dates of harvest and number of samples								Total
		17.05	25.05	7.06	19.06	27.06	18.07	2.08	23.08	
1.	*Rhagoletis cerasi*	17	63	104	13	60	73			330
2.	Wasps	1					1		5	7
3.	Other *Diptera*	5				10	40		14	69
4.	*Chrysopa* sp.					6	29		9	44
5.	Lepidoptera					1	1		2	4
6.	*Ortoptere*						1			1
7.	*Coccinella 7 punctata*						1			1
8.	Cicads						2			2
Total arthropods		23	63	104	13	77	148	0	30	458

The flight curve of the species *Rhagoletis cerasi* (Fig. 4) in this variant followed the dynamics of the collections from the Decis Traps.

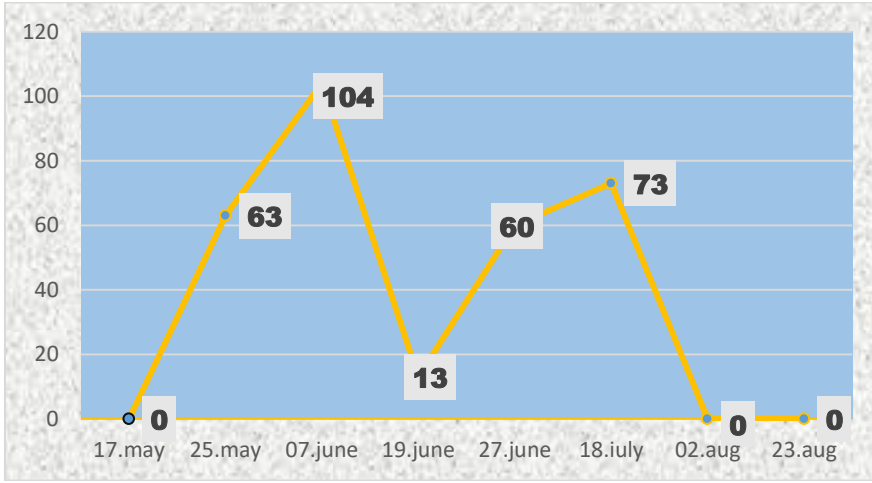

Fig. 4. Dynamics of *Rhagoletis cerasi* specimen collection in 2022, for the Regina variety

CONCLUSIONS

Observations were conducted throughout 2022 in a cherry orchard from May to August.

Arthropod collection was performed using Decis Trap type traps within three experimental variants represented by three orchard plots cultivated with the varieties: Rivan (V1), Stela (V2), and Regina (V3).

The arthropods collected during the 8 sampling sessions belonged to the following groups of insects: *Diptera, Hymenoptera, Heteroptera, Chrysopidae*, and *Lepidoptera*.

The dominant species in all three variants was *Rhagoletis cerasi*. A flight curve was prepared for this species, based on which chemical treatments for its control were carried out.

The dynamics of the *Rhagoletis cerasi* population varied according to the cultivated variety and the climatic conditions specific to each observation period. In all three plots, the peak activity of this species was recorded in early July, when the population density reached its maximum values.

In addition to *Rhagoletis cerasi*, other arthropod species were also captured in Decis Trap type traps, but in significantly smaller numbers. These included secondary pest species as well as natural predators, such as *Chrysopidae,* which play an important role in the biological control of pests.

The study's conclusions highlight the importance of dynamic monitoring of pest populations to apply chemical treatments at the optimal time, thereby reducing crop damage and limiting the negative impact on beneficial entomofauna.

REFERENCES

1. **Herea Monica, Tălmaciu M., Boboc Cristina, Tălmaciu Nela, 2019** - *Observations on existing arthropod fauna in some orchards*. Scientific Works Horticulture Series, USAMV Iași, 62 (2), p. 87-92.
2. **Herea Monica, Tălmaciu Nela, Mocanu Ionela, Tălmaciu M., 2019** – *Contributions to the knowledge of the structure of coleopteran species collected from apple tree fruit orchards*. 19th International Multidisciplinary Scientific GeoConference SGEM, 19 (5.1), p. 125-133.
3. **Minoiu N. and Lefter Gh., 1987** - *Diseases and pests of pit fruit species*. Editura Ceres, Bucharest, Romania.
4. **Serrano J. C. and Kawai A.C., 2011** - Monitoring the cherry fruit fly: Techniques and traps. Journal of Applied Entomology, 135(9), 632-641.
5. **Tălmaciu M., Mocanu Ionela, Herea Monica, Tălmaciu Nela, Manole Liliana, 2016** - *Observations on invertebrate fauna encountered in some agricultural crops*, Global Illuminators, Full Paper Proceeding NDMRP-2016,2, p. 119-129.

OBSERVATIONS ON THE FLIGHT CURVE AND PEST CONTROL OF *CYDIA POMONELLA* L. IN THE NORTH-EAST AREA OF ROMANIA

OBSERVAȚII PRIVIND CURBA DE ZBOR ȘI CONTROLUL DĂUNĂTORULUI *CYDIA POMONELLA* L. IN ZONA DE NORD EST A ROMANIEI

TURCU Cristina Ionela[1]*, TALMACIU Mihai[2], GHERGHEL Madalina Iuliana[1], PERJU Ionel[1], CHELARU Simona Mihaela[1], AFTUDOR MANOLACHE Agurița[1], TALMACIU Nela[2], HEREA Monica[2]

*Corresponding author e-mail: ing.cristinaboboc@gmail.com

Abstract.
The observations refer to the monitoring of the appearance of the pest Cydia pomonella L. in the apple orchards within the SCDP Iași. The data regarding the monitoring of the pest that causes significant damage in apple orchards helps us to combat it according to the biological cycle of the species, recording in recent years an incomplete third generation, the period of activity being extended, in 2021 the first appearances on the pheromonal traps were on 07.05.2021 and in 2022 they were on 27.04.2022. Analyzing the catches on the pheromonal traps in 2021, the maximum flight curve for the first generation was reached on 24.05 and in 2022 on 22.05. Phytosanitary treatments for both the first generation and the second generation of the pest Cydia pomonella L. were warned according to the maximum of the flight curve.
Key words: apple, traps, phytosanitary treatments

Rezumat.
Observațiile se referă la monitorizarea apariției dăunătorului Cydia pomonella L. in livezile de măr din cadrul SCDP Iași. Datele privind monitorizarea dăunătorului ce produce pagube însemnate în livezile de măr ne ajută la combaterea acestuia în funcție de ciclul biologic al speciei, înregistrând în ultimii ani o a treia generație incompletă, perioada de activitate fiind extinsă, în anul 2021 primele apariții pe capcanele feromonale au fost în data de 07.05.2021 iar în anul 2022 au fost in data de 27.04.2022. Analizând capturile de pe capcanele feromonale din anul 2021 maximul curbei de zbor pentru prima generație a fost atins în data de 24.05 iar în anul 2022 în data de 22.05. Tratamentele fitosanitare atât pentru prima generație cât și pentru cea de-a doua generație a dăunătorului Cydia pomonella L. au fost avertizate în funcție de maximul curbei de zbor.
Cuvinte cheie: măr, capcane, tratamente fitosanitare

[1] Research Station for Fruit Growing Iasi
[2] ”Ion Ionescu de la Brad” Iași University of Life Sciences, Romania

INTRODUCTION

Cydia pomonella L. (*Lepidoptera: Tortricidae*), commonly known as the apple worm, is one of the most important pests of fruit species in the temperate zone, having a significant impact on apple, pear and quince crops [Ivic et al., 2019]. In the northeastern region of Romania, where climatic and agrotechnical conditions influence the population dynamics of this pest, monitoring the flight curve becomes essential for the implementation of effective control strategies [Bažok et al., 2020].

Previous studies have shown that climatic factors, such as temperature and humidity, play a crucial role in determining the optimal time to combat *Cydia pomonella* larvae, which underlines the importance of correlating observations of adult flight with the application of phytosanitary treatments [Witzgall et al., 2019]. In this context, the use of pheromone traps for population monitoring can contribute to the optimization of integrated control measures and the reduction of excessive use of insecticides [Knight, 2021].

The objective of this study is to analyze the dynamics of the flight curve of the species *Cydia pomonella* L. in the northeastern area of Romania and to evaluate the efficiency of the control methods used, taking into account the influence of specific climatic conditions.

MATERIALS AND METHODS

The studies were carried out within the Iași Pomiculture Research-Development Station on its plantations over a period of two years (2021, 2022) in which research was carried out on the Cydia pomonella L. species.

The experience was carried out on an experimental lot of apple, which includes various varieties, where AtraPom traps sold by the "Raluca Ripan" Cluj-Napoca Chemistry Institute were placed (Figure 1, 2, 3) to determine the flight curve of the affected agent being tracked.

Fig.1. The first appearance of the pest, visible in the field

Fig. 2. Reading pheromonal traps

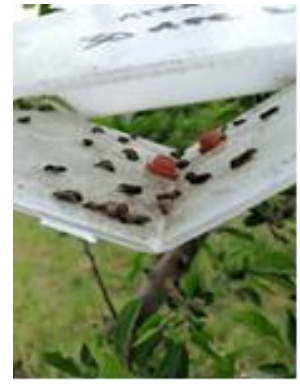

Fig. 3. Trap AtraPom

The recording of climatic data (table1- 2) was carried out with the help of the weather station Adcon Telemetry addVANTAGE A840, the data processing in the field being highlighted with the help of the Microsoft Office package.

Table 1

Climatic data recorded in 2021, RSFG Iasi

Year 2021	HC Air temperature [°C]			HC Relative humidity [%]	Precipitation [mm]
	Average	Max	Min	Average	Amount
January	0.39	11.68	**-19.62**	29.39	26.8
February	-0.47	19.42	-15.74	58.49	22.8
March	3.37	17.39	-7.24	14.77	65.6
April	8.22	23.93	-3.66	67.42	56.4
May	15.19	30.39	0.82	78.62	87
June	19.79	33.77	8.46	87.75	115
July	23.23	**36.65**	12.14	69.81	71.6
August	20.96	33.73	9.7	69.98	155.6
September	14.61	27.52	3.4	73.81	12.4
October	9.01	22.9	-3.24	73.85	5.6
November	6.69	19.05	-4.6	85.9	14.2
December	0.79	12.17	-12.12	32.38	60.2
Avg/min/max	**10.14**	**36.65**	**-19.62**	**61.84**	**693.2**

Table 2

Climatic data recorded in 2022, RSFG Iasi

Year 2022	HC Air temperature [°C]			HC Relative humidity [%	Precipitation [mm]
	Average	Max	Min	Average	Amount
January	0.69	13.14	**-10.5**	25.83	14.4
February	3.63	16.71	-6.85	48.25	16.4
March	3.09	23.13	-9.56	63.52	16
April	10.25	26.31	-3.78	51.07	80.6
May	16.5	31.92	2.08	36.96	24
June	21.58	**37.01**	9.17	43.49	24.6
July	23.01	35.79	8.57	63.59	20.4
August	22.77	34.84	13.63	77.77	53
September	15.64	28.31	3.01	30.98	78
October	11.74	27.21	-3.75	45.85	18.8
November	5.67	18.71	-1.27	17.76	69.2
December	1.4	13.68	-9.48	71.44	20.2
Avg/min/max	**11.33**	**37.01**	**-10.5**	**48.04**	**435.6**

RESULTS AND DISCUSSIONS

The presented graph reflects the population dynamics of *Cydia pomonella* L. (apple worm) in the years 2021 and 2022, based on catches recorded at various time intervals. This data is essential for understanding the activity of the pest and for adopting control measures at critical moments.

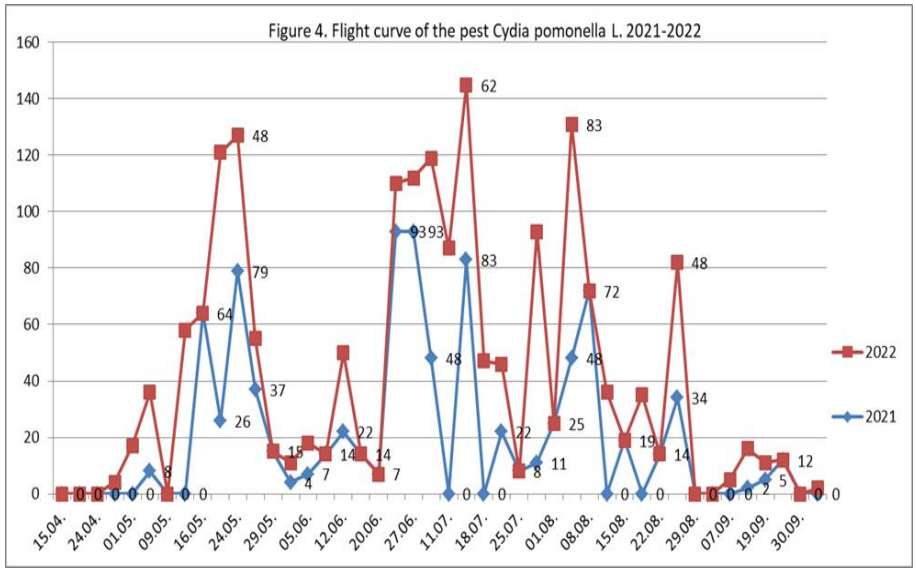

Fig. 4. Flight curve of the pest *Cydia pomonella* L. 2021-2022

In 2021, the activity of the pest becomes significant around 07.05, when the first notable captures are recorded (8 catches). The flight curve continues to rise, reaching a first major peak on 24.05, with 79 individuals captured (Fig.4). During the year, several peaks are observed, one of the most important being that of 23.06, when 93 individuals were recorded. After this peak, activity gradually declines, marking the end of the flight cycle by the end of August.

In 2022, the activity starts earlier, on 27.04, with a first capture of 4 individuals, and the first peak of the flight curve is reached on 22.05, with 95 individuals. Unlike 2021, the second major peak of activity occurs in 05.08, with 83 individuals captured.

The flight curve shows higher population pressure of *Cydia pomonella* L., reflected by higher catch peaks and more intense activity overall.

NO. TRATMENT	Produs	Doza
T1:BBCH 01-07	Ovipron TOP	15 l/ha
	Decis 25 wg	0.045 kg/ha
	Bouille Bordelaise WDG	5 kg/ha
T2: BBCH 10-61	Fontelis	0.75 l/ha
	Polyactiv B	1 l/ha
	Mospilan 20 SG	0.45 kg/ha
T3:BBCH 65-69	Kumulus	4 kg/ha
	Mavrik 2F	0.75 l/ha
	Chorus	0.6 kg/ha
T4: BBCH 71	Score 250 ec	0.2 l/ha
	Coragen	0,.5 l/ha
T5: BBCH 74	Folicur Solo	0.7 l/ha
	Nissorun	0.5 kg/ha
	Decis 25 wg	0.045 kg/ha
T6 10 Days after previous treatment	Score 250 ec	0.2 l/ha
	Mospilan 20 SG	0.45 kg/ha
T7 10 Days after previous treatment	Folpan 80 wdg	2 kg/ha
	Vantex 60 CS	0.2 l/ha
T8 10 Days after previous treatment	Folicur Solo	0.7 l/ha
	Rezistevo	4 kg/ha
	Coragen	0.15 l/ha
T9 10 Days after previous treatment	Score 250 ec	0.2 l/ha
	Karate Zeon	0.25 l/ha
T10 10 Days after previous treatment	Affirm Opti	2 kg/ha
	Merpan 80 wdg	2 kg/ha
	Finalevo	3.5 kg/ha
T11: BBCH 87	Decis 25 wg	0.045 kg/ha
	Bellis	0.8 kg/ha

Fig.5 Apple treatment program RSFG IASI

These year-to-year variations are influenced by factors such as climatic conditions, which affect the life cycle of the pest. In 2022, pest pressure was higher compared to 2021, which suggests the need to intensify control measures during the period of maximum activity.

In conclusion, this information is crucial for the effective management of the pest *Cydia pomonella* L. Identifying peaks of activity helps farmers to apply appropriate control measures, such as the use of insecticides (Fig.5) or traps, during critical periods to minimize economic losses.

CONCLUSIONS

The conclusion of the flight curve of the pest Cydia pomonella L. shows an intense activity during spring and summer, with several significant peaks in both analyzed seasons (2021 and 2022). In 2022, pest activity was higher compared to 2021, indicating greater pressure on crops this year. Peak periods were observed in May and June, followed by a second wave of activity in July and August.

This information is essential for planning control measures, as phytosanitary treatments should be applied at times of maximum insect activity to limit crop damage.

The Importance of Effective Pest Management

Effective pest management in apple orchards is crucial to ensure quality fruit production and minimize economic losses. Integrated pest control methods, which combine careful monitoring, the use of traps and the application of specific insecticides, have been shown to be the most effective. In addition, adapting control strategies to climatic conditions and pest population dynamics can help protect crops and maintain the health of apple orchards.

In conclusion, pests represent a significant challenge for all apple producers, but through careful monitoring and the application of integrated control methods, damage can be considerably reduced. Continuous research and innovation in the field of plant protection is essential to develop effective pest management strategies, thereby ensuring the sustainability and productivity of plantations.

ACKNOWLEDGEMENTS

This research was carried out within the thematic plan, theme 2.4. The study of biology, ecology, symptomatology and preventive measures at the attack of the main harmful agents from plantations of trees, fruit bushes and strawberry.

REFERENCES

1. **Bažok R., Barčić J.I., Lemić D.and Drmić Z., 2020** - *Integrated pest management of codling moth (Cydia pomonella) in pome fruit orchards.* Applied Sciences, 10(4), 1234.
2. **Ivic D., Cug R.and Vranic M., 2019** - *Impact of climate factors on the population dynamics of Cydia pomonella in Central Europe*. Journal of Applied Entomology, 143(2), 156-165.
3. **Knight A.L., 2021** - *Advances in pheromone-based monitoring and control of codling moth (Cydia pomonella).* Pest Management Science, 77(5), 2143-2155.
4. **Witzgall P., Kirsch P. and Cork A., 2019 -** *Sex pheromones and their impact on pest management.* Journal of Chemical Ecology, 45(3), 200-215.

THE EFFECT OF THE FOLIAR FERTILIZER PISTACHIO MIX PLUS NPA ON THE YIELD AND QUALITY OF CHERRY (*PRUNUS AVIUM* L.) FRUITS OF THE CV SWEET STEPHANY, GRAFTED ON GISELA 6 ROOTSTOCKS

EFECTUL ÎNGRĂȘĂMÂNTULUI FOLIAR PISTACHIO MIX PLUS NPA ASUPRA RANDAMENTULUI ȘI CALITĂȚII FRUCTELOR DE CIREȘ (*PRUNUS AVIUM* L.) SOIUL SWEET STEPHANY, ALTOIT PE PORTALTOI GISELA 6

BALAN Valerian [1]*, BILICI Inna[1], RUSSU Stanislav[1]

Corresponding author email: valerianbalan@gmail.com

Abstract.
The paper presents an analysis of the effect of the nanotechnology-based Pistachio Mix Plus NPA foliar fertilizer on cherry fruit yield and quality in the cv Sweet Stephany cherry variety, grafted on Gisela 6, planted at a distance of 4x1 m. Between 2023 and 2024, the foliar fertilizer was used during four phenophases of flower bud development in a dose of 2.5 l/ha. The fruit yield increased by 12,5-19,8%, when the Pistachio Mix Plus NPA was used 2.5 l/ha three times, in comparison with the yield of the sweet cherry trees which were not treated with the fertiliser. The foliar fertilization with microelements has increased the number of fruits with a diameter larger than 30 mm by 54,4-58,3%. Thus, the fruit yield and quality can be improved in sweet cherry orchards using nanotechnology-based foliar fertilizers during three fruiting phenophases, namely pink-white bud + petal shedding + the beginning of ripening.
Keywords*: Prunus avium*; foliar fertilization; yield; fruit quality

Rezumat.
Lucrarea prezintă o analiză a efectului îngrășământului foliar Pistachio Mix Plus NPA bazat pe nanotehnologie asupra recoltei și calității fructelor de cireș la soiul de cireș Sweet Stephany, altoit pe Gisela 6, plantat la distanța de 4x1 m. În perioada anilor 2023-2024, îngrășământul foliar a fost administrat în 4 fenofaze de dezvoltare a mugurilor florali în doza de 2,5 l/ha. Randamentul fructelor a crescut cu 12,5-19,8% în cazul aplicării Pistachio Mix Plus NPA 2,5 l/ha de trei ori comparativ cu varianta netratată. Fertilizarea foliară cu microelemente a mărit ponderea fructelor cu diametrul mai mare de 30 mm pînă la 54,4-58,3% Randamentul și calitatea fructelor pot fi îmbunătățite în livada de cireș folosind îngrășământ foliar bazat pe nanotehnologie în trei fenofaze de fructificare (buton alb-roz + scuturatul petalelor + începutul pârgii).

[1] Technical University of Moldova, Chișinău

Cuvinte cheie: *Prunus avium*; fertilizarea foliară; randament; calitatea fructelor

INTRODUCTION

In modern orchards chemical fertilizers and nutrient management in the plantation is an important challenge on a global level [Balan et. al., 2001; Balan, 2009; Zulfiqar et. al., 2019; Csihon et. al., 2021]. Soluble fertilizers, which are combinations of N, P, K, Ca, Mg, S and micronutrients in different ratios, are used in drip irrigation and foliar spray systems [Stampar et. al., 2003; Nagy et. al., 2012]. They allow the rapid compensation of deficient elements, reduce nutrient losses and increase the harvest through the correct management of water and nutrients [Babuc, 2012; Robinson and Lopez, 2012; Malhotra, 2016]. The objective of this paper was to determine the impact of the Pistachio Mix Plus NPA, which contains microelements (B – 0.3; Cu – 0.5; Fe – 2.0; Mn – 0.5; Zn – 1.0), on the yield and quality of sweet cherries.

MATERIAL AND METHOD

The studies were carried out between 2023 and 2024, in the northern fruit-growing area of the Republic of Moldova, namely in the sweet cherry orchard planted in 2018 with the Sweet Stephany, Kordia and Regina varieties, which were grafted on the Gisela 6 and planted at a distance of 4x1 m.

The effect of the microelements-based foliar fertilizer (Pistachio Mix Plus NPA), used during four phenophases of sweet cherry flower bud development in a dose of 2.5 l/ha using 1000 l/ha of low pH (PH 6.5) water, was studied. The first treatment was carried out when the generative buds' scales cracked (G2); when the flower buds were visible and separate (G3); when the floral buds in most flowers took the shape of a white-pink ball, the petals were well developed. The first flower was open (G4) and the most petals had shed (G5). Afterwards, the treatments were carried out in groups G2, G3 and G4, when all the petals had shed, and at the beginning of ripening.

The experiments were presented linearly and included 3 groups of 8 trees each. In each experiment and group, two trees were not fertilized for differentiation purposes. In each group, 10 l of solution was used for 24 trees.

The statistical processing of the data was carried out using the method of monofactorial dispersion analysis and the correlation and regression method [Dospehov, 1985]. The comparison of the sample averages was performed using the one-way analysis of variance (ANOVA) and the Tukey's test; the P-value of the test was less than 0.05 ($P \leq 0.05$).

RESULTS AND DISCUSSIONS

Over the years of research, the yield of the cv Sweet Stephany was average (Table 1). The lowest yield was obtained in the trees in G1 each year (6,25-7,26 kg/tree). The yield of the trees treated with microelements was 7,66-8,28 kg/tree in 2023, and 6,45-7,49 kg/tree in 2024. The yield was higher in G4, when the trees were fertilized three times.

Table 1

The impact of the foliar fertilizer Pistachio Mix Plus NPA on the sweet cherry harvest

Group	Yield, kg/tree			Yield, t/ha		
	Year 2023	Year 2024	Average indices	Year 2023	Year 2024	Average indices
G1	6.22	3.33	4.77	15.55	8.32	11.93
G2	6.62	3.45	5.03	16.55	8.62	12.58
G3	7.15*	4.12*	5.63	17.87*	10.30*	14.08
G4	7.24*	4.33*	5.78	18.11*	10.82*	14.46
G5	6.68	3.50	5.09	16.71	8.75	12.72
LSD 0,05%	0.54	0.35	-	1.012	1.55	-

Note: * the difference between the treated and control groups was statistically significant ($P<0.05$).

The yield per hectare in 2023 was higher (18,15-20,71 t/ha) compared to 2024 (15,62-18,72 t/ha). The lowest yield was produced by the untreated trees (15,62-18,15 t/ha), while the trees treated with microelements showed yields that ranged from 6,12 to 20,71 t/ha. In 2023, the highest harvest (20,42-20,71 t/ha) was produced by the trees in G3 and G4, while the yield of the trees in the control group was lower by 12,5-14,1%. In 2024, the harvest in G3 and G4 (10.3-10.82 t/ha) also exceeded the harvest produced by the trees in the control group by 14,1-19,8% (15,62 t/ha).

The treatment of trees with microelements during the phenophases of green bud (G3) and white-pink bud (G4) significantly increased the yield of the cv Sweet Stephany grafted onto the Gisela 6 rootstock.

The size of the sweet cherries was between 26,51 and 29,98 mm (Table 2). Thus, on average over two years, the weight of the fruit in the groups, in which the trees were fertilized, increased by 4,1-11,4%, being greater in G3 (10,75 g), G4 (11,3 g) and G5 (10,45 g) as compared to the weight of the fruit from the untreated trees in the control group.

Table 2

The impact of the foliar fertilizer Pistachio Mix Plus NPA on the size of the sweet cherries

Group	Fruit diameter, mm			Fruit weight, g		
	Year 2023	Year 2024	Average indices	Year 2023	Year 2024	Average indices
G1	28.3	26.7	27.5	10.1	9.2	9.65
G2	27.7	27.8	27.75	9.8	9.9	9.85
G3	29.5	27.6	28.55	11.5	10.1	10.8
G4	29.6	27.9	28.75	11.9	10.6	11.25
G5	28.8	27.8	28.3	11.2	10.1	10.65

The most impressive changes can be observed in the redistribution of sweet cherries by diameter (Table 3). In the untreated group (G1), the proportion of fruit with a diameter of 22-26 mm amounted to 18,2-21,9%, with a diameter of 26-30 mm – 18,2-21,9%, and with a diameter greater than 30 mm – 32,5-50,07%.

Table 3

The impact of the foliar fertilizer Pistachio Mix Plus NPA on the redistribution of sweet cherries by diameter

Group	Proportion of sweet cherries (%) depending on their diameter					
	22-26 mm		26-30 mm		>30 mm	
	Year 2023	Year 2024	Year 2023	Year 2024	Year 2023	Year 2024
V1	21,9	18,2	45,6	31,1	32,5	50,7
V2	20,7	17,4	38,0	27,1	41,3	55,5
V3	19,9	17,2	36,9	24,5	43,2	58,3
V4	17,0	18,0	34,1	27,6	48,9	54,4
V5	21,7	18,1	37,2	25,1	41,1	56,8

Consequently, 49,3-67,5% of the fruit had a diameter smaller than 30 mm. In the treated varieties, the proportion of fruit with a diameter larger than 30 mm increased significantly and amounted to 41,1-58,3%; it was greater in G3 (58,3%) and G4 (58,6%). Thus, the foliar fertilization based on nanotechnology increased the proportion of sweet cherries with a diameter larger than 30 mm.

It should be noted that the greatest number of high-quality fruit was obtained when the fertilization process was carried out during the green bud (G3) and white-pink bud phenophase of the generative buds (G4).

CONCLUSIONS

The utilization of the microelement solution of B – 0.3%, Cu – 0.5%, Fe – 2.0%, Mn – 0.5% and Zn – 1.0% in the dose of 2.5 l/ha, three times during the sweet cherry growth period, contributed to the increase of the harvest of the cv Sweet Stephany by 12,5-14,1% in 2023 and by 14,1-19,8% in 2024. The untreated trees produced 43.5% of fruit with a diameter larger than 30 mm, while the foliar fertilization with microelements in the green bud (G3) and white-pink bud phenophase of generative buds (V4) increased the proportion of fruit with a diameter larger than 30 mm up to 54,4-58,3% in the cv Sweet Stephany.

The first fertilization must be carried out when the floral bud in most flowers takes the shape of a white-pink ball, the petals are well developed and the first flower is open, the second fertilization – when all the petals have shed, and the third fertilization – when the fruit turn from green to white-pink and greenish-yellow.

ACKNOWLEGMENTS

This research was supported by the Technical University of Moldova within the institutional subprogram the *Research and Extension Centre in Agriculture, Biodiversity and Rural Development*.

REFERENCES

1. Babuc V., 2012 - *Pomicultura*. Chişinău, 662 p. ISBN 978-9975-53-067-5.

2. Balan V., 2009 - *Sisteme de cultură în pomicultură. Randamentul producției de fructe*. Academos, Chișinău, nr. 4 (15), p. 82-90.

3. Balan V., Cimpoieș Gh., Barbăroșie M., 2001 - *Pomicultura*. Chișinău: Museum, 452 p. ISBN 9975-906-39-7.

Csihon Á., Gonda I., Holb, I. J., 2021 - *Effect of a nanotechnology-based foliar fertilizer on the yield and fruit quality in an apple orchard*. International Journal of Horticultural Science 27: 29-32. https://doi.org/10.31421/ijhs/27/2021/9809

4. Dospehov A. C., 1985 - *Методика полевого опыта*. Москва: Агропромиздат, 351 с.

5. Malhotra S. K., 2016 - *Water soluble fertilizers in horticultural crops - an appraisal*. – Ind. J. Agric. Sci. 86: 1245-1256.

6. Nagy P. T., Ambrus A., Nyéki J., Soltész M., Szabó Z., 2012 - *Effect of foliar spraying with algae suspension on leaf and fruit quality parameters of apple varieties*. International Journal of Horticultural Science. 18(1): 35-38. p. https://doi.org/10.31421/IJHS/18/1/991

7. Robinson T., Lopez S., 2012 - *Crop load affects 'Honeycrisp' fruit quality more than nitrogen, potassium, or irrigation*. Journal Acta Horticulturae, No. 940 pp. 529-537. ISSN 0567-7572 ISBN 978-90-66056-85-5 USA.

8. Stampar F., Solar A., Hudina M., 2003 - *Influence of foliar nutrition on apple production*. International Journal of Horticultural Science. 9(2): 15-18. https://doi.org/10.31421/ IJHS/9/2/384

9. Zulfiqar F., Navarro M., Ashraf M., Akram N. A., Munne-Bosch S., 2019 - *Nanofertilizer use for sustainable agriculture: advantages and limitations*. Plant Sci. 289: 110270. DOI: 10.1016/j.plantsci.2019.1 10270.

BEHAVIOUR OF SOME CHERRY VARIETIES IN THE CONDITIONS OF NORTH-EAST REGION OF ROMANIA

COMPORTAREA UNOR SOIURI DE CIRES IN CONDITIILE DIN REGIUNEA DE NORD EST A ROMANIEI

DASCĂLU Marius[1], ISTRATE Mihai[1], ZLATI Cristina[1], BERNARDIS Roberto-Renato[1], BOZIANU Ionuț[1]

*Corresponding author e-mail: marius.dascalu@iuls.ro

Abstract.
Cherry, a species always present in orchards, has undergone continuous improvements both in technological aspects and varieties assortment. While today cherry culture in Europe knows "a new breath", in particular by increasing the number of plants per unit surface in conjunction with obtaining rootstocks and varieties of low vigor, existing plantations can be subject to detailed studies to better understand the secrets of the specie.
Key words: Cherry fruits., crown shape, superintensive orchards

Rezumat.
Cireşul, o specie întotdeauna prezenta în livezi, a cunoscut o continuă dezvoltare atât sub aspectul tehnologiei de cultură cât şi la nivelul sortimentului. Astăzi cultura cireşului în Europa cunoaşte "un nou suflu", determinat în mod deosebit de creşterea densităţii pomilor pe unitatea de suprafaţă în colaborare cu obţinerea de portaltoi şi soiuri de vigoare redusă, iar plantaţiile existente pot fi subiectul unor studii detaliate pentru o mai bună înţelegere a secretelor acestei specii.
Cuvinte cheie: Cireș, formă de coroană, livadă superintensivă

INTRODUCTION

Super intensive cherry plantations are being established more and more often in the North-Eastern region of Moldova, and Iasi County offers optimal conditions for the development and fruiting of the species.

New varieties and rootstocks ensure superior production, with cherries being sought after both on the domestic and foreign markets, offering producers material benefits, especially in the first part of the agricultural year.

MATERIAL AND METHOD

The studies necessary for the preparation of this paper were carried out in Ciortesti commune, Iasi county, within the S.C. Hortifruct S.R.L. farm between 2021 – 2023. Four cherry varieties (Summit, Canada Giant, Kordia, Regina) grafted onto Gisela 5 rootstock (Dallabetta N., Franchini S., Pantezzi T. and Zucchi P., 2019), managed in the

[1] "Ion Ionescu de la Brad" Iași University of Life Sciences, Romania

form of a UFO crown (Upright Fruiting Offshots) at a planting distance of 4x2 m, resulting in approximately 1250 trees per hectare, were studied (fig. 1, 2, 3, 4, 5).

RESULTS AND DISCUSSIONS

Table 1 presents data on the average height of the trees. As can be seen, the highest value is recorded by the Summit variety (305 cm), followed by the Canada Giant, Kordia and Regina varieties.

Table 1

Tree height data (cm)

Variant	Year	Value (cm^2)	Average '22-'24 (cm)	% compar. to control	Diff. from control	Semnif.
Summit	2021	301	305	120.07	+51	***
	2022	304				
	2023	310				
Canada Giant	2021	286	290	114.17	+36	**
	2022	291				
	2023	293				
Kordia	2021	285	288	113.38	+34	**
	2022	287				
	2023	292				
Regina (Mt)	2021	249	254	100	-	-
	2022	253				
	2023	260				
DL 5% = 1.82			DL 1% = 4.15		DL 0.1% = 12.96	

The cross-section of the tree trunk ranged from 90 cm^2 for the Summit variety to 45.7 cm2 for the Regina variety. The Canada Giant and Kordia varieties achieved intermediate values (Table 2).

Table 2

Trunk cross-sectional area data

Variant	Year	Value (cm^2)	Average '22-'24 (cm^2)	% compar. to control	Diff. from control	Semnif.
Summit	2021	89,3	90.0	196.9	+44.3	***
	2022	90,1				
	2023	90,6				
Canada Giant	2021	77,4	77.9	170.4	+32.2	***
	2022	77,9				
	2023	78,5				
Kordia	2021	55,3	55.9	122.3	10.2	**
	2022	55,9				
	2023	56,6				
Regina (Mt)	2021	45,2	45.7	100	-	-
	2022	45,8				
	2023	46,3				
DL 5% = 3.53			DL 1% = 8.12		DL 0.1% = 25.79	

The volume of the tree crown was approximately 6m3 for the Summit, Regina and Canada Giant varieties, and in the case of the Kordia variety an average value of 5.28 cm^3 was calculated (Table 3).

Table 3

Data on total crown volume (m^3/tree)

Variant	Year	Value (m^3/tree)	Average '22-'24 (m^3/tree)	% compar. to control	Diff. from control	Semnif.
Summit	2021	6,59	6.92	109.49	+0.6	**
	2022	6,79				
	2023	7,39				
Canada Giant	2021	5,61	5.99	94.77	-0.33	o
	2022	5,92				
	2023	6,45				
Kordia	2021	4,23	5.28	83.54	-1.04	oo
	2022	6,60				
	2023	5,03				
Regina (Mt)	2021	5,55	6.32	100	-	-
	2022	6,20				
	2023	7,23				
DL 5% = 0.27			DL 1% = 0.51		DL 0.1% = 1.47	

The number of fruit branches per tree was 206 for the Kordia variety, followed by the Summit variety with 192. The other 2 varieties recorded 144 and 130 per tree, respectively (Table 4).

Table 4

Data on the number of fruit branches present on the tree (pcs.)

Variant	Year	Value (pcs./tree)	Average '22-'24 (pcs./tree)	% compar. to control	Diff. from control	Semnif.
Summit	2021	192	192.00	147.69	+62	***
	2022	184				
	2023	200				
Canada Giant	2021	140	144.66	111.27	+14.66	*
	2022	147				
	2023	147				
Kordia	2021	186	206.00	158.46	+76	***
	2022	210				
	2023	222				
Regina (Mt)	2021	126	130.00	100	-	-
	2022	126				
	2023	138				
DL 5% = 6.13			DL 1% = 14.72		DL 0.1% = 44.56	

Fruit production ranged from 9.8 t/ha for the Canada Giant variety to 12 t/ha for the Kordia variety. In the case of the Summit and Regina varieties, the recorded fruit production was approximately 10 t/ha (Table 5). Images in fig. 1-5 represent the studied varieties.

Table 5

Data on top production (t/ha)

Variant	Year	Value (t/ha)	Average '22-'24 (t/ha)	% compar. to control	Diff. from control	Semnif.
Summit	2021	16	10.5	101.9	+0,2	ns.
	2022	3,8				
	2023	11,9				
Canada Giant	2021	15,8	9.8	95.14	-0.5	ns.
	2022	3,5				
	2023	10,1				
Kordia	2021	17,1	12.1	117.4	+1.8	**
	2022	4,3				
	2023	15				
Regina (Mt)	2021	15,3	10.3	100	-	-
	2022	3,9				
	2023	11,7				
DL 5% = 1.21			DL 1% = 2.39		DL 0.1% = 7.11	

Fig 1. Summit variety

Fig. 2. Canada Giant variety

Fig. 3. Kordia variety

Fig. 4. Regina variety

Fig. 5. Fruiting image

CONCLUSIONS

The modern form of tree management (U.F.O.) in conjunction with the Gisela 5 rootstock facilitates the intensive cultivation of cherry trees in the conditions of Ciortesti commune, Iasi county.

All 4 varieties chosen in the experience achieve biometric and fruiting characteristics characteristic of low-vigor trees, thus simplifying specific technological operations (cutting, harvesting and treatments) [Vercammen J. *et al.* a, 2019].

The production obtained, except for years with climatic accidents, fully justifies the investment, being in line with the European production trend for this species [Vercammen J. *et al.* b, 2019].

REFERENCES

Dallabetta N., Franchini S., Pantezzi T. and Zucchi P., 2019 - *Training systems for high-density cherry orchards in Trento province.* Acta Hortic. 1235, 177-182 DOI: 10.17660/ActaHortic.2019.1235.23.

Vercammen J., Gomand A., Claes N. and Bylemans D., 2019 a - *Training systems of sweet cherries in Belgium.* Acta Hortic. 1235, 169-176 DOI: 10.17660/ActaHortic.2019.1235.22.

Vercammen J., Gomand A., Claes N. and Bylemans D., 2019 b- *Testing of sweet cherry cultivars in Belgium.* Acta Hortic. 1235, 271-278 DOI: 10.17660/ActaHortic.2019.1235.37.

THE IMPACT OF THE MECHANIZED CONTOUR PRUNING OF SWEET CHERRY TREES (*PRUNUS AVIUM L.*) OF THE CV SWEET STEPHANY, GRAFTED ON THE GISELA 6 ROOTSTOCK, ON FRUIT PRODUCTION AND QUALITY

EFECTUL TĂIERII MECANIZATE DE CONTUR A POMILOR DE CIREŞ (PRUNUS AVIUM L.) SOIUL SWEET STEPHANY, ALTOIT PE PORTALTOI GISELA 6, ASUPRA PRODUCȚIEI ȘI CALITĂȚII FRUCTELOR

RUSSU Stanislav[1], BĂLAN Valerian[1]*, BILICI Inna[1]

Corresponding author email: valerianbalan@gmail.com

Abstract.
This work is a comparative analysis of the mechanized contour pruning of sweet cherry trees carried out after fruit harvesting in an intensive cultivation system in the northern zone of the Republic of Moldova (47.9163º; 27.4587º; 160 m.) The orchard of sweet cherry trees with slender spindle-shaped crowns of the Sweet Stephany variety, grafted on the Gisela 6 rootstock and planted at a distance of 4x1 m, was established in 2018. The method and degree of contour pruning during the vegetation period of the trees was studied. The fruit quality can be improved using contour pruning without affecting the crop yield. The weight of the fruit (10.92-11.19 g), in the groups where mechanized contour pruning was used, was significantly greater than the weight of the fruit grown using annual maintenance and fruiting pruning (10.75 g). Regardless of the technique and degree of pruning, the Sweet Stephany variety has produced more than 80% of fruit larger than 26 mm in diameter.
Key words: *Prunus avium* L., fruit tree pruning, yield, fruit quality

Rezumat.
Lucrarea prezintă o analiză comparativă a tăierii mecanizate de contur, după recoltarea fructelor, a pomilor de cireș în sistem intensiv de cultură în condițiile de nord a Republicii Moldova (47.9163º; 27.4587º; 160 m.) Livada a fost înființată în anul 2018, cu pomi din soiul Sweet Stephany, altoit pe portaltoiul Gisela 6, la distanța de 4 x 1 m, conduși după coroana fus zvelt. S-a studiat modul și gradul tăierii de contur în perioada de vegetație a pomilor. Calitatea fructelor poate fi îmbunătățită, folosind tăierea de contur fără a afecta randamentul culturii. Masa fructelor (10,92-11,19 g) în variantele, unde s-a aplicat tăierea mecanizată de contur, este semnificativ mai mare comparativ cu tăierea de întreținere și de fructificare aplicate anual (10,75 g). Indiferent de modul și gradul de

[1] Technical University of Moldova, Chișinău

tăiere a pomilor, soiul Sweet Stephany a format peste 80 % de fructe cu diametrul mai mare de 26 mm.

Cuvinte cheie: *Prunus avium* L., tăierea pomilor, randament, calitatea fructelor

INTRODUCTION

In intensive orchards, in which there is not an interdependence of crown training system, tree pruning, planting density and fruit number regulation, trees produce high yields but small fruit [Whiting, et. al., 2005, 2006; Balan and Sarban, 2021]. Typically, fruit yield and quality are controlled by pruning during the dormant period [Babuc, 2012]. But this approach may be insufficient for intensive orchards that produce high yields of fruit which are competitive on the market [Balan and Sarban, 2021]. Therefore, the fruit size can determine the future of a sweet cherry orchard. Thus, the yield and quality of sweet cherry fruit can be regulated by the pruning carried out during the vegetative dormant period of the trees [Long et al., 2014] and the pruning done during the vegetation [Balan and Sarban, 2023]. It was decided to estimate the impact of the mechanized contour pruning of sweet cherry trees (*P. avium L.*) during the growing season on the yield and quality of the Sweet Stephany sweet cherry variety grafted on Gisela 6 rootstock.

MATERIAL AND METHOD

The study was conducted in the northern fruit-growing region of Moldova, in a sweet cherry orchard (cv. Sweet Stephany on Gisela 6 rootstock, planted in 2018 at 4×1 m spacing) belonging to Sermofarm Company, Sturzeni village, Riscani district. Orchard management followed integrated pest control principles. The study aimed to assess how varying intensities of contour pruning affect yield and fruit quality in the Sweet Stephany variety (Table 1).

Table 1.

The method and degree of the contour pruning of sweet cherry trees (*P. avium L.*)

Group	The intensity of the contour pruning
G1	Maintenance and fruiting pruning done annually (control group).
G2	Mechanized contour pruning, after harvesting the fruit, on one side of the crown one year and on the other side the following year, observing the same side every two years, which is supplemented, in early autumn, by pruning inside the crown carried out annually.
G3	Mechanized contour pruning, after harvesting the fruit, on one side of the crown one year and on the other side the following year, observing the same side every three years, which is supplemented, in early autumn, by pruning inside the crown carried out annually.
G4	Mechanized contour pruning, to limit the height and width of the crown, is carried out once every three years, after harvesting the fruit, and supplemented, in early autumn, by pruning inside the crown carried out annually.

In order to determine the angle and depth of the brunch pruning at the "blind" limitation of the height and the lateral extension of the crown, using a tree trimming

machine, namely the FL 250P model, it is necessary to establish the distance between the tree rows (L) according to the geographical latitude of the locality (φ), the height of the crown (H), the width at the bottom of the crown (B), the angle of inclination of the lateral surface of the crown to the vertical (α) following the formula proposed by V. Balan, namely **L = H tg φ – Htg α + B** (Balan, 1996, 2001).

The first contour pruning, on both sides of the crown along the row, is done at an inclination angle of 12-13°, which corresponds to the natural shape of the crown, and the second pruning is done at an angle of 4-5° in relation to the vertical plane to the top of the tree, in order to avoid the compaction of the outer part of the tree crown (Balan, 2001). The contour pruning at the base of the crown is carried out at a distance of 70-80 cm from the symmetry plane of the crown. When carrying out contour pruning, the thickness at the base of the crown is maintained at 150-180 cm

The first contour pruning, when limiting the height, is carried out at 280-300 cm, the second is reduced by 30-40 cm compared to the first pruning to avoid the compaction of the crown in its upper part.

Four randomized groups of eight trees each were used to carry out the experiment. Fruits were harvested at the stage of consumption ripeness. The fruit in each variant from the 24 trees were weighed individually and reported per hectare. The number of fruits from 3 typical trees in each group was studied during the harvest. Fruit quality indices were assessed based on fruit weight (g), diameter (mm), soluble solids content (°Bx), titratable acidity expressed as % malic acid, and fruit hardness (kg/cm^2). The fruit weight was determined by weighing 1 kg of sweet cherries in each group using a digital scale (± 0.01 g) (AS 82/220.X2) and counting them afterwards. The soluble dry matter content was measured using the digital refractometer (DR201-95, Germany). The fruit diameter and firmness were determined using 20 cherries of each variety in four identical samples (n = 80).

The statistical processing of the data was carried out using the monofactorial dispersion, correlation and regression analysis methods (Dospehov, 1985).

RESULTS AND DISCUSSIONS

Crown structure significantly influences fruit yield, quality, and the efficiency of manual pruning and harvesting, justifying the study of mechanized contour pruning (Table 2). Mechanized pruning was performed in mid-July, followed by manual inner-crown pruning in early September.

Fruit yield. The fruit yield amounted to 6.03-6.43 kg/tree. The highest yield was recorded when the maintenance and fructification pruning were done annually (G1) and when the mechanized contour pruning, to limit the height and wideness of the canopy, was carried out every three years after harvesting, which was supplemented, in early autumn, by pruning inside the crown carried out annually (G4). The mechanized contour pruning, after harvesting the fruit, on one side of the crown one year and on the other side the following year (G2, G3) caused a slight decrease in the yield (6.03-6.13 kg/tree) as compared to the control group (6.36 kg/tree). The sweet cherry yields varied slightly depending on the pruning methods, since the orchard's structural indices were maintained at an optimal level, and the orchard maintenance process was at a high level.

Table 2.

The impact of the contour pruning on the production and quality of the Sweet Stephany sweet cherry variety grafted on Gisela 6 rootstock

Group	Yield		Number of fruits per tree, pcs	Fruit weight, g	Fruit diameter, mm
	kg/tree	t/ha			
G1	6.36	15.9	592	10.75	28.66
G2	6.13	15.3	561	10.92	28.89
G3	6.03	15.1	544	11.08	29.12
G4	6.43	16.1	575	11.19	29.27
LDS, 5%	0.45	1.07	35.42	0.15	-

Effects of fruit number. The number of fruits varied from 544 pcs/tree in G3 to 592 pcs/tree in the control group. The number of fruit in the groups, where mechanized contour pruning was used on one side of the crown in one year, and on the other side in the following year (544-561 pcs/tree) decreased insignificantly compared to the number of fruit in the groups in which maintenance and fruiting pruning was carried out annually (592 pcs/tree).

Fruit weight and diameter. Fruit weight varied depending on the tree pruning system. In the second year after the utilization of the mechanized contour pruning, the weight of the sweet cherries was 10.75-11.19 g. The fruit had a greater weight when performing mechanized contour pruning on one side of the crown in one year, and on the other side in the following year (10.92-11.08 g), and also for the purpose of limiting the height and width of the crown once every 3 years (11.19 g). The weight of the fruit (10.92-11.19 g) in the groups, where mechanized contour pruning inside the crown was done annually (G2, G3, G4), was significantly greater as compared to the weight of the fruit in the groups in which maintenance and fruiting pruning was carried out annually (10.75 g).

The diameter of the fruit at the time of harvesting directly depended on the weight of the fruit and amounted to 26.66–29.27 mm. In the groups in which mechanized contour pruning was carried out (G2, G3, G4), the diameter of the fruit was larger and significantly assured, compared to the diameter of the fruit in the groups in which maintenance and fruiting pruning was done annually (G1).

Fruit quality indices. The content of soluble dry matter slightly varied depending on the pruning used and was 17.81-17.95 °Brix (Tab. 3). The titratable acidity ranged from 0.63 to 0.64 g of malic acid per 100 g^{-1}. Data in Table 3 show that the firmness of the sweet cherry fruit was 3.25-3.28 kg/cm^2. The fruit diameter and weight had a minor impact on the fruit firmness. The firmness of the fruit in the Sweet Stephany variety was insignificant in the groups in which mechanized contour pruning was carried out, namely 3.3 kg/cm^2 in G2, 3.27 kg/cm^2 in G3 and 3.25 kg/cm^2 in G4, in comparison with the firmness of the fruit in the groups in which maintenance and fruiting pruning was done annually (G1), namely 3.28 kg/cm^2. Fruit quality indices in the Sweet Stephany variety, grafted on the Gisela 6 rootstock, were constant and varied slightly depending on the tree pruning system.

Table 3.

The impact of the contour pruning on the quality of the Sweet Stephany sweet cherry variety, grafted on Gisela 6 rootstocks

Group	Soluble dry matter (° Bx)	Titratable acidity, mg of malic acid per 100 g	Fruit firmness, kg/cm²
G1	17.81	0.64	3.28
G2	17.83	0.63	3.3
G3	17.80	0.63	3.27
G4	17.85	0.64	3.25
LSD, 5%	0.54	0.21	0.48

Fruit size distribution. The size of the sweet cherries changed depending on the pruning system. The size of the fruit was assessed by its diameter and weight, but the selling price of sweet cherries was determined primarily by the size and colour of the fruit, then by its firmness, taste and aroma. For these reasons, the sweet cherries were divided into groups depending on their diameter, namely 22-26 mm, 26-30 mm, 30 mm and larger (figure 1).

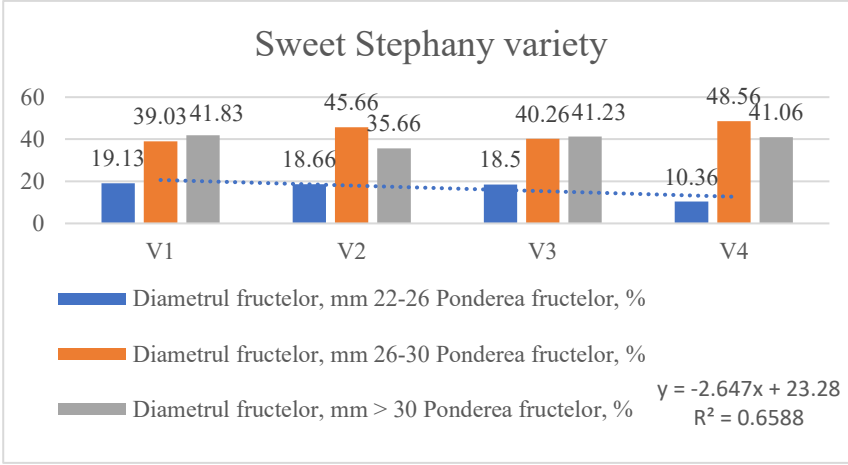

Fig. 1. The impact of the contour pruning on the distribution of fruit by diameter in the Sweet Stephany sweet cherry variety, grafted onto the Gisela 6 rootstock

The trees in the control group (G1) produced 19.3% of fruit with a diameter of 22-26 mm, 39.03% – with a diameter of 26-30 mm, and 41.83% – with a diameter of 30 mm and larger. In the groups in which mechanized contour pruning was carried out (G2, G3, G4), the fruit distribution by diameter was identical to the distribution of fruit in the groups in which the maintenance and fruiting pruning was done annually (G1), i.e. more than 80% of the fruit had a diameter larger than 26 mm and the fruit the diameter of which was less than 26 mm made up only 10.36-19.13%. The data obtained, regarding the fruit distribution by diameter in the Sweet Stephany sweet cherry variety, are significant and demonstrate a fairly high

level of reliability, where R^2 equals 0.6588.

CONCLUSIONS

The mechanized contour pruning of sweet cherry trees (*P. avium L.*) during the growing season is a practical approach aimed to improve fruit size distribution and reduce the manual labour in tree pruning. The weight of the fruit (10.92-11.19 g) in the groups, where mechanized contour pruning inside the crown (G2, G3, G4) was carried out annually, was significantly greater compared to the weight of the fruit where maintenance and fruiting pruning was done annually (10.75 g).

The method of tree pruning did not significantly affect the yield (15.1-16.1 t/ha) and the fruit quality of the Sweet Stephany variety, grafted on the Gisela 6 rootstock. The content of soluble dry matter (17.81-17.95 °Bx), the titratable acidity (0.63-0.64 mg malic acid in 100 g^{-1}) and the fruit hardness (3.25-3.28 kg/cm^2) did not depend on the method of tree pruning. Regardless of the method and degree of tree pruning, the Sweet Stephany sweet cherry variety, grafted onto the Gisela 6 rootstock, produced more than 80% of fruit with a diameter greater than 26 mm.

ACKNOWLEGMENTS

This research was supported by the Technical University of Moldova within the institutional subprogram the *Research and Extension Centre in Agriculture, Biodiversity and Rural Development*.

REFERENCES

1. Babuc V., 2012 - *Pomicultura*. Chișinău. 662 p. ISBN 978-9975-53-067-5.

2. Balan V., 1996 - *Metodă de stabilire a distanței dintre rândurile de pomi fructiferi:* brevet MD nr. 361 (FI). Nr. depozit: 95-0117. Data depozit: 06.01.1995. Publ. 31.01.1996. In: BOPI. 1996, nr. 1. 0,18.

3. Balan V., 2001 - *Structura plantației pomicole ca factor determinativ al productivității*. In: Lucrări științifice, USAMV "Ion Ionescu de la Brad". Iași, 2001, vol. 44(1): Horticultură, pp. 163-168. 0,25.

4. Balan V., Sarban V., 2021 - *The impact of the cherry tree pruning period on the production and quality of fruit in an intensive cultivation system*. In: International Agriculture Congress: conf. șt. intern., 16-17 dec. 2021, ed. a 4-a, Turcia. pp. 107-117. ISBN 978-605-80128-6-8.

5. Balan V., Șarbanv., 2023 - *Efectul perioadei de tăiere privind randamentul și mărimea fructelor soiurilor de cireș* Stella și Skeena, altoite pe Maxma 14. In: Știința Agricolă, nr. 2, pp. 30-38, ISSN 1857-0003 E-ISSN 2587-3202

6. Dospehov B., 1985 - *Методика полевого опыта (с основами статистической обработки результатов исследования)*. Москва: Агропромиздат. 351 с.

7. Long, Lynn E., Long Marlene, Pește anu A., Gudumac E., 2014 - *Producerea cireșelor*. Manual tehnologic. Chișinău, p. 119-126

8. Whiting M., Ophardt D., Lenahan O., Elfving D., 2005 - *Managing sweet cherry crop load: new strategies for a new problem*. Compact Fruit Tree 38: 52-58.

9. Whiting M., Ophardt, D., Mc Ferson J. 2006 - *Chemical blossom thinners vary in their effect on sweet cherry fruit set, yield, fruit quality, and crop value*. Hortechnology 16:66–70.

THE INFLUENCE OF SOIL MANAGEMENT SYSTEMS OF THE INTERVAL BETWEEN VINE ROWS ON THE PENETRATION RESISTANCE OF SOILS FROM COTNARI VINEYARD

INFLUENȚA UNOR SISTEME DE LUCRARE PE INTERVALUL DINTRE RANDURILE DE VIȚĂ DE VIȚĂ ASUPRA REZISTENȚEI LA PENETRARE A SOLURILOR ÎNTR-O PLANTAȚIE DE VIȚĂ DE VIE DIN POGORIA COTNARI

ALEXANDRU Mihai[1]*, ȚOPA Denis[1], FILIPOV Feodor[1], CALISTRU Anca-Elena[1], JITĂREANU Gerard[1]

*Corresponding author e-mail: al.mihai@yahoo.com

Abstract.
Soil is not only the physical support but also the main reserve of nutrients and water for the vines, which, together with meteorological factors and the level of agricultural techniques used, determine the quantity and quality of grape production. Vineyard mechanisation technology is the totality of all production processes, agricultural works, and operations carried out in a certain sequence, in optimal conditions and in compliance with agricultural technical requirements. The volume of work and the order in which it is carried out constitute the tillage system. The tillage systems used in vine plantations influence the physico-mechanical properties of the soil by using different systems of machinery and equipment during the course of a vineyard year. The studies were carried out on the western slope of Bejeneasa Farm, Cotnari Vineyard, in the Moldavian Hills Wine Region. The studied area is 0.31 ha. It is located in the upper part of the slope with a western exposure, and the slope of the land is <5%. The altitude is 170 m, and the mean annual precipitation and mean annual temperature values are 508.9 mm and 10.9°C, respectively. In order to highlight the effects of tillage systems in the plot cultivated with vines on the land with 8% slope and western exposure, three tillage systems were practised: a tillage system with a tiller, a tillage system with ridging, and a tillage system with a cultivator. For each tillage system, determinations were made on both the tractor wheel tracks and the mechanical spacing between the vine rows. Penetration resistance was determined using a penetrologger to a depth of 80 cm. The analytical data obtained showed that the penetration resistance of soils was influenced by the tillage system used. The range of variation of the values of penetration resistance for the wheel tracks of agricultural equipment was higher compared to those recorded on the vine rows.
Key words: penetration resistance, tillage system, vineyard plantation

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania

Rezumat.

Solul nu este doar suportul fizic, ci și principala rezervă de nutrienți și apă pentru vița-de-vie, care, împreună cu factorii meteorologici și nivelul tehnicilor agricole utilizate, determină cantitatea și calitatea producției de struguri. Tehnologia mecanizării viticole reprezintă totalitatea proceselor de producție, lucrărilor agricole și operațiunilor efectuate într-o anumită succesiune, în condiții optime și cu respectarea cerințelor tehnice agricole. Volumul de lucru și ordinea în care se efectuează constituie sistemul de prelucrare a solului. Sistemele de lucrare a solului utilizate în plantațiile de viță-de-vie influențează proprietățile fizico-mecanice ale solului prin utilizarea diferitelor sisteme de mașini și echipamente pe parcursul unui an viticol. Studiile au fost efectuate pe versantul vestic al Fermei Bejeneasa, Podgoria Cotnari, în Regiunea Viticolă Dealurile Moldovei. Suprafața studiată este de 0,31 ha. Este situată în partea superioară a versantului cu expunere vestică, iar panta terenului este <5%. Altitudinea este de 170 m, iar valoarea medie anuală a precipitațiilor și a temperaturii medii anuale sunt de 508,9 mm și, respectiv, 10,9°C. Pentru a evidenția efectele sistemelor de lucrare a solului în parcela cultivată cu viță-de-vie asupra terenului cu panta de 8% și expunere la vest, s-au practicat trei sisteme de lucrare a solului: un sistem de lucrare a solului cu motocultor, un sistem de lucrare a solului cu crestere și un sistem de lucrare a solului cu cultivator. Pentru fiecare sistem de prelucrare a solului s-au făcut determinări atât pe șenilele roților tractorului, cât și pe distanța mecanică dintre rândurile de viță de vie. Rezistența la penetrare a fost determinată folosind un penetrolog până la o adâncime de 80 cm. Datele analitice obținute au arătat că rezistența la pătrundere a solurilor a fost influențată de sistemul de prelucrare a solului utilizat. Gama de variație a valorilor rezistenței la pătrundere pentru șenilele de roți ale utilajelor agricole a fost mai mare comparativ cu cele înregistrate pe rândurile de viță de vie.

Cuvinte cheie: rezistență la pătrundere, sistem de prelucrare a solului, plantație viticolă

INTRODUCTION

Soil penetration resistance is an indicator that mechanically characterises the state of soil tilth in vineyards by determining the degree of soil compaction.

The penetration resistance characterises very significantly the physico-mechanical properties of the soil and is particularly used in comparative studies of tillage systems carried out with different agricultural machines. Penetration resistance depends largely on the degree of compaction of soil and its bulk density, moisture, organic matter content, granulometric composition, and crop.

Bulk densities and penetration resistance generally increase with depth in soil profiles, and these changes in physical properties can be mitigated and/or eliminated by using soil loosening machines appropriate to wheel gauge, controlled traffic practices, deep ripping and conservation tillage [Țopa *et al.*, 2013].

Soil compaction can occur either at or near the surface (shallow compaction) or deeper in the soil (subsoil compaction) and is influenced by the loss of soil

aggregation caused by soil erosion, reduced organic matter levels and forces exerted by the weight of agricultural equipment. Soil compaction is attributed to wheel loading, not tillage [Van Dijck and Van Asch, 2002].

Soil compaction, especially just below the cultivated layer, hinders root penetration, limiting the ability of plants to absorb water and nutrients from the lower soil horizons [Chan *et al.*, 2006].

Compaction is also exacerbated by the intensity and frequency of maintenance work between plant rows through the repeated movement of heavy-wheeled agricultural machinery on approximately the same routes to carry out disease and pest control treatments [Pagliai *et al.*, 2004].

The pressure exerted on the contact surface of the wheels varies with the size of the machines and the slope. The mass of commonly used tractors ranges from 2.6 to 3.7 Mg, and the width ranges from 1.15 to 1.40 m. Therefore, the wheel tracks are located close to the vine row and, thus, may affect soil conditions in the root zone [Ferrero et al., 2005].

Compaction is also significantly influenced by the water content of the soil at the time of tillage because when soil is wetter than the plasticity limit, it can become severely compacted if tilled or subjected to traffic. This occurs because soil aggregates are pushed into each other, forming a dense and stretched mass, favouring increased dilution of organic matter [Laudicina *et al.*, 2014].

Compacted soils generally have a higher penetration resistance at a given moisture level than well-structured soils. Penetration resistance for high-quality, moist soil is usually well below the critical level at which root growth ceases for most crops.

Soil compaction often reduces soil porosity and increases soil bulk density and resistance to penetration, leading to increased surface runoff and degradation by erosion [Bogunovic *et al.*, 2019; Pijl *et al.*, 2020].

The consequences of soil compaction can also be seen from the fact that the loss of large pores in aggregates is very detrimental for fine and medium-textured soils, which depend on these pores for good water infiltration and percolation as well as for air exchange with the atmosphere, whereas for coarse-textured soils the impact is less severe.

The technologies applied and the tillage systems practised in vine cultivation influence the distribution of vine roots in the soil in terms of rooting depth and, in particular, root density. The presence of interspersed rows covered by permanent grass or continuous tillage between rows can cause a different development of the root system, influencing the number, diameter and density of roots [Linares Torres *et al.*, 2018].

The degree of soil compaction influences the stage of development of the root system of crop plants and their ability to penetrate the soil. Measured values below 300 PSI (2.00 MPa) do not negatively influence root penetration into the soil. At recorded values above 400–500 PSI (2.70–3.40 MPa), roots do not penetrate into the soil [Rusu *et al.*, 2012].

By practising different tillage techniques between the rows, the root system of the grapevine can be affected, playing an important role in the quality and quantity of grape production, which in turn are the basis for wine production [Smart et al. 2006].

The main effect of increasing the values of penetration resistance is the restriction of root penetration as well as their density, which implies a slowed development of the root system and, consequently, a reduction in their capacity to absorb water and nutrients [Răus and Jităreanu, 2007].

As soil penetration resistance increases, root elongation and growth decrease. In terms of vine growth, at values above 3 MPa, root growth is retarded, except in cracks and old root canals. The critical values (2.85 MPa) achieve resistance to penetration at depths of 35–40 cm in the wheel tracks of agricultural machinery, while between these tracks, the measured values do not approach this value. The highest value was 2.31 MPa, which was recorded at depths of 30–35 cm (plow hardpan). At 40–50 cm deep, the values ranged from 1.93 in the middle of the alley to 2.59 MPa on the wheel tracks [Țopa *et al.*, 2013].

Agronomic practices in vineyards, in particular inter-row management, influence the response of soil properties and root development of grapevine plants [Bordoni *et al.*, 2019].

This paper aims to present the research carried out in a vine plantation under vines operated by SC Cotnari SA in the period 2021–2023 on the influence of three tillage systems.

MATERIAL AND METHOD

Soil penetration resistance studies were conducted in a vineyard located on the western slope of Bejeneasa Farm, Cotnari Vineyard, Iași county, northeastern Romania (Figure 1).

The experimental field was organised between the years 2022 and 2023 in a plot cultivated with grapevines. The geographical coordinates determined with the Global Positioning System (GPS) had the following values: latitude 479º17´58´N, longitude 269º59´36´E, and altitude of 170 m, located in physical block 993, T 25. The slope of the land is <5% with western exposure on carbonate diluvial deposits. In the vineyard plot with the total area of 2.70 ha, of which the area taken in the study was 0.31 ha, three intervals of vine rows with a length of 95 m were considered. The distance between the rows of vines was 3.00 m and the distance between the vines on row was 1.00 m. For each grading of A factor (tilled, trellised, cultivated with cultivator), a number of three repetitions were considered and between each variant/repetition, neighbouring rows of protection, tilled in the system specific to the area, were left (interleaved).

The experimental field was organised using the randomised block design.

Fig. 1. Experimental field, Bejeneasa Farm

In order to achieve the aim of this study, the following stages were completed:

- determining the volumetric water content;
- determining the soil bulk density;
- determining the soil penetration resistance;
- gathering data regarding rainfall and air temperature;
- storing and processing data obtained in the field.

The device used to determine the soil penetration resistance was the Eijkelkamp Penetrologger (2010), measuring down to 80 cm in depth. The device was equipped with a GPS system for precise localisation of the determination point and can be connected to up to 12 satellites. Special attention was paid to the penetration speed of the penetration tip into the soil, which is recommended to be 2 cm/s. The determinations were carried out on the same day and performed both on the spacing between the rows of vine stumps and on the wheel tracks of the machines used to carry out the work in 10 replicates on each cropping system up to a depth of 80 cm in order to obtain a representative value. The data collected could be viewed graphically or numerically on the penetrologger screen in the field and then downloaded to the computer and processed with the corresponding software.

The state of soil compaction was established both on the basis of morphological indicators observed in the field during the soil profile description and on the basis of bulk density values determined from soil samples taken in natural settlement in stainless cylinders with a volume of 100 cubic cm.

RESULTS AND DISCUSSIONS

In the spring of 2021, the penetration resistance values in all three variants were lower than 3 MPa. The compactness state was not restrictive for the development of the vine root.

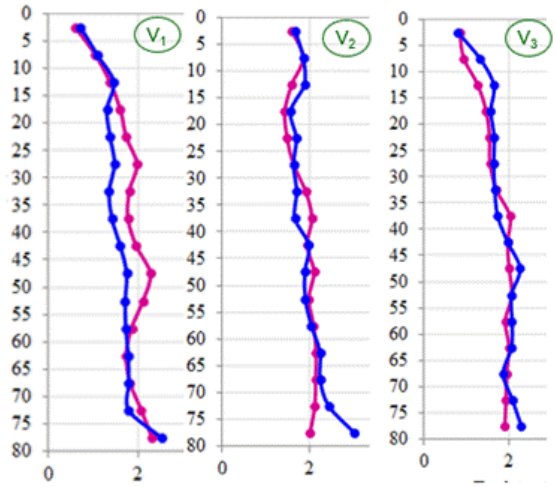

Fig. 2. V_1 – soil worked with the tiller; V_2 – soil kept grassy; V_3 – soil worked with the cultivator.

In the middle of the interval between the vine rows, the penetration resistance values exceeded 5 MPa, starting with the depths of 15 cm (V_1) and 25 cm (V_2 and V_3). Penetration resistance values higher than 5 MPa from tractor wheel tracks were recorded starting with depths of 15 cm (V_1), 30 cm (V_2) and 45 cm (V_3). The state of soil compaction changed differently in the three variants only at a depth of 0–30 cm.

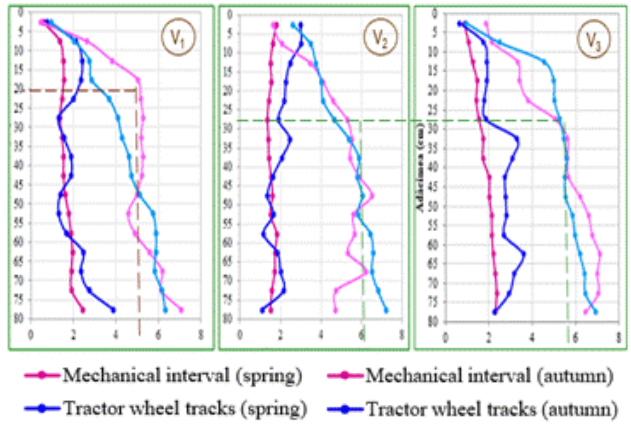

Fig. 3. Interval between the vine rows

CONCLUSIONS

The penetration resistance values were lower than 3 MPa in all three variants.

Between the wine rows, in the middle, the penetration resistance values were higher than 5 MPa, starting at 15 cm depth for the first variant and 25 cm for the other two variants.

The results of the study found that determining penetration resistance before establishing the experimental field is useful for establishing the state of soil compaction.

REFERENCES

1. **Bogunovic I., Kovács G.P., Dekemati I., Kisic I., Balla I., Birkás M., 2019 -** *Long-term effect of soil conservation tillage on soil watercontent, penetration resistance, crumb ratio and crusted area.* Plant Soil Environ. 2019,65, 442–448.
2. **Bordoni M., Vercesi A., Maerker M., Ganimede C., Reguzzi M.C., Capelli E., Wei X., Mazzoni E., Simoni S., Gagnarli E., Meisina C., 2019 -** *Effects of vineyard soil management on the characteristics of soils and roots in the lower Oltrepò Apennines (Lombardy, Italy).* Science of The Total Environment. vol 693, 25 November 2019, 133390.
3. **Chan K.Y., Oates A., Swan A.D., Hayes R.C., Dear B.S., Peoples M.B., 2006 -** *Agronomic consequences of tractor wheel compaction on clay soil*. Soil Till. Res. 89, pp. 13–21.
4. **Ferrero A., Usowicz B., Lipiec J., 2005** - *Effects of tractor traffic on spatial variability of soil strength and water content in grass covered and cultivated sloping vineyard.* Soil and Tillage Research, vol. 84, no. 2, December 2005, pp 127-138.
5. **Laudicina V.A., Agata N., Luciano G., Badalucco L., 2014 -** *Soil carbon dynamics as affected by long-term contrasting cropping systems and tillages under semiarid Mediterranean climate.* Applied Soil Ecology. Vol. 73, January 2014, pp. 140-147.
6. **Linares Torres R., De La Fuente L.M., Junquera Gonzalez P., Lissarrague García-Gutierrez J.R, P. Baeza Trujilloşi P., 2018 -** *Effect of soil management strategies on the characteristics of the grapevine root system in irrigated vineyards under semi-arid conditions.* Australian Journal of Grape and Wine Research, vol. 24, no. 4, pp. 439-449.
7. **Pagliai M., Vignozzi N., Pellegrini S., 2004 -** *Soil structure and the effect of management practices.* Soil and Tillage Research. Vol. 79, no. 2, December 2004, pp. 131-143.
8. **Pijl A., Lara E. H. Reuter, Quarella E., Vogel T.A., Paolo Tarolli P., 2020 -** *GIS-based soil erosion modelling under various steep-slope vineyard practices.* Catena, vol. 193, october 2020, 104604.
9. **Răus L., Jităreanu G., 2007 -** *Corelații între unii indicatori ai stării de compactare a solului și producția culturilor de grâu, fasole și porumb*. Lucrări Ştiinţifice, vol. 50, seria Agronomie.
10. **Rusu T., Bogdan I., Pop A.I., 2012 –** *Îndrumător de lucrări practice la Agrotehnică.* Edit. Grinta, Cluj-Napoca, pp. 88-91.
11. **Smart D.R., Schwass E., Lakso A., Morano L., 2006 -** *Grapevine Rooting Patterns: A Comprehensive Analysis and a Review*. Am J Enol Vitic. 2006 57:89-104. DOI: 10.5344/ajev.2006.57.1.89.
12. **Ţopa D., Filipov F., Cara M., Chiriac Ghe., Coroi I., 2013 –** *Observation on some soil physical properties in Cotnari vineyard*. Lucrări ştiinţifice, seria Horticultura vol. 55 (supliment), ISSN 1454-7376.
13. **Van Dijck S.J.E., van Asch Th.W.J., 2002 –** *Compaction of loamy soils due to tractor traffic in vineyards and orchards and its effect on infiltration in southern France.* Soil & Tillage Research 63: 141–153.

ENZYMATIC ACTIVITY ON QUINOA LEAVES (*CHENOPODIUM QUINOA,* WILLD.), UNDER ABIOTIC STRESS

ACTIVITATEA ENZIMATICĂ DIN FRUNZELE DE QUINOA (*CHENOPODIUM QUINOA*, WILLD.), SUB INFLUENŢA STRESULUI ABIOTIC

CHIRIȚĂ Raluca[1], APOSTOL Maria[1], STOLERU Vasile[1]*

*Corresponding author e-mail: vasile.stoleru@iuls.ro

Abstract.
Quinoa (Chenopodium quinoa sp.), is a species known throughout the world, native to Latin America, and is increasingly appreciated in many parts of the world. The aim of the research was to evaluate fertigation and irrigation on the enzyme activity in the leaves of two cultivars of quinoa (Vikinga and Puno), for its introduction as vegetable crop. The experiment was carried out in the IULS Iasi greenhouse, in vegetative pots, of 42 variants, the experiment was organized in randomized blocks. The results obtained, under the influence of the factors: cultivar, fertilization and irrigation, show that the most intense enzymatic activity was evidenced in Vikinga cultivar - chemically fertilized variant, with irrigation 50% of the substrate field capacity. The results are positively correlated with the increase in the amount of chemical fertilizer administered. The most evident decreases in CAT activity were evidenced in the experimental variants to which Micoseed MB® was applied, in both cultivars.
Key words: quinoa, fertilization, irrigation, enzyme activity.

Rezumat.
Quinoa (Chenopodium quinoa sp.), este o specie cunoscută pe întreg mapamondul, originară din America Latină, fiind tot mai apreciată în mai toate zonele lumii. Studiile și cercetările proprii ne-au arătat că anumite populații pot fi utilizate ca legume pentru frunze. Scopul cercetării a avut in vedere evaluarea ferilizării și irigării asupra activității enzimatice în frunzele a două cultivare de quinoa (Vikinga și Puno), în vederea introducerii acesteia în cultură, ca plantă legumicolă. Experiența a fost organizată în sera USV Iasi, în vase de vegetație, în 42 de variante, experiența fiind organizată în blocuri randomizate. Rezultatele obținute, sub influența factorilor: cultivar, fertilizare și irigare arată că activitatea enzimatică cea mai intensă s-a evidențiat la cultivarul Vikinga- varianta fertilizată chimic, cu irigare 50 % din capacitatea de câmp a substratului. Rezulattele sunt pozitiv corelate cu creșterea cantității de îngrășământ chimic administrat. Cele mai evidente scăderi ale activității CAT au fost

[1] "Ion Ionescu de la Brad" Iași University of Life Sciences, Romania

evidențiate în variantele experimentale la care s-a aplicat Micoseed MB®, la ambele cultivare.

Cuvinte cheie: quinoa, fertilizare, irigare, activitate enzimatică.

INTRODUCTION

Quinoa (*Chenopodium quinoa* Willd.) is considered a pseudo-cereal, native from Latin America. The species still has a strong traditional imprint, even if new modern practices appear, due to studies conducted at the University of Colorado (USA) and in Europe [Pedersen *at al.*, 2015; Mujica, 2001].

The cultivation of the species was largely abandoned with the arrival of the Spanish conquerors, who replaced the quinoa plant with cereals brought from Europe (wheat and barley), much more productive at that time. The quinoa plant is currently grown throughout the Andean region, in the USA, in Europe, Asia and Africa [Bazile *et al.*, 2016; Mazoyer *et al.*, 2006]. Quinoa is a plant grown mainly for its edible seeds, with a high degree of digestibility [Asao et al., 2010]. Also, the leaves can be eaten as a substitute for spinach, in various dishes, well known in the area of origin [Stoleru *et al.*, 2022 B; Vitanescu, 2020].

The nutritional value of quinoa leaves is special, quinoa is a very interesting food, being a precious source of protein, vitamins and minerals [FAO, 1992]. According to the Food and Agriculture Organization of the United Nations (FAO), quinoa can assure the global food security due to its high nutritional qualities as well as tolerance to various abiotic stresses including salinity [FAO, 2013].

Due to the fact that it can be grown in the fields, as well as in tunnels and greenhouses, quinoa can ensure also a sustainable production throughout the year [Stoleru *et al.*, 2022 A; Pedereson *et al.*, 2020].

In this respect, the efforts of our researcher is mainly focused on the following research direction, namely: evaluation of enzymatic activity on quinoa leaves against abiotic stressors - drought and fertilization.

One of the most important environmental factors affecting the success of plant growth and productivity is the amount of water available during the growing season of plants [Shahnaz *et al.*, 2022]. Reduced water availability in plants induces drought stress, which causes numerous morphological and physiological changes [Seleiman *et al.*, 2021]. This natural phenomenon alters chlorophyll content and components, inhibits plant photosynthesis and harms the development of photosynthetic apparatus [Nayyar and Gupta, 2006].

Water stress affects all metabolic processes by impairing enzyme activity [Esfandiari *et al.*, 2008].

Application of biofertilizers under water stress conditions increases production, chlorophyll content and antioxidant enzyme activity. Plants are believed to apply defensive mechanisms such as synthesis of antioxidant enzymes and phenolic compounds to mitigate the effects of water stress [Shahnaz *et al.*, 2022].

In order to study the influence of the experimental factors on the growth and development of Vikinga and Puno varieties under controlled conditions, biochemical determinations of leaf enzyme activity were performed. Evidence of the cumulative influence of the two experimental factors on the growth of the two quinoa varieties was obtained by determining the enzymatic activity of ascorbate peroxidase and catalase during the growing period when the plants reached the 8 true leaf stage.

The results obtained on APX values in the two varieties were compared with the control. The increase of ascorbate peroxidase activity can be considered as an indicator to assess the stress level caused by growing conditions or by the unfolding of physiological processes specific to the vegetation phenophase.

MATERIAL AND METHOD

The research was carried out in a greenhouse of Iasi University of Life Sciences (IULS), Romania, during March to April 2021-2024. vegetation pots (2700 cm^3), chemically and organically fertilized substrate, resulted 42 variants, of 5 replicates, 8 plants for each repetition.

The biological material - seeds of two cultivars Puno and Vikinga. The plants were grown (16-18ºC/20-22ºC) humidity (70-75%/60-65%) and natural light (13/11hours).

The fertilizers used were represented by biologic fertilizer, Micoseed MB® and chemical fertilizer, KSC® II, in different quantities.

To test the influence of type of fertilizations on plant growth were used the following amounts:

- Biological fertilization: 500g/m^3 (F1); 1000 g/m^3 (F2); 1500 g/m^3 (F3)- Micoseed MB®;
- Chemical fertilization: 1000 g /m^3 (F4); 2000 g/m^3 (F5); 3000 g/m^3 (F6) KSC®.

For the watering of the substrate, water was used in different percentages quantities 50%/75%/100 % of substrate capacity.

The experience was organised in vegetation pots (2700 cm^3 capacity). Corresponding to the proposed factors resulted 42 variants, of 5 replicates, 8 plants for each repetition.

The determination of catalase (CAT) and ascorbate peroxidase APX was carried out by the spectophotometric method.

For the determination of catalase (CAT) and ascorbate peroxidase (APOX) activity, 0.5 g of plant material was soaked on ice in K-phosphate buffer pH 7.0. To obtain the supernatant from which the enzyme activity was analyzed, the extract obtained from the soaking was centrifuged at 12 000 rpm for 20 min at 40C.

Total CAT activity was tested by measuring the initial rate of H_2O_2 disappearance according to the method of Aebi [1984].

APX activity was determined according to the method of Chen and Asada (1989) by monitoring the decrease in absorbance at 290 nm.

For statistical analyses the data are expressed as the means ± standard deviation (SD). The analysis of variance (ANOVA) was used to see the influence of cultivar, fertilization and irrigation on the number of leaves, chlorophyll pigments, leaf surface and green leaf biomass of quinoa. To determine the significant differences between treatments were established by using Tukey's post hoc test with a degree of confidence of 95% ($p \leq 0.05$), using a SPSS ver. 21.

RESULTS AND DISCUSSIONS

Enzyme activity in quinoa leaves play a vital role in numerous biochemical reactions necessary for their growth, development, defense against pathogens and survival.

The limitations of this study and the current research note that the most intense enzymatic activity was evidenced in chemically fertilized variants.

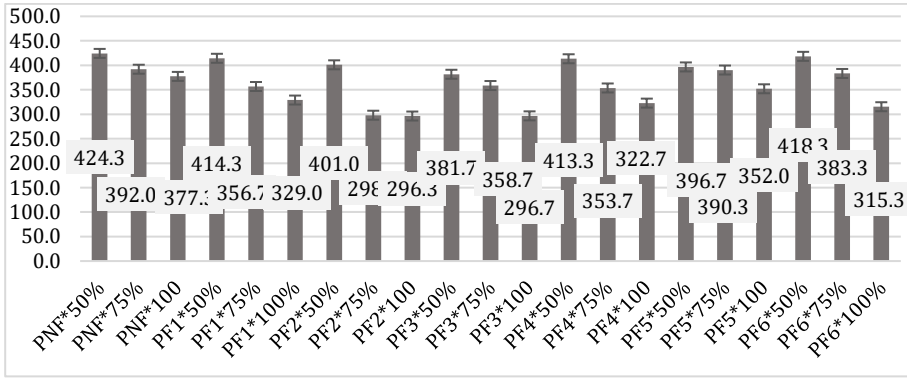

Fig. 1. The influence of the fertilization regime on the enzymatic activity in quinoa leaves (Puno), APX(U/min/g) S.P.

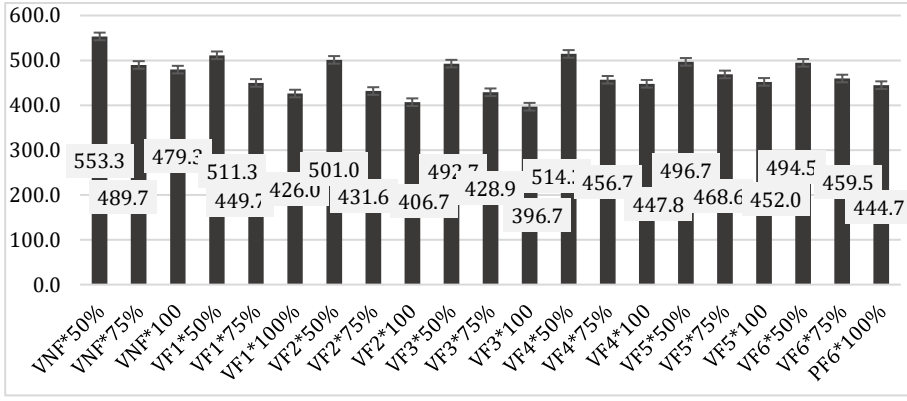

Fig. 2. The influence of the fertilization regime on the enzymatic activity in quinoa leaves (Vikinga), APX(U/min/g) S.P.

The increase in ascorbate peroxidase activity can be considered an indicator of the level of stress caused by the culture conditions or the development of physiological processes specific to the vegetation phenophase. By comparing the results, the greatest increases in APX activity were highlighted in the amount of 553.3 U/g/min S.P., in the Vikinga variety, the non-fertilized-NF variant, with an irrigation regime of 50% (Figure 2) and values the lowest of APX in the Puno variety, amounting to 296.3 U/g/min S.P. in the F2 variant, biologically fertilized,

with 100% irrigation regime (Figure 1). It can be seen that under drought conditions APX values increase, while high amounts of water cause enzyme activity to decrease.

The results obtained regarding the APX (ascorbate peroxidase) values in the two varieties, in which biochemical determinations were made regarding the enzymatic activity in the leaves, were compared with the non-fertilized variety – NF.

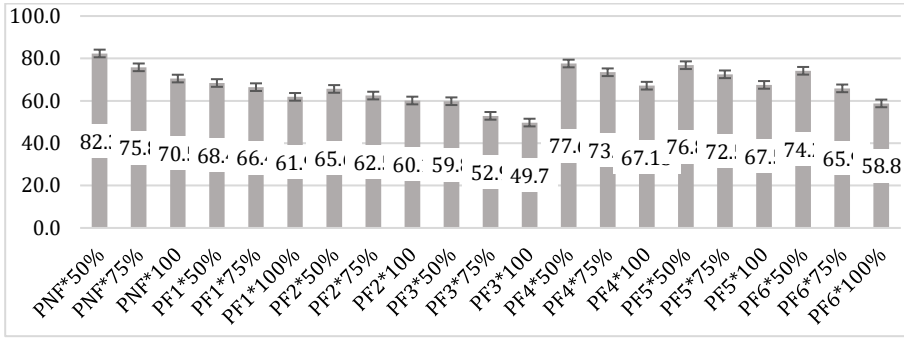

Fig. 3. The influence of the fertilization regime on the enzymatic activity in quinoa leaves (Puno) CAT(U/min/g) S.P

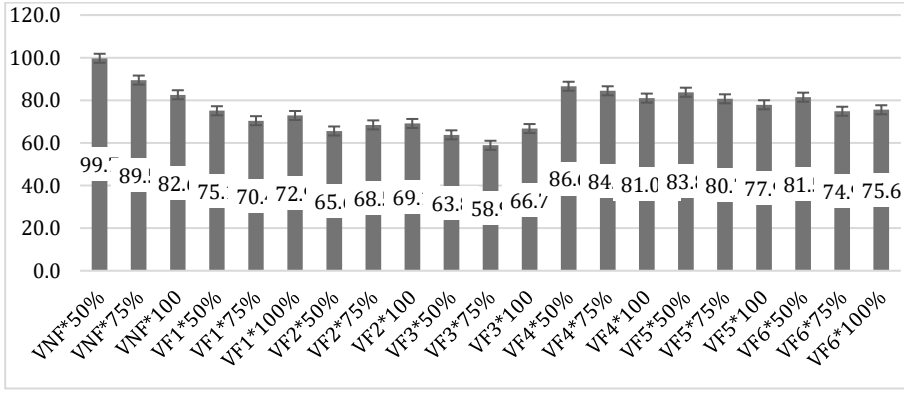

Fig. 4. The influence of the fertilization regime on the enzymatic activity in quinoa leaves (Vikinga), CAT(U/min/g) S.P.

Regarding the results of catalase activity (CAT), by comparing the results from the experimental variants with those from the control, the same trend was highlighted as in the case of APX. The lowest values of CAT activity were obtained in the biologically fertilized variant - F3, with 100% irrigation regime, for the cultivar Puno, the value being 49.7 U/g/min S.P. (Figure 3), and the highest values of CAT activity were noted in the F4 variant, with a 50% irrigation regime, in the case of the Vikinga cultivar, the value being 86.6 U/g/min S.P. (Figure 4).

As an observation, according to the graphs, we can say that the most obvious decreases in CAT activity were highlighted in the experimental variants to which Micoseed MB® was applied, in both cultivations.

Decreases in CAT activity compared to the non-fertilized variant were highlighted in all the experimental variants to which fertilizer was applied, with the irrigation regime above 50%.

In the case of the Puno cultivar, comparing the results obtained from the control variant, NF, with those from the variants fertilized with Micoseed MB® and KSC I®, an increase in the total content of assimilatory pigments is observed, along with the increase in the concentration of fertilizer in the substrate. In the Puno cultivar, the variants fertilized with Micoseed MB® presented a total content in chlorophyll pigments that varied between 2.29mg/g s.p. in the NF variant, irrigation regime of 50% and 4.01 mg/g s.p. in the version with the highest concentration of biofertilizer PF3, 100% irrigation regime (biofertilizer was administered in a concentration of 1500 g/m3 Micoseed MB® in the substrate). Also, the values register a slight increase in the chemically fertilized variants, KSC I®, directly proportional to the increase in the amounts of administered water (irrigation regime of 75% and 100%).

CONCLUSIONS

The most obvious decreases in CAT activity were highlighted in the biological experimental version - Micoseed MB®, in both cultivations.

By comparing the results, the greatest increases in APX activity were highlighted in the Vikinga variety, the non-fertilized-NF variant, with an irrigation regime of 50%. It can be seen that in drought conditions the APX values increase, while large amounts of water cause the enzymatic activity to decrease.

The result regarding all the factors shows that the specie is suitable for cultivation in protected areas.

REFERENCES

1. **Aebi H., 1984** - *Catalase in vitro*. Methods in Enzymology 105: 121-126. DOI: 10.1016/S0076-6879(84)05016-3.
2. **Asao M., Watanabe K., 2010** - *Functional and Bioactive Proprieties of Quinoa and Amaranth*. Food Science and Technology Research, 16 (2), 163-168.
3. **Bazile D., Jacobsen S.-E., Verniau A., 2016** - *The Global Expansion of Quinoa: Trends and Limits*. Frontiers in Plant Science, 7, 622, 1-6.
4. **Chen G.X., Asada K., 1989** - *Ascorbate peroxidase in pea leaves: occurrence of two isozymes and the differences in their enzymatic and molecular properties*. Plant and Cell Physiology 30: 987-998. doi: 10.1093/oxford journals.pcp.a077844.
5. **Esfandiari E, Shakiba MR, Mahboob SA, Alyari H, Shahabivand S., 2008** - *The effect of water stress on the antioxidant content, protective enzyme activities, proline content and lipid peroxidation in wheat seedling*. Pak J Biol Sci. 2008; 11: 1916-1922
6. **FAO, 1992** - *Quinoa: an ancient crop to contribute to world food security*. Food Agriculture Organization United Nations.
7. **FAO, 2013** - *International year of quinoa*. http://www.fao.quinoa.org.(16.03.2022).

8. Mazoyer M., 2006 - *The histoy of the world agriculture*. Publishing house Monthly Review Press 630(9), 217-245.

9. Nayyar H, Gupta D., 2006 - *Differential sensitivity of C3 and C4 plants to water deficit stress: Association with oxidative stress and antioxidants*. Environ Exp Bot. 2006; 58: 106–113.

10. Peterson A., Jacobsen S.E., Bonifacio A., Murphy K., 2015 - *A Crossing Method for Quinoa*. Sustainability Journal, 7, (3), 3230-3243.

11. Seleiman M.F., Al-Suhaibani N., Ali N., Akmal M., Alotaibi M., Refay Y., Dindaroglu T., Abdul-Wajid H.H., Battaglia ML., 2021 - *Drought stress impacts on plants and different approaches to alleviate its adverse effects*. Plants. 10, 259.

12. Shahnaz F., Sahebali B., Saeedeh A.S. and Fariborz Z.N., , 2022 - *Effects of Biological Fertilizers on Some Physiological Traits of Sweet Basil under Water Deficit Stress*. Journal of Medicinal Plants and By-products.

13. Stoleru V., Jacobsen S.E., Vitanescu M., Jitareanu M., Butnariu M., Munteanu N., Stan T., Teliban G.C., Cojocaru A., Mihalache G., 2022 A - *Nutritional and antinutritional compounds in leaves of quinoa*. Food Bioscience, 45,101494.

14. Stoleru V., Vitanescu M., Teliban G.C., Cojocaru A., Vlase L., Gheldiu A.M., Mangalagiu I., Amariucai-Mantu D., Burdeucea M., Zheljazkov V., Rusu O.R., 2022 B - *Phytosterol and Polyphenol Contents and Quinoa Leave Yields Variation in Relationships to Variety, Density and Harvesting Date*. *Agronomy* 2022, 12(10), 2397.

IMPACT OF DIFFERENT CULTIVATION PRACTICES ON THE PERENNIAL WALL-ROCKET IN GREENHOUSES

IMPACTUL DIFERITELOR PRACTICI DE CULTIVARE ASUPRA RUCOLEI PERENE ÎN SOLAR

PRECUPEANU Cristina[1], RĂDEANU Georgiana[1], TELIBAN Gabriel-Ciprian[1], CARUSO Gianluca[2] and STOLERU Vasile[1]*

*Corresponding author e-mail: vasile.stoleru@iuls.ro

Abstract.
Evaluation of best practices for planting time, mulching and fertilization of perennial wall-rocket (Diplotaxis tenuifolia) in Romania is an important step in development of sustainable and efficient agriculture. In the context of the diversity of climatic and soil conditions in Romania, identifying the most appropriate agricultural techniques for this crop becomes essential to ensure both crop productivity and quality. By analysing the interaction between these agricultural practices, the study aimed to identify the most efficient methods for growing perennial wall-rocket under optimal conditions. Within it, we evaluated the behaviour of the variety, Bologna, under influence of three technological factors, in two experimental years (2022-2023): planting time (with three gradations: 28.03 = Epoch 1, 7.04 = Epoch 2 and 17.04 = Epoch 3), mulching (with three gradations: non mulching - NM, mulching with white polyethylene film - WLDPE, and mulching with black polyethylene film - BLDPE) and fertilization (with three gradations: unfertilized - NF, organic fertilized - O, and chemical fertilization - Ch). The experiment was conducted in an unheated plot, during the winter-summer cropping cycle, using a split-plot design with three replications. For the Epoch factor, the highest yield resulted from the first Epoch, 53.90 t ha^{-1}. For the mulching factor the highest yield resulted from WLDPE 55.91 t ha^{-1}. For the fertilization factor the highest yield was obtained from the organic fertilized, 55.67 t ha^{-1}.
Key words: Planting time, Mulching, Fertilization, Bologna.

Rezumat.
Evaluarea celor mai bune practici privind epoca de plantare, mulcirea și fertilizarea culturilor de rucola perenă (Diplotaxis tenuifolia) în România reprezintă un pas important în dezvoltarea unei agriculturi durabile și eficiente. În contextul diversității condițiilor climatice și pedologice din România, identificarea celor mai adecvate tehnici agricole pentru această cultură devine esențială pentru a asigura atât productivitatea, cât și calitatea culturii. Analizând interacțiunea dintre aceste practici

[1] „Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania
[2] University of Naples Federico II, Italy

agricole, studiul a urmărit să identifice cele mai eficiente metode de cultivare a rucolei perene în condiții optime. În cadrul acestuia, am evaluat comportamentul soiului Bologna sub influența a trei factori tehnologici, în doi ani experimentali (2022-2023): epoca de plantare (cu trei graduații: 28.03 = Epoca 1, 7.04 = Epoca 2 și 17. 04 = Epoca 3), mulcirea (cu trei graduații: nemulcit - NM, mulcirea cu folie de polietilenă albă - WLDPE și mulcirea cu folie de polietilenă neagră - BLDPE) și fertilizarea (cu trei graduații: nefertilizat - NF, fertilizat organic - O și fertilizat chimic - Ch). Experimentul a fost realizat într-o parcelă neîncălzită, în timpul ciclului de cultură iarnă-vară, folosind un plan de tip split-plot cu trei repetiții. Pentru factorul epocă, cea mai mare producție a fost obținută de prima epocă, 53,90 t/ha. Pentru factorul mulcire, cea mai mare producție a fost obținută de mulcirea cu folie albă, 55,91 t/ha. În ceea ce privește factorul fertilizare, cea mai mare producție a fost obținută de fertilizarea organică, 55,67 t/ha.

Cuvinte cheie: epoca de plantare, mulcire, fertilizare, bologna.

INTRODUCTION

In the last twenty years, as a result of the continuous growth of the global population, technological advances in horticultural systems for greenhouse vegetable production have been aimed at increasing production. These improvements focus on optimizing planting timing, climate control, irrigation and nutrient supply to increase productivity and ensure sustainability of food resources [Stoleru *et al.*, 2020].

Diplotaxis tenuifolia, commonly known as perennial wall-rocket, is a leafy vegetable belonging to the *Brassicaceae* family and is specific to the Mediterranean region. Recently, it has been cultivated from wild flora [Bonasia *et al.*, 2019]. Its popularity is increasing due to its unique flavour, attributed to isothiocyanates, and its wide range of beneficial compounds [Signore *et al.*, 2023]. In Romania, the study of perennial wall-rocket has only recently begun. Cultivating perennial wall-rocket contributes to more sustainable agriculture, as it requires less soil preparation and enhances soil structure over time, reducing soil erosion and the need for fertilizers. Additionally, consumption of perennial wall-rocket has risen due to its recognized nutritional benefits. The staggered crop production ensures a steady supply of fresh produce to the market, meeting consumer demand and providing farmers with a reliable income [Precupeanu *et al.*, 2024].

The planting time (Epoch) is a critical factor influencing the growth and development of perennial wall-rocket. In Romania, where the climate varies significantly from region to region, determining the optimal planting time is essential for adapting the crop to local conditions. By evaluating different planting periods, valuable information can be gathered to maximize yield, ensuring that plants benefit from the best conditions for germination and development in accordance with the climatic characteristics of the region.

Mulching is an essential agricultural practice for water management and weed control, especially given the specific soil conditions in Romania. Applying a

mulch layer helps conserve soil moisture, maintain optimal soil temperature, and prevent soil erosion. Additionally, mulching can improve soil structure, making it more conducive to the growth of perennial wall-rocket. Evaluating various mulch materials and application methodologies is necessary to determine the most effective techniques to meet the crop's specific needs in different parts of the country [Teliban *et al.*, 2020].

Fertilization plays an important role in maximizing the yield potential of perennial wall-rocket. In the context of Romanian agriculture, where soils can vary significantly across regions, it is crucial to establish fertilization regimes tailored to local specificities. In conclusion, evaluating best practices regarding planting time, mulching, and fertilization of perennial wall-rocket in Romania is vital for developing sustainable and efficient agriculture. This approach will not only help optimize production and crop quality but also contribute to the protection of natural resources and the adaptation of agricultural techniques to the diverse soil and climatic conditions in Romania.

MATERIAL AND METHOD

The Bologna cultivar, known for its excellent productivity and flavour, was sourced from Italy for study. The seedlings were produced at the Research Institute for Agriculture and Environment (ICAM) of the Agronomic University of Iași in a greenhouse equipped with advanced technology for climate, irrigation, and light control. Sowing was conducted in cellular pallets at a temperature of 18-20°C, with seedlings planted 10 days apart to adhere to the planting schedule. After 30 days, the seedlings were transplanted into a polytunnel [Hall *et al.*, 2012] located at the Horticultural Farm V. Adamachi, covering an area 5.6 meters wide and 22 meters long. The planting scheme consisted of three raised beds, each containing four rows of plants, with a spacing of 25 cm between plants per row, 20 cm between rows, and 15 cm from the edge of the bed, resulting in a density of 89,000 plants per hectare. At the time of planting, basal fertilization was performed using Italpollina and KSC, which were dissolved in water for uniform application. Black and white polyethylene mulch sheets were applied to the soil to protect the plants and create a microclimate conducive to growth. These mulch films significantly impacted light, which is essential for warming and promoting plant growth [Caruso *et al.*, 2018].

After planting, maintenance activities such as weed control, disease and pest treatments, and drip irrigation were implemented. Harvesting occurred four times during each growing season, with the first harvest taking place 30 days after planting, followed by three additional harvests at 30-day intervals. The leaves of perennial wall-rocket (*Diplotaxis tenuifolia*) were harvested by cutting them at a height of 3-5 cm above the cotyledons to protect the regenerating shoots [Schiattone *et al.*, 2018]. The leaves were harvested when they reached a size of 10-15 cm, as the smaller leaves had a more delicate flavour, while the larger ones became more pungent and bitter. After harvesting, the leaves were transported to the laboratory and stored in cold conditions to preserve their freshness for analysis. Nest mass, leaf number, leaf area, percent dry matter, water content, chlorophyll pigments and photosynthetic assimilation rate (A) were analysed at each harvest. Gas exchange parameters were measured with a portable photosynthesis system and chlorophyll content with a portable meter, CCM-200 plus. Leaf area index (LAI) was determined with a Li-3100 leaf area meter. Dry

matter was measured by dehydrating leaves at 70°C. Data were processed in Excel and compared by Duncan test (P = 0.05) using SPSS 26 software.

RESULTS

The results of the influence of grading on the productivity of the Bologna cultivar over the two years of the experiment indicate that the highest production was achieved in the first grading, with a clutch mass of 605.57 g, 651 leaves, and a leaf area of 10,515.44 cm². In contrast, the lowest production was recorded in the last sampling, with a mass of 561.32 g, 539 leaves, and a leaf area of 9,386.82 cm².

Mulching with white film yielded the best results, with a clutch mass of 628.14 g, 615 leaves, and a leaf area of 10,583.37 cm². Conversely, mulching with black film produced the lowest values, with a mass of 536.84 g and a leaf area of 9,372.37 cm². Organic fertilization had a positive impact, resulting in a crop mass of 625.48 g, 612 leaves, and a leaf area of 10,592.57 cm². The chemically fertilized variety had the highest number of leaves (613), while the non-fertilized variety exhibited the lowest values, with a mass of 528.08 g and a leaf area of 9,174.12 cm² (Table 1).

Table 1

Influence of staggering on yield parameters in the cultivar Bologna

Experimental version	Weight/nest (g)	No. of leaves/nest	LAI ($cm^2 \cdot cm^{-2}$)
PLANTING TIME			
Epoch I	605.57 ± 14.09 a	650.91 ± 14.55 a	10515.44 ± 208.92 a
Epoch II	595.18 ± 13.57 ab	604.18 ± 10.13 b	10318.74 ± 220.59 a
Epoch III	561.32 ± 4.44 b	538.59 ± 3.29 c	9386.82 ± 112.41 b
Signification	*	*	*
MULCH TYPE			
NM	597.09 ± 12.23 a	599.95 ± 4.97 ab	10265.25 ± 203.86 a
WLDPE	628.14 ± 14.36 a	614.07 ± 10.27 a	10583.37 ± 196.63 a
BLDPE	536.84 ± 2.56 b	579.65 ± 11.98 b	9372.37 ± 41.89 b
Signification	*	*	*
FERTILIZATION TYPE			
NF	528.08 ± 9.64 b	568.71 ± 15.02 b	9174.12 ± 144.23 b
O.	625.48 ± 7.23 a	611.98 ± 6.14 a	10592.57 ± 57.46 a
Ch.	608.51 ± 15.49 a	612.98 ± 8.63 a	10454.30 ± 188.72 a
Signification	*	*	*

NM=non-mulched, WLDPE=mulched with white polyethylene film, BLDPE=mulched with black polyethylene film, NF=non-fertilized, O=organically fertilized, Ch.=chemical fertilization. Values are means ± standard error from three independent replicates. One-way ANOVA procedure followed by Duncan test was used to assess statistical significance. Different lowercase letters (a-d) in the same line indicate statistically significant differences between perennial arugula groups at p≤ 0.05. a is the highest value among all values analysed.

During the two years of the experiment (2022-2023), the influence of staggering, mulching, and fertilization on the yield of the Bologna cultivar

demonstrated that the first staggering achieved the highest yield of 53.90 t/ha, while the last staggering resulted in the lowest yield of 49.96 t/ha (Figure 1). Mulching with white film produced the highest yield at 55.91 t/ha, whereas black mulch yielded only 47.78 t/ha. Organic fertilization resulted in the best yield of 55.67 t/ha, followed by chemical fertilization at 54.16 t/ha, while the unfertilized variant recorded the lowest yield of 47 t/ha.

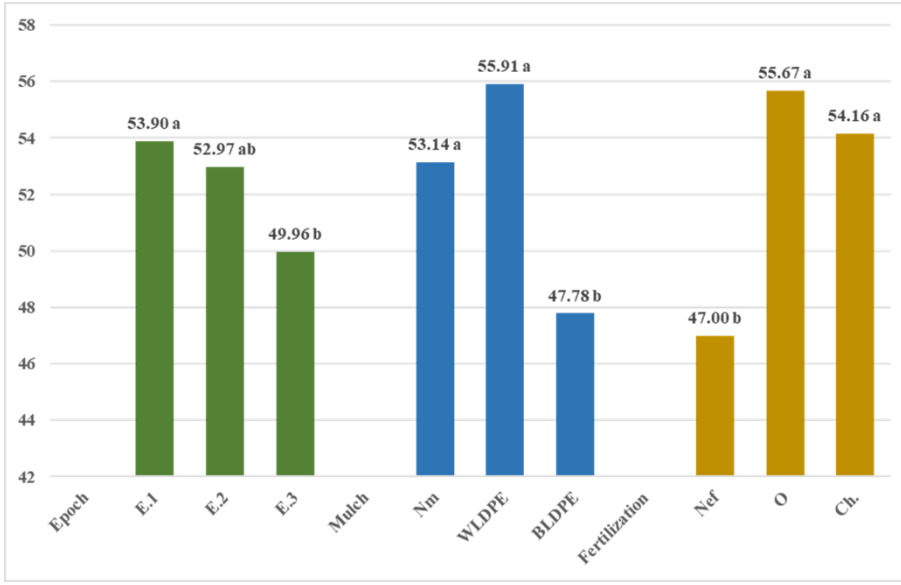

Fig. 1. Average yield over the two years for Bologna (t/ha)
(NM=non-mulched, WLDPE=mulched with white polyethylene film, BLDPE=mulched with black polyethylene film, NF=non-fertilized, O=organically fertilized, Ch.=chemical fertilization)

The results regarding the influence of sampling on the quality indices for the Bologna cultivar (2022-2023) indicate that the highest dry matter content (8.90%) and the lowest moisture content (91.11%) were recorded at the third sampling, while the first sampling exhibited the highest moisture content (91.86%) and the lowest dry matter content (8.14%). In terms of chlorophyll pigments, the first sampling had the highest content (18.32 CCI), while the last sampling recorded the lowest (16.67 CCI).

Mulching with black film resulted in the highest dry matter content (8.59%) and the lowest moisture content (91.41%), whereas mulching with white film yielded the highest chlorophyll pigment content (17.50 CCI) and the highest assimilation rate (13.52). Chemical fertilization produced the highest dry matter content (8.69%) and the lowest moisture content (91.31%), while organic fertilization resulted in the highest assimilation rate (13.06). The non-fertilized variant had the highest chlorophyll pigment content (17.66 CCI) but the lowest assimilation rate (11.86) (Table 2)

Table 2

Influence of mulching on quality parameters in Bologna cultivar

Experimental version	Dry matter (%)	Humidity (%)	Chlorophyll pigments (CCI)	A (μmol m^{-2} s^{-1})
PLANTING TIME				
Epoch I	8.14 ± 0.14 b	91.86 ± 0.14 a	18.32 ± 0.25 a	10.60 ± 0.10 b
Epoch II	8.19 ± 0.12 b	91.81 ± 0.12 a	17.00 ± 0.23 b	12.93 ± 0.19 a
Epoch III	8.90 ± 0.11 a	91.11 ± 0.11 b	16.67 ± 0.12 b	13.36 ± 0.07 a
Signification	*	*	ns	ns
MULCH TYPE				
NM	8.37 ± 0.10 a	91.63 ± 0.10 a	17.37 ± 0.25 a	12.14 ± 0.06 b
WLDPE	8.27 ± 0.16 a	91.73 ± 0.16 a	17.50 ± 0.08 a	13.52 ± 0.18 a
BLDPE	8.59 ± 0.11 a	91.41 ± 0.11 a	17.13 ± 0.18 a	11.22 ± 0.12 c
Signification	*	*	ns	*
FERTILIZATION TYPE				
NF	8.21 ± 0.12 b	91.79 ± 0.12 a	17.66 ± 0.14 a	11.86 ± 0.08 b
O.	8.33 ± 0.11 ab	91.67 ± 0.11 ab	17.36 ± 0.21 ab	13.06 ± 0.20 a
Ch.	8.69 ± 0.14 a	91.31 ± 0.14 b	16.98 ± 0.18 b	11.97 ± 0.07 b
Signification	*	*	*	*

NM=non-mulched, WLDPE=mulched with white polyethylene film, BLDPE=mulched with black polyethylene film, NF=non-fertilized, O=organically fertilized, Ch.=chemical fertilization. Values are means ± standard error from three independent replicates. One-way ANOVA procedure followed by Duncan test was used to assess statistical significance. Different lowercase letters (a-d) in the same line indicate statistically significant differences between perennial arugula groups at $p \leq 0.05$. a is the highest value among all values analysed.

CONCLUSIONS

Following the analysis of the results, it was found that the highest yields were recorded for the variety planted in the first epoch, with a yield of 53.90 t/ha, for the variety covered with white film at 55.90 t/ha, and for the organically fertilized variety at 55.67 t/ha. The results indicate that the cultivation practices applied significantly influence the perennial arugula crop. Therefore, depending on the crop's intended use, it is recommended to implement cultivation practices that positively impact the desired outcomes.

REFERENCES

1. **Bonasia A., Conversa G., Lazzizera C. & Elia A., 2019 -** *Post-harvest performance of ready-to-eat wild rocket salad as affected by growing period, soilless cultivation system and genotype*. Postharvest Biology and Technology, 156, 110909.
2. **Caruso G., Parrella G., Giorgini M., Nicoletti R., 2018 -** *Crop systems, quality and protection of Diplotaxis tenuifolia*. Agriculture, 8, 55.
3. **Hall M.K.D., Jobling J.J., Rogers G.S., 2012** - *Factors affecting growth of perennial wall rocket and annual garden rocket.* International Journal of Vegetable Science, 18, 393–411.
4. **Precupeanu C., Munteanu N., Caruso G., Rădeanu G., Teliban G.C., Cojocaru A., Stan T., Popa L.D., Stoleru V., 2024 -** *Preliminary studies on biology and harvest*

technology at Diplotaxis tenuifolia (L.) D.C. ISHS Acta Horticulturae, 1391, IX South-Eastern Europe Symposium on Vegetables and Potatoes.

5. **Schiattone M.I., Viggiani R., Di Venere D., Sergio L., Cantore V., Todorovic M., Perniola M., Candido V., 2018 -** *Impact of irrigation regime and nitrogen rate on yield, quality and water use efficiency of wild rocket under greenhouse conditions*. Scientia Horticulturae, 229, 182–192.
6. **Signore A., Amoruso F., Gallegos-Cedillo V.M., Gómez P.A., Ochoa J., Egea-Gilabert C., Costa-Pérez A., Domínguez-Perles R., Moreno D.A., Pascual J.A. & Fernández J.A., 2023 -** *Agro-industrial compost in soilless cultivation modulates the vitamin C content and phytochemical markers of plant stress in rocket salad (Diplotaxis tenuifolia (L.) D.C.)*. Agronomy, 13, 544.
7. **Stoleru V., Burlica R., Mihalache G., Dîrlău D., Pădureanu S., Teliban G. C., Astanei D., Cojocaru A., Beniuga O. & Patraș, A., 2020 -** *Plant growth promotion effect of plasma activated water on Lactuca sativa L. cultivated in two different volumes of substrate*. Scientific Reports, 10, 20920.
8. **Teliban G.C., Caruso G., Munteanu N., Cojocaru A., Popa L.D., Stoleru V., 2020 -** *Greenhouse perennial wall-rocket crop as influenced by mulching and fertilization practices*. Scientific Papers. Series B, Horticulture, 64(1).

THE EFFECT OF THREE TECHNOLOGICAL FACTORS ON SOME QUANTITATIVE INDICES OF *PHASEOLUS COCCINEUS*

EFECTUL INTERACȚIUNII A TREI FACTORI TEHNOLOGICI ASUPRA UNOR INDICI CANTITATIVI ȘI CALITATIVI LA *PHASEOLUS COCCINEUS*

RĂDEANU Georgiana [1], PRECUPEANU Cristina [1], TELIBAN Gabriel [1], COJOCARU Alexandru [1], STOLERU Vasile [1]*

*Corresponding author e-mail: vasile.stoleru@iuls.com

Abstract.
The species Phaseolus coccineus has multiple uses, in food, its nutritional characteristics being similar to those of P. vulgaris, but the size of the grain advantage it among consumers, but, also as an ornamental plant, being used in landscape compositions for its lush foliage and impressive size of the flower racemes. In Romania, there are a large number of local populations of this species, without any cultivar being released. Thus, the aim of this study is to evaluate the interaction of three technological factors on some quantitative and qualitative traits in runner beans. In 2022, a trifactorial experiment was set up in the teaching field of the vegetable growing discipline, to analyzing the interaction of two support systems, (pyramid and trellis), with three local populations (Cozia 1, Cozia 2, and Cozia 3), with three types of fertilization (unfertilized, organic fertilizer, and chemically fertilized). Following data collection, the results were statistically analyzed, the means being expressed as the interaction of two experimental factors. For the characters Mass of beans/nest, average number of pods/nest, and average number of beans/pod, the Pyramid x Cozia 3 variant stood out, for the mass of grains/hectare the Trellis x Cozia 2 variant obtained 5.7 t/ha, and the highest result for MMB, was obtained by the Cozia 1 x Chemical variant.
Key words: runner bean, support system, fertilization, yield

Rezumat
Specia Phaseolus coccineus are multiple utilizări, în alimentație, caracteristicile sale nutriționale fiind asemănătoare cu cele ale P. vulgaris, dar mărimea bobului o avantajează în rândul consumatorilor, dar și ca plantă ornamentală, fiind folosită în compoziții peisagistice pentru frunzișul luxuriant și mărimea impresionantă a racemelor florale. În România, există un număr mare de populații locale ale acestei specii, fără a fi omologat vreun cultivar. Astfel, scopul acestui studiu este de a evalua interacțiunea a trei factori tehnologici asupra unor caractere cantitative și calitative la fasolea mare. În anul 2022, a fost înființat un

[1] „Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania

experiment trifactorial în câmpul didactic al disciplinei legumicultură, pentru analizarea interacțiunii a două sisteme de susținere, (piramidă și spalier), cu trei populații locale (Cozia 1, Cozia 2 și Cozia 3), cu trei tipuri de fertilizare (nefertilizat, fertilizat organic și fertilizat chimic). În urma colectării datelor, rezultatele au fost analizate statistic, mediile fiind exprimate ca interacțiune a doi factori experimentali. Pentru caracterele Masa de boabe/cuib, numărul mediu de păstăi/cuib și numărul mediu de boabe/cuib, s-a evidențiat varianta Piramidă x Cozia 3, pentru masa de boabe/hectar varianta Trellis x Cozia 2 a obținut 5,7 t/ha, iar cel mai mare rezultat pentru MMB, a fost obținut de varianta Cozia 1 x Chimic.
Cuvinte cheie: fasole mare, sistem de susținere, fertilizare, randament

INTRODUCTION

The species *Phaseolus coccineus* has multiple uses, as food, its nutritional characteristics being similar to those of *P. vulgaris*, [Teliban, 2015] but the size of the grain gives it an advantage among consumers [Labuda, 2010; Munteanu et al., 2007], as an ornamental plant, being used in landscape compositions for its habits and leaves and impressive size of the floral racemes [Popa, 2010; Hamburda and Munteanu, 2016].

Large bean cultivars respond positively to chemical and organic fertilization but also to abundant irrigation [Stan et al., 2003].

In Romania, there are a large number of local populations of this species, without any cultivar being released [Giurca, 2009; Popa, 2010; Brezeanu et al., 2018]. The most important risk factors are atmospheric and soil drought under critical plant development phases and climatic accidents. Thus, the aim of this study was to evaluate the interaction of three technological factors on some quantitative and qualitative traits in field bean.

MATERIAL AND METHOD

In the year 2022, a trifactorial experiment with three replications was set up in the teaching field of the subject of vegetable growing, to analyze the interaction of two support systems (pyramid and row), with three local populations (Cozia 1, Cozia 2 and Cozia 3), with three types of fertilization (unfertilized, organic and chemically fertilized). During the growing period, specific technological works were applied and at the end of the growing period the following parameters were analyzed: average mass of grains/pod, average mass of grains/ha, mass of a thousand grains, number of pods/pod, number of grains in the pods. Following the data collection, the results were statistically analyzed using Duncan test, at $p \leq 0.05$, the means being expressed as the interaction of two experimental factors ± standard error.

RESULTS AND DISCUSSIONS

The results obtained regarding the main productivity elements and the physiological characterization of the interaction of fertilization with support systems (Table 1) highlight statistically significant results for all analyzed indicators, such that the highest mass of grains/nest was obtained by the Pyramid x

Organic variant, of 263.33 g/nest, while the Trellis x Chemical variant obtained the highest results for the mass of grains/ha, of 5605.33 kg/ha. This variant also obtained the highest mass of 1000 grains, respectively 1754.67 g.

Table 1

Results on the productivity elements of the interaction between support systems and fertilization

Variant	Beans weight/ nest (g)	Beans mass/ha (kg)	MMB (g)
Pyramid x Unfertilized	238.33 ± 2.19 bc	2974.00 ± 28.10 c	1659.67 ± 17.84 ab
Pyramid x Organic	***263.33 ± 1.20 a***	3286.33 ± 16.13 c	1571.33 ± 7.31 b
Pyramid x Chemic	253.33 ± 1.45 ab	3162.00 ± 20.55 c	1619.67 ± 11.89 ab
Trellis x Unfertilized	196.67 ± 4.26 e	4921.00 ± 108.21 b	1651.33 ± 80.14 ab
Trellis x Organic	213.00 ± 10.79 de	5316.67 ± 267.91 ab	1716.33 ± 64.99 ab
Trellis x Chemic	224.00 ± 8.33 cd	***5605.33 ± 210.19 a***	***1754.67 ± 60.00 a***

The results obtained regarding the interaction of fertilization with support systems, on the quality indicators of runner beans (Table 2) obtained significant differences mostly between the support systems. Regarding the average number of pods/nest, the Pyramid x Chemical variant achieved the highest results, 77 pods/nest. This character can positively correlate with the average number of grains/pod, respectively 2.49 grains/pod, the same result was also achieved by the Pyramid x Organic variant.

Table 2

Results on the interaction of support systems with fertilization on quality indicators

Variant	No. pods/nest environment	No. medium beans/pod
Pyramid x Unfertilized	72.00 ± 0.00 a-c	2.45 ± 0.01 a
Pyramid x Organic	76.00 ± 1.00 ab	***2.49 ± 0.02 a***
Pyramid x Chemic	***77.00 ± 0.58 a***	***2.49 ± 0.02 a***
Trellis x Unfertilized	64.33 ± 2.19 c	2.24 ± 0.04 b
Trellis x Organic	66.00 ± 5.13 bc	2.30 ± 0.06 b
Trellis x Chemic	70.00 ± 5.03 a-c	2.26 ± 0.07 b

Regarding the analysis of the results obtained regarding the main productivity elements and the physiological characterization of the interaction of fertilization with local populations (Table 3) we can observe that the data obtained are statistically significant. The mass of grains/nest and the mass of grains/ha are positively correlated in this case, and obtained the highest results in the Cozia 3 x Chemical variant, of 251.33 g/nest, respectively 4636.33 kg/ha.

The mass of a thousand grains obtained the highest results in the Cozia 1 x Chemical variant, 1791.67 g. We can conclude that the productivity traits obtained

the best results in the case of chemical fertilization, depending on the population taken into study.

Table 3

Results on the interaction of local populations with fertilization on key productivity factors

Variant	Beans mass/nest (g)	Beans mass/ha (kg)	MMB (g)
Cozia 1 x Unfertilized	212.33 ± 8.57 cd	3775.00 ± 180.29 b	1708.67 ± 88.08 a-c
Cozia 1 x Organic	229.67 ± 3.38 a-d	4126.67 ± 77.82 ab	1745.33 ± 80.74 ab
Cozia 1 x Chemic	219.00 ± 8.33 b-d	4005.67 ± 204.72 ab	***1791.67 ± 48.27 a***
Cozia 2 x Unfertilized	207.67 ± 10.33 d	3936.33 ± 214.43 ab	1667.33 ± 12.02 abc
Cozia 2 x Organic	243.00 ± 11.59 ab	4549.33 ± 278.36 a	1609.00 ± 12.53 bc
Cozia 2 x Chemic	246.33 ± 5.04 ab	4509.33 ± 115.93 a	1687.33 ± 26.69 a-c
Cozia 3 x Unfertilized	232.67 ± 3.28 a-d	4131.00 ± 56.67 ab	1591.00 ± 12.86 c
Cozia 3 x Organic	241.00 ± 14.64 a-c	4228.67 ± 376.53 ab	1577.33 ± 21.54 c
Cozia 3 x Chemic	***251.33 ± 9.96 a***	***4636.33 ± 222.64 a***	1582.00 ± 22.55 c

From the analysis of the results regarding the interaction of fertilization with local populations, on the quality indicators of runner beans (Table 4) we can observe that the data are statistically significant for all the analyzed traits. The highest average number of pods/nest was determined by the Cozia 3 x Chemical variant, 81 pods/nest, the average number of grains in pods was obtained by the Cozia 3 x Unfertilized variant, 2.43 grains/pod.

Table 4

Results on the interaction of local populations with fertilization on quality indicators

Variant	No. pods/nest	No. of beans/pod
Cozia 1 x Unfertilized	65.67 ± 0.67 cd	2.33 ± 0.04 ab
Cozia 1 x Organic	62.33 ± 1.45 d	2.42 ± 0.02 a
Cozia 1 x Chemic	63.33 ± 4.18 d	2.41 ± 0.04 a
Cozia 2 x Unfertilized	67.00 ± 4.04 b-d	2.27 ± 0.03 b
Cozia 2 x Organic	75.67 ± 3.93 a-c	2.39 ± 0.04 ab
Cozia 2 x Chemic	77.00 ± 1.00 ab	2.39 ± 0.04 ab
Cozia 3 x Unfertilized	72.00 ± 1.00 a-d	***2.43 ± 0.03 a***
Cozia 3 x Organic	75.33 ± 5.04 a-c	2.38 ± 0.04 ab
Cozia 3 x Chemic	***81.00 ± 3.61 a***	2.34 ± 0.04 ab

The results obtained regarding the main productivity elements and the physiological characterization of the interaction of the support system with local populations (Table 5) highlight the variant Pyramid x Cozia 3 as having the best results for the mass of grains/nest, 273 g. Regarding the mass of grains/ha, the

variant Trellis x Cozia 2 obtained the highest value, 5712.33 kg/ha. The highest value for MMB, 1780.33 g was found in the variant Trellis x Cozia 1.

Table 5

Results on the main productivity elements of the interaction of the support system with local populations

Variant	Beans mass/nest (g)	Beans mass/ha (kg)	MMB (g)
Pyramid x Cozia 1	245.67 ± 1.86 b	3062.67 ± 24.77 c	1717.00 ± 13.32 ab
Pyramid x Cozia 2	236.67 ± 4.18 b	2951.33 ± 52.45 c	1592.67 ± 30.86 ab
Pyramid x Cozia 3	***273.00 ± 2.08 a***	3408.33 ± 24.44 c	1540.67 ± 10.04 b
Trellis x Cozia 1	194.67 ± 3.67 d	4875.67 ± 90.67 b	***1780.33 ± 125.69 a***
Trellis x Cozia 2	228.67 ± 6.33 bc	***5712.33 ± 159.17 a***	1715.67 ± 64.89 ab
Trellis x Cozia 3	210.00 ± 14.57 cd	5255.67 ± 365.09 ab	1625.67 ± 13.35 ab

The interaction of the support system with local populations on the quality indicators of runner beans (Table 6) obtained statistically significant results, thus the average number of pods/nest correlates positively with the average number of grains/pod, the highest values being obtained by the Pyramid x Cozia 3 variant, 82.33 g/nest and 2.51 grains/pod. The highest percentage of grains was also obtained by the pyramid type system, combined with the Cozia 2 population, 79.29% grains, while the trellis type system combined with the Cozia 3 population obtained the highest percentage of pods, 24.59%.

Table 6

Results on the interaction of the support system with local populations on quality indicators

Variant	No. pods/nest environment	No. medium beans/pod
Pyramid x Cozia 1	67.67 ± 0.33 bc	2.48 ± 0.02 a
Pyramid x Cozia 2	75.00 ± 1.15 ab	2.45 ± 0.01 a
Pyramid x Cozia 3	***82.33 ± 0.33 a***	***2.51 ± 0.01 a***
Trellis x Cozia 1	59.67 ± 3.38 c	2.30 ± 0.04 b
Trellis x Cozia 2	71.00 ± 3.21 b	2.24 ± 0.05 b
Trellis x Cozia 3	69.67 ± 4.67 b	2.26 ± 0.06 b

CONCLUSIONS

Analyzing bean production per hectare, we note that the best results were obtained through the following interactions:

In the case of combining the support system with fertilization, the Trellis x Chemic variant offered a production of 5.6 t/ha, being the most efficient.

When the interaction between the local population and fertilization type was analyzed, Cozia 3 x Chemic generated the best result, with 4.6 t/ha.

Regarding the combination of the support system and local population, the Trellis x Cozia 2 variant was the most productive, reaching 5.7 t/ha.

These data highlight the importance of optimizing these factors to maximize agricultural production.

REFERENCES

1. **Brezeanu C., Ambarus S., Brezeanu P.M., Antal C. A., 2018** - *Study of Phaseolus coccineus biodiversity in order to select valuable germoplasm.* Sudii și cercetări științifice – seria Biologie, Universitatea "Vasile Alecsandri" Bacău vol. 27(1).
2. **Giurca D.M., 2009 -** *Morphological and phenological differences between the two species of the Phaseolus genus (Phaseolus vulgaris and Phaseolus coccineus)***.** Cercetări Agronomice în Moldova, vol. 42(2).
3. **Hamburda S.B., Munteanu N., 2016** - *Tehnologia de cultivare a fasolei mari* (*Phaseolus coccineus*). Editura Performantica, Iași.
4. **Labuda H., 2010** - *Runner bean (Phaseolus coccineus L.) - Biology and use.* Acta Scientiarum Polonorum Hortorum Cultus, vol. 9(3), 117–132.
5. **Munteanu N., Popa L.D., Stoleru V., 2007** - *On the agrobiological value of some local population of runner bean.* Lucrări ştiinţifice, seria Horticultură, vol.50, USAMV Iaşi.
6. **Popa L.D., 2010** - *Cercetări privind agrobiologia speciei Phaseolus coccineus L. în vederea optimizării cultivării.* Teză de doctorat, USAMV Iași.
7. **Stan N., Munteanu N., Stan T., 2003** - *Legumicultură, vol. III.* Editura „Ion Ionescu de la Brad", Iaşi.
8. **Teliban G.C., 2015** - *Evaluarea posibilităților de cultivare a fasolei mari (Phaseolus coccineus L.), în sistemul de culturi legumicole protejate*. Raport postdoctoral, USAMV Iaşi.
9. **Tofan C., 2001** – *Igiena şi securitatea produselor alimentare*. Editura AGIR, Bucuresti, p. 56.

PRELIMINARY RESULTS ON GROWING EARLY CABBAGE IN ORGANIC SYSTEM

REZULTATE PRELIMINARII PRIVIND CULTURA VERZEI TIMPURII ÎN SISTEM ECOLOGIC

ZAHARIA (ROGOJINĂ) Mihaela[1], STOLERU Carmen-Maria[2], TĂNASE Beatrice[1], STOLERU Vasile[1]*

*Corresponding author e-mail: vasile.stoleru@iuls.ro

Abstract.
Cabbage is one of the most important vegetable crops in the world for its resilience. Cabbage crops require soils with a pH between 6 and 7.5. If necessary, amendments are used to correct soil acidity. Organic and inorganic fertilizers provide nutrients available to cabbage plants for proper vegetative growth. It has been found that nitrates accumulate predominantly in the outer leaves rather than in the head. The method of obtaining the biostimulant has different effects on nitrate content. Thus, in most cases, biostimulants obtained through mechanical homogenization decreased the nitrate content in the leaves but increased the nitrate content in the head; biostimulants obtained using ultrasound had the opposite effect, namely increasing nitrate content in the leaves but decreasing it in the head. The results obtained regarding the influence of herbal biostimulants on the content of microelements and macroelements will be presented.
Key words: early cabbage, nutrients, cultivars.

Rezumat.
Cultura de varză este una dintre cele mai importante culturi legumicole la nivel mondial, datorită rezilienței ridicate. Cultura de varză necesită soluri cu pH cuprins între 6 și 7,5. Dacă este necesar, se folosesc amendamente pentru corecția acidității solului. Îngrășămintele organice și cele anorganice furnizează nutrienți disponibili pentru plantele de varză pentru o creștere vegetativă adecvată. S-a constatat că nitrații s-au acumulat preponderent în frunzele exterioare decât în căpățână. Modul de obținere a biostimulantului are efecte diferite asupra conținutului de nitrați. Astfel, în majoritatea cazurilor, biostimulanții obținuți prin omogenizare mecanică au scăzut conținutul de nitrați în frunze, dar au crescut conținutul de nitrați în căpățână; biostimulanții obținuți cu ajutorul ultrasunetelor au avut un efect opus, adică au crescut conținutul de nitrați în frunze, dar au scăzut conținutul de nitrați în căpățână. Se vor prezenta rezultatele obținute privind influența utilizării unor biostimulanți pe bază de plante asupra conținutului de microelemente și macroelemente.
Cuvinte cheie: varza timpurie, nutrienți, cultivare.

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania
[2] "Virgil Madgearu" Economic College Iasi, Romania

INTRODUCTION

Cabbage is one of the important vegetables, being cultivated worldwide. It is part of the Cruciferae family, which also includes, among others, broccoli, cauliflower, and Brussels sprouts. It can be consumed raw, cooked, or pickled. Over time, it has been used both as food and for therapeutic purposes (in rural areas, even today, poultices made from cabbage leaves are used for wounds or minor burns) [Ștefan and Ona, 2020].

The food value of cabbage can be evaluated by nutritional value and sensory quality. Innocuousness is the absence or presence within safe limits of harmful substances and contaminants for humans [Goran, 2014]. This is one of the qualitative components of cabbage.

Nutritive value can be assessed by the amount of nutrients present that ensure the proper functioning of metabolic processes in the body. It depends on the variety or hybrid, the way of cultivation, the season and the elements in the cultivation technology [Dobrotă, 2010].

Mineral nutrition in plants involves the physiological process of mineral substance absorption from the environment for the synthesis of complex organic substances essential for proper developmental processes within the plant organism [Jităreanu and Marta, 2019]. If a necessary chemical element is lacking or insufficient in plant nutrition, physiological diseases occur, with multiple symptomatic manifestations. An excess of one or more elements can become toxic to the plant, while inadequate amounts lead to deficiency symptoms.

The nutrients necessary for the growth and development of cabbage plants are mostly found in the soil. The supply of nutrients to plants is closely related to their presence in the soil, soil temperature, moisture, photosynthesis, respiration, and soil pH. The degree of solubilization and dissociation of these nutrients into forms that can be absorbed by plants is crucial.

Soil fertilization is carried out to ensure that the necessary quantities of nutrients are present in the soil; this fertilization can be carried out with synthetic chemicals (in intensive farming) or with chemicals obtained from natural fertilizers (in organic farming).

It has been confirmed that the exclusive and unbalanced use of mineral fertilizers continuously leads to a decrease in the efficiency of nutrient absorption by plants, resulting in either stagnation of production or reduction of yield [Negi *et al.*, 2017]. At the same time, prolonged use of intensive agriculture makes the transition to organic farming much more difficult and takes a longer period of time. Thus, even five years after conversion, residues of organochlorine pesticides (OCP) have been detected in soil samples [Stoleru *et al.*, 2016].

Biofertilizers offer an economically advantageous and environmentally sustainable alternative for reducing external inputs and improving both the quality and quantity of vegetable production. They contain microorganisms capable of mobilizing nutrients, transforming them from an inaccessible form into an available form through various biological processes [Negi *et al.*, 2017].

For a food product to be considered safe, it is necessary to understand the risk factors throughout the entire technological chain, from raw materials to the final product. These risk factors can be internal or external, and their identification helps minimize negative effects on product quality and, consequently, on human health [Rusu *et al.*, 2025].

All agricultural crops, including cabbage crops, are constantly subjected to pest attacks. Various experiments have concluded that there is a close relationship between the cultivar and pest control methods [Stoleru *et al.*, 2012].

Cabbage crops require soils with a pH between 6 and 7.5. In practice, not all soils meet this condition. In such cases, soil amendments are used to correct soil acidity, one of which is biochar. Biochar can be produced through the slow pyrolysis of biomass residues.

Applying biochar on marginal agricultural soils enhances soil quality, positively influences plant growth and production, and minimizes biomass residues. Due to its porous structure, biochar possesses a significant capacity for water absorption and retention in the soil.

Biochar can enhance soil structure, increase porosity, elevate pH value, improve water holding capacity (WHC), boost cation exchange capacity (CEC), enhance nutrient retention capacity, and increase organic carbon concentration, available phosphorus concentration, and total carbon and nitrogen. Additionally, it contributes to a reduction in soil bulk density (BD), nutrient loss, and heavy metal bioavailability. Furthermore, it can inhibit pathogens in the soil and promote the growth and activity of beneficial microbial populations, as well as increase the activity of soil enzymes.

These positive effects of biochar on soil physico-chemical and biological properties increase nutrient availability to plants, which generally leads to improved crop performance. Several studies have shown that biochar applied in combination with inorganic or organic fertilizers improved soil fertility and plant performance. Increased soil fertility results in reduced fertilizer input as well as higher crop productivity and therefore additional CO_2 consumption, leading to agronomic, environmental and economic benefits.

The effects of biochar on the soil-plant system are influenced by several factors, including the physico-chemical properties and dosage of biochar, the type and dosage of fertilizer, plant species, soil characteristics, and climate conditions. The physicochemical properties of biochar are determined by the type and pre-treatment of the raw material, as well as the pyrolysis conditions and post-pyrolytic treatments. Biochar produced at higher temperatures typically exhibits greater alkalinity, higher water holding capacity, increased fixed carbon and ash concentrations, enhanced aromaticity, fewer surface functional groups, and lower cation exchange capacity compared to biochar produced at lower temperatures. The agronomic benefits of biochar amendment are most pronounced in sandy soils, followed by sandy-clay soils, and subsequently in saline soils, with a greater impact observed in acidic soils as opposed to neutral and alkaline soils.

The extremely slow decomposition of the biochar itself is favourable to humus formation and contributes to the improvement of soil fertility through long-term action. Additionally, biochar can alter the form of toxic elements, reduce pollution during plant growth, promote the absorption of nutrients, and stimulate plant growth [Calcan *et al.*, 2022].

It should be noted that, although they belong to the same species, different cabbage varieties have different phytochemical composition; for this purpose, white cabbage (*Brassica oleraceae* var. *capitata* f. *alba*), red cabbage (*Brassica oleraceae* var. *capitata* f. *rubra*), conical cabbage (*Brassica oleraceae* var. *capitata* f. *acuta*) and Savoy cabbage (*Brassica oleraceae* var. *capitata* f. *sabauda*) were compared. Red cabbage is an important source of phenolic compounds (especially anthocyanins), while white cabbage has the highest concentration of glucosinolates. Conical cabbage contains both glucosinolates and has a more consistent phytochemical composition [Statilko *et al.*, 2024].

Several plants from the *Brassicaceae* family were analyzed to compare the concentration of phenolic compounds, glucosinolates, proteins, sugars and vitamin C, as well as their antioxidant potential. The studied plants included kohlrabi (*Brassica oleracea* var. *acephala gongylodes*), Savoy cabbage (*B. oleracea sabauda*), Brussels sprouts (*B. oleracea gemmifera*), cauliflower (*B. oleracea botrytis*), radish (*Raphanus sativus*), and garden cress (*Lepidium sativum*).

The study found that kohlrabi had the highest concentration of phenolic compounds, while Savoy cabbage and Brussels sprouts exhibited the highest levels of glucosinolates. Garden cress had the lowest content of soluble sugars. The protein content showed insignificant variation among the studied plants, while radish had the highest vitamin C content. Additionally, plants from the *Brassica* genus demonstrated significantly higher antioxidant capacity than radish and garden cress [Šola *et al.*, 2024].

MATERIAL AND METHOD

A single variety of cabbage was cultivated in sandy loam soil with a pH of 7.4, characterized by low levels of organic carbon, nitrogen, and potassium, and high phosphorus content. The distance between transplanted seedlings was 45x45 cm. The nutrient rates were noted as S_1 (recommended rate of NPK 120-60-60 kg/ha), S_2 (20 t/ha of manure) and S_3 (half the recommended rate of NPK 120-60-60-60 kg/ha + 10 t/ha of manure). These nutrition prescriptions were associated with the use of a biofertilizer (phosphate-solubilizing bacteria), denoted B_0 (without biofertilizer application) and B_1 (with biofertilizer application).

The three nutritional treatments were applied three times, while the biofertilizer was applied only once, at the time of transplanting.

Data were collected on the morphological characteristics of the cabbage plants, including plant height, head weight, and head diameter, as well as the productive potential, evaluated in terms of production per hectare.

RESULTS AND DISCUSSIONS

The following results were obtained.

a. Plant height

Plant height was measured at 30, 45 and 60 days after transplanting and the results obtained are presented in Table 1.

Table 1

The effect of different nutritional treatments on cabbage plant height

Days after transplanting	Biofertilizer application	Nutrition treatments		
		S_1	S_2	S_3
30	B_0	15.33	14.90	15.87
	B_1	15.80	15.33	16.40
45	B_0	25.20	26.87	29.27
	B_1	27.16	28.67	30.00
60	B_0	30.00	31.80	36.53
	B_1	33.40	37.27	37.20

The best response in terms of cabbage plant height was observed with the combined nutrition of NPK fertilizer and manure (S_3 treatment). Although initially, the NPK fertilizer treatment (S_1) promoted plant growth, it ultimately proved to be the least beneficial. The application of a biofertilizer had a positive effect on plant height during all growth stages, with the strongest effect occurring during the head development phase. These results are graphically represented in Figure 1.

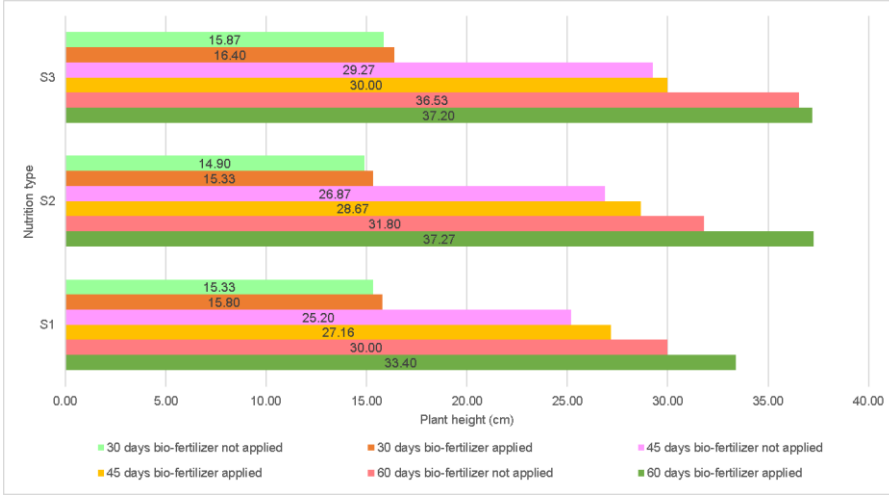

Fig. 1. Graphical representation of nutrition results on cabbage plant height

b. Head diameter

The results regarding the effect of nutrition on the diameter of cabbage heads are presented in Table 2.

Table 2

Effect of nutritional treatments on the diameter of cabbage heads

	Biofertilizer application	Nutrition treatments		
		S_1	S_2	S_3
Head diameter (mm)	B_0	152.40	131.33	175.80
	B_1	170.70	141.00	189.43

There are quite large differences in head size depending on the nutritional treatment. Once again, the largest heads were obtained with the combined nutrition of NPK fertilizer and manure (S_3 treatment). The application of a biofertilizer had a positive effect on head size, with heads being up to 12% larger (S_1 treatment).

These results are graphically presented in Figure 2.

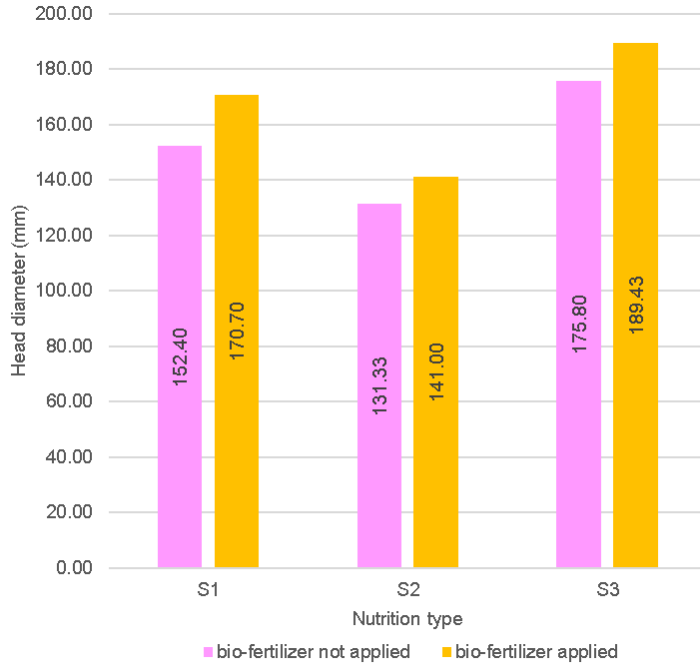

Fig. 2. Graphical representation of the results regarding the effect of nutrition on cabbage head diameter

c. Head weight and cabbage yield

The results obtained on the effect of nutrition on head weight and cabbage yield are presented in Table 3.

Table 3

Effect of nutritional treatments on cabbage head weight and yield

	Biofertilizer application	Nutrition treatments		
		S_1	S_2	S_3
Head weight (g)	B_0	2260.67	2438.33	2407.33
	B_1	2389.67	2511.67	2716.33
Yield (kg/Ha)	B_0	34,293	41,397	46,480
	B_1	37,551	44,173	54,330

It is observed that the nutrition formulas have resulted in obtaining heavier heads and higher yields when combined with biofertilizer, compared to when they were applied alone.

Graphically, these results are presented in Figure 3.

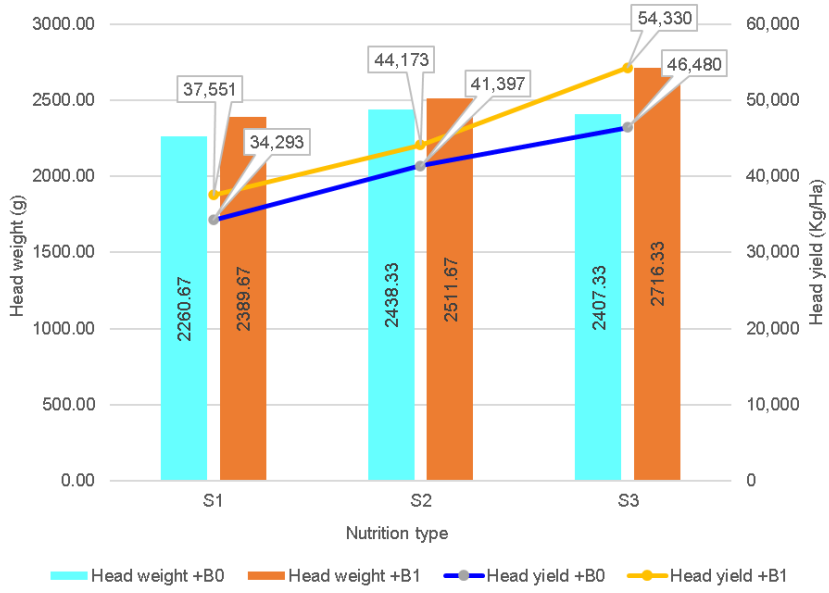

Fig. 3. Graphical representation of the results regarding the effect of nutrition on cabbage head weight and yield

Cabbage crops require fertile soil and their development is influenced by the soil profile. Hard layers, clay layers, and compacted soil generally restrict root growth. This, in turn, leads to reduced nutrient and water absorption, ultimately limiting plant growth and yield (Hossain et al., 2015).

CONCLUSIONS

The good results were achieved using the S_3 recipe, which comprised half of the recommended NPK dose of 120-60-60 kg/ha combined with 10 t/ha of manure.

This result can be attributed to the synergistic effects of organic and inorganic fertilizers, which supplied essential nutrients to the cabbage plants, facilitating adequate vegetative growth. Additionally, the introduction of biofertilizers, specifically phosphate solubilizing bacteria, enhanced phosphorus availability to the plants. The application of manure improved water holding capacity, micronutrient supply, and the availability of primary nutrients, thereby creating favourable soil conditions. These beneficial effects of manure have also been observed in broccoli crops (Mal et al., 2015).

REFERENCES

1. **Calcan S.I., Pârvulescu O.C., Ion V.A., Răducanu C.E.; Bădulescu L., Madjar R., Dobre T., Egri D.; Moț A., Iliescu L.M., Jerca I.O., 2022** - *Effects of biochar on soil properties and tomato growth*. Agronomy 12(8), 1824.
2. **Hossain, M.F., Farhana, T., Raihan, M.Z., Hasan, M.S., Mia, M.M., & Rahman, M.M., 2015** - *Effect of different fertilization practices on the growth and yield of cabbage*. Asian Journal of Medical and Biological Research, 1(2), 182–186. https://doi.org/10.3329/ajmbr.v1i2.25610
3. **Jităreanu C.D., Marta A.E., 2019** - *Fiziologia plantelor*, Ed. Ion Ionescu de la Brad, Iași.
4. **Mal D., Chatterjee R., Nimbalkar K.H., 2015** - *Effect of vermi-compost and inorganic fertilizers on growth, yield and quality of sprouting broccoli (Brassica Oleracea L. Var. Italica Plenck).* International Journal of Bio-Resource and Stress Management; 5(4):507-512.
5. **Rusu O.R., G.C. Teliban, A. Borș, V.C. Florișteanu, Gh. Vlad, A. Cojocaru, M. Roșca and V. Stoleru, 2025** - *Possibilities of implementing the HACCP plan for tomato crop*. Acta Horticulturae no. 1416, 501-508. Proceedings of the International Symposium on Sustainable Vegetable Production from Seed to Health Booster Sources ISBN-978-94-6261-415-4.
6. **Šola I., Vujčić Bok V., Popović M., Gagić S., 2024** - *Phytochemical composition and functional properties of brassicaceae microgreens: impact of in vitro digestion*. Int. J. Mol. Sci, 25, 11831. https://doi.org/10.3390/ijms252111831
7. **Statilko O.; Tsiaka T.; Sinanoglou V.J.; Strati I.F., 2024** - *Overview of phytochemical composition of Brassica oleraceae var. capitata cultivars*. Foods, 13, 3395. https://doi.org/10.3390/foods13213395
8. **Ștefan I.M.A., Ona A., 2020** - *Cabbage (Brassica oleracea L.). Overview of the health benefits and therapeutical uses.* Hop and Medicinal Plants, Year XXVIII, No. 1-2, ISSN 2360–0179 print, ISSN 2360–0187 electronic.
9. **Stoleru V., Munteanu N., Hura C., Sellitto V.M., Gavrilescu M., 2016** - *Organochlorine pesticide residues in soil and edible vegetable.* Environmental Engineering and Management Journal. 15(3): 527-535. 10.30638/eemj.2016.057
10. **Stoleru V., Munteanu N., Stoleru C.M., Rotaru L., 2012** - *Cultivar selection and pest control techniques on organic white cabbage yield*. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, *40*(2), 190–196. https://doi.org/10.15835/nbha4027993

OBSERVATIONS REGARDING MULTIPLICATION ON VEGETATIVE WAY OF *JUNIPERUS COMMUNIS* L. SPECIES IN IAŞI COUNTY CONDITIONS

OBSERVAŢII PRIVIND ÎNMULŢIREA PE CALE VEGETATIVĂ A SPECIEI *JUNIPERUS COMMUNIS* L. ÎN CONDIŢIILE JUDEŢULUI IAŞI

BERNARDIS Roberto-Renato[1], ZLATI Cristina[1], SANDU Tatiana[1], DASCĂLU Marius[1], POŞTA Daniela Sabina[2]

*Corresponding author e-mail: daniela.posta@usvt.ro

Abstract.
Within the multitude of dendrological species, Juniperus species are particular importance in green areas and especially in our country's conditions that are generally favorable and very favorable to these species. The aim of the paper is to highlight the potential for vegetative propagation of the most popular species, namely Juniperus communis L., *which is found in Iasi county. During the vegetation period, observations were made on the action of rooting biostimulators and the growth rate of cuttings roots by determining the percentage of rooted cuttings, the average length of roots emitted per cuttings and the average number of roots per cut.*
Key words: seedlings, substrate, rooting bio-stimulators.

Rezumat.
În cadrul multitudinii de specii dendrologice, speciile genului Juniperus au o importanţă deosebită în amenajarea spaţiilor verzi şi mai ales în condiţiile de la noi din ţară care sunt în general favorabile şi foarte favorabile pentru aceste specii. Scopul lucrării este de a pune în evidenţă potenţialul de înmulţire pe cale vegetativă a celei mai cunoscute specii, respectiv Juniperus communis L., care se întâlneşte în judeţul Iaşi. Pe parcursul perioadei de vegetaţie s-au efectuat observaţii privind acţiunea biostimulatorilor de înrădăcinare şi sporul de creştere al rădăcinilor butaşilor prin determinări privind procentul de butaşi înrădăcinaţi, lungimea medie a rădăcinilor emise pe butaşi şi numărul mediu de rădăcini pe butaş.
Cuvinte cheie: butaşi, substrat, biostimulatori de înrădăcinare

[1] ”Ion Ionescu de la Brad” Iași University of Life Sciences, Romania
[2] University of Life Sciences "King Mihai I" from Timișoara, Romania

INTRODUCTION

One of the basic components of the green spaces that ensures the aesthetic appearance of the localities is the landscaping.

Within the multitude of dendrological species of ornamental shrubs, Juniperus species are of particular importance in green areas, and the conditions in our country that are generally favorable and very favorable to this species.

The necessity of diversifying the assortment is a priority given the diversity of biological material and especially the achievements achieved worldwide. This work is complemented by specialists in the field as an efficient and well documented material because it follows the percentage of rooting in *Juniperus communis* L. under unprotected conditions [Bernardis, 2010; Iliescu, 2002].

MATERIAL AND METHOD

The production of the rooted cuttings of *Juniperus communis* L. took place in the Tudor Neculai nursery in Iaşi in 2022. The knock-off period and the arrangement on rooting substrates was carried out in April. The time interval was two months (April, May).

The biological material used consists of semi-milled cuttings from spiked peaks, with an average length of 6-8 cm that have been degraded in the basal part on a segment of 4 centimeters. The cuttings were harvested from healthy plants from the Tudor Neculai nursery collection in Iasi. The harvesting, preparation and placement of the cuttings on the rooting substrate took place on the same day.

The experience is of type 3x2, in two repetitions:

- Factor A - the type of rooting substrate with three graduations: a1- Prut sand; a2-Prut sand + forest vegetation (1: 1); a3-pearlite granules + sand (1: 1);
- Factor B - treatment with rhizogenic bio-stimulators (Radi-Stim No 2): b1- treated; b2- untreated.

By combining factor A with factor B and graduations, 6 experimental variants resulted (Table 1). These variants were based on the subdivided plot method.

The substrates prepared for the experiments were placed on a layer 15 cm thick uniformly. Twenty cuttings were prepared and seated for each intentional experimental variation.

Table 1

***Experimental variants of rooted cuttings Juniperus communis* L.**

Var. no.	Var. symbol	Type of substrate/type of cuttings
V_1	a_1 b_1	Prut sand, untreated cuttings
V_2	a_1 b_2	Prut sand, treated cuttings
V_3	a_2 b_1	Pearlite granules + sand (1:1), untreated cuttings
V_4	a_2 b_2	Pearlite granules + sand (1:1), treated cuttings
V_5	a_3 b_1	Black earth + sand (1:1), untreated cuttings
V_6	a_3 b_2	Black earth + sand (1:1), treated cuttings

Measurements and determinations have been made regarding the percentage of rooted cuttings (the number of rooted cuttings from the total of those planted on variants); the average length of roots emitted per cuttings and the average number of roots per cut.

To determine the average root length of the cuttings, measurements were made for each individual root and their amount was reported as the number of roots.

With these measurements, the parameters related to the evolution of the growth of the root system of the cuttings, the importance of the rooting biostimulators on the rooting efficiency and the growth rate of the roots of the cuttings were calculated.

RESULTS AND DISCUTIONS

In Romania, *Juniperus communis* L. are found in most nurseries, having an ornamental, therapeutic and environmental value [Mihail, 2005]. An extremely valuable method for production is the multiplication of the species by vegetative way through cuttings. The results obtained at the end of the rooting period of cuttings of *Juniperus communis* L., untreated and treated with rhizogenic bio-stimulator, on various rooting substrates were reported in table 2 and table 3 and the primary data were statistically transformed and interpreted. Risogenesis is the phenomenon of organogenesis with a major implication in vegetative multiplication, because in its study a complex of factors that interact must be considered.

Table 2

Experimental results on the rooting of untreated cuttings by *Juniperus communis* L. under the influence of substrate composition

Substrate type	Rooted cuttings (%)
	b_1— untreated
a_1—prut sand	37
a_2— perlit granules + sand (1:1)	50
a_3—black earth + sand (1:1)	92

Table 2 shows large differences in the rooting percentage of untreated cuttings on the three rooting layers. We observe that the highest rooting percentage is obtained with the mixture of black earth + sand (1: 1), 92%, and the percentage difference between it and the Prut sand is 55%. 2 variants of the total of the 3 experimental variants ensured a rooting of over 50%.

Table 3

Experimental results on the rooting of treated cuttings *Juniperus communis* L. under the influence of substrate composition

Substrate type	Rooted cuttings (%)
	b_2— treated
a_1—Prut sand	78
a_2— perlit granules + sand (1:1)	33
a_3— black earth + sand (1:1)	100

According to table 3, we notice large differences in the rooting percentage of the cuttings at the level of the three rooting layers due to the risogenic Stimulator treatment Radi-Stim no. 2. We find that the highest rooting percentage was

achieved in the case of the black earth + sand (1: 1) mixture, 100%. Two variants of the three experimental variants ensured a 78% -100% rooting.

The highest rooting percentage was achieved with black / sand (1: 1) mixed soil, 92% -100%. Three variants of the total of the 6 experimental variants ensured a 78% -100% rooting. The rhizogenic substance and the composition of the substrate have differentially influenced the rooting of *Juniperus communis* L.

Table 4

Primary results on the rooting of the cuttings of *Juniperus communis* L.

Var. no.	Var. symbol	Average roots length (cm)	Average number of roots (pcs.)
V_1	a_1 b_1	6.30	7.00
V_2	a_1 b_2	6.30	7.50
V_3	a_2 b_1	7.70	26.50
V_4	a_2 b_2	8.60	24.60
V_5	a_3 b_1	5.50	20.50
V_6	a_3 b_2	7.20	18.20

The first data in table 4 was statistically processed to determine the influence of the stimulator and the substrate on the rhizogenesis of *Juniperus communis* L. The results are presented and interpreted in tables 5 and 6.

Table 5

Influence of substrate composition on the average length of roots of untreated cuttings of *Juniperus communis* L.

Var. no.	Substrate type	Average roots length (cm))		Diferences (cm)	Semnific.
		cm	%		
V_1	Prut sand	6.30	100	-	-
V_3	Perlite granules+sand (1:1)	7.70	116.2	1.20	--
V_5	Black earth+sand (1:1)	5.50	80	-0.80	00
DL 5%=0.45 DL 1%=0.76 DL 0.1%=1.40					

It is found that the best results were obtained in variant V3 regarding the influence of the type of substrate on the average length of the untreated *Juniperus* roots on 7,70 cm Prut + peat (1: 1) sand substrate with a difference of 1.20 cm (table 5).

In rooted cuttings, we observe positive values recorded in variants V4 due to the influence of the factors studied on the root length at the rooted cuttings, perlite granules + sand (1: 1), cut cuttings, with a difference of 2.13 cm from the Prut sand.

Observing the results obtained for the 6 variants analyzed, we observe very positive values recorded on variant V4, perlite granulate + sand (1: 1) substrate, treated cuttings, with a difference of 2.13 cm from the Prut sand and distinct values significantly positive were made on variant V3, perlite granulate + sand (1: 1), to untreated cuttings, with a difference of 1.20 cm from the Prut sand.

Table 6

The combined influence of the substrate and rhizogenic composition on the average length of the roots of *Juniperus communis* L.

Var. no.	Substrate type	Average roots length (cm)		Diferences (cm)	Semnific.
		no	%		
V_1	Prut sand	6.30	100	-	
V_2	Prut sand	6.30	100	-	-
V_4	Perlite granules+sand (1:1)	9.64	127.5	2.13	---
V_6	Black earth+ sand (1:1)	7.20	95.8	-0.50	0
DL 5%=2.67 DL 1%=3.60 DL 0,1%=7.80					

Table 7

Influence of substrate composition on the average number of roots on untreated cuttings of *Juniperus communis* L.

Var. no.	Substrate type	Average roots number		Diferences (cm)	Semnific.
		no	%		
V_1	Prut sand	7.00	100	-	-
V_3	Perlite granules+ sand (1:1)	26.50	373.4	19.50	**
V_5	Black earth+ sand (1:1)	20.50	280.4	13.50	**
DL 5%=2.67 DL 1%=3.60 DL 0.1%=7.80					

Regarding the influence of the type of substrate on the average number of roots on the *Juniperus* untreated cuttings, it was found that the best results are in variant V3, perlite granulate + sand (1: 1) substrate of 26,50, the difference being of 19.50 compared to Prut sand and variant V5, on the ground of black forest + sand (1: 1) with a number of 20.50, the difference being of 13.50 compared to Prut sand Table 7), thus showing significant positive differences in the two cases.

The combined influence of the studied factors on the average number of roots in the rooted cuttings shows significant positive values recorded in variants V4 (perlite granulate + sand substrate in 1: 1 ratio, with a difference of 13.30 roots compared to Sand of Prut, V6 on a black ground + sand substrate in a ratio of 1: 1, with a difference of 10.20 roots to the Prut sand (table 8).

Table 8

Combined influence of substrate and rhizogenic composition on the average number of roots on *Juniperus communis* L.

Var. no.	Substrate type	Average roots number		Diferences (cm)	Semnific.
		no.	%		
V_1	Prut sand	7.00	100	-	-
V_2	Prut sand	7.50	103.0	0.20	-
V_4	Perlite granules+sand (1:1)	24.60	270.0	13.30	**
V_6	Black earth +sand (1:1)	18.20	239.2	10.20	**

CONCLUSIONS

According to recorded and analyzed data, at the end of the rooting period, the following were found:

1. A very good percentage of 90% was obtained by rooting the untreated cuttings on a black soil + sand (1: 1) substrate, with a 50% percentage difference from the Prut sand substrate;
2. Using the rhizogenic stimulator, 100% was obtained in combination with the black soil + sand (1: 1) substrate which influenced the rooting of the previous situation;
3. The perlite granule + sand substrate (1: 1) influenced a long-term increase in the root system of the *Juniperus* untreated cuttings; there were significant positive increases;
4. The combination of the studied factors influenced the average number of roots in the rooted cuttings, observing positive values recorded in the variants V4 (on a pearlite granulate + sand substrate in a ratio of 1: 1, with a difference of 13.30 roots from the sand of Prut, V6 on the ground of black forest + sand in a ratio of 1: 1, with a difference of 10.20 roots to the Prut sand.

It has been found that the substrate provides a triple and double percent of the number of cuttings roots, either treated with or without rhizogenic biostimulators.

The success of a large number of cuttings depends on the roots that will be adapted to the conditions in the nurseries.

REFERENCES

1. Bernardis R., 2010- *Arboricultură ornamentală.vol.1.* Editura Ion Ionescu de la Brad, Iaşi
2. Iliescu Ana Felicia, 2002 – *Cultura arborilor şi arbuştilor ornamentali.* Editura Ceres, Bucureşti.
3. Mihail M., 2005 – *Dendrologie.* Editura "Bioterra", Bucureşti.

BIODIVERSITY HOTSPOTS IN URBAN DESIGN: THE ROLE OF PERENNIAL MEADOWS IN REPLACING ORNAMENTAL TURF IN INSTITUTIONAL SETTINGS

HOTSPOTURI DE BIODIVERSITATE ÎN DESIGNUL URBAN: ROLUL PAJIȘTILOR PERENE ÎN ÎNLOCUIREA GAZONULUI ORNAMENTAL ÎN CADRUL INSTITUȚIONAL

VLADIMIR (ASIMINEI) Ina[1], COJOCARIU Mirela[1]*

*Corresponding author e-mail: mirela.cojocariu@iuls.ro

Abstract.
Recent studies in urban landscape design highlight the importance of green areas in cities, emphasizing their essential role in addressing the climate crisis and biodiversity decline. In recent years, creating urban meadows has been globally recognized as a practical solution for tackling these issues and bringing social benefits. In urban design, perennial meadows represent an ecological alternative to traditional ornamental lawns, often requiring considerable resources and contributing to biodiversity loss. Implementing perennial meadows in institutional spaces, such as university campuses or administrative complexes, can create biodiversity "hotspots", supporting local species and improving environmental quality. This paper proposes the development of a perennial meadow design to replace the existing lawn in the outdoor space of the Faculty of Biomedical Engineering at the "Grigore T. Popa" University of Medicine and Pharmacy in Iasi, evaluating the success of the initiative by analyzing three key factors: impact on biodiversity, improvement of local climate conditions, and benefits for the institution's users.
Key words: perennial meadows, urban biodiversity, institutional settings

Rezumat.
Studiile recente în peisagistica urbană subliniază importanța zonelor de vegetație din orașe, accentuând rolul esențial al acestora în combaterea crizei climatice și a declinului biodiversității. În ultimii ani, crearea de pajiști urbane a fost recunoscută global ca o soluție eficientă, având nu doar potențialul de a rezolva aceste probleme, dar și de a aduce beneficii sociale. În designul urban, pajiștile perene reprezintă o alternativă ecologică la gazonul ornamental tradițional, care adesea necesită resurse considerabile și contribuie la scăderea biodiversității. Implementarea pajiștilor perene în spații instituționale, precum campusuri universitare sau complexe administrative, poate crea „hotspoturi" de biodiversitate, sprijinind speciile locale și îmbunătățind calitatea mediului. Prin lucrarea dată se propune dezvoltarea unui design de pajiște perenă

[1] "Ion Ionescu de la Brad" Iași University of Life Sciences, Romania

pentru a înlocui gazonul existent în cadrul spațiului exterior al Facultății de Bioinginerie Medicală din incinta Universității de Medicină și Farmacie "Grigore T.Popa" din Iași, evaluând succesul inițiativei prin analiza a trei factori cheie: impactul asupra biodiversității, ameliorarea condițiilor climatice locale și beneficiile pentru utilizatorii instituției.
Cuvinte cheie: pajiști perene, biodiversitate urbană, cadru instituțional

INTRODUCTION

Many environmental issues face humanity today, such as the imperative need to slow climate change, prevent biodiversity decline, and improve living standards. In response to these challenges, innovative approaches to landscape management, such as sequestering carbon, reducing greenhouse gas emissions, managing stormwater, and creating healthier urban environments, have emerged.

One of the current topics in contemporary landscape research is the process of rapid and uneven urbanization. This factor is a significant cause of species decline, driven by habitat destruction, fragmentation, and the spread of invasive plants [Kowarik, 2011]. In this context, biodiversity conservation and restoration research aims to increase the value of habitats for native species in urban areas, connecting biological diversity hotspots while mitigating urbanization's adverse effects [Miller and Hobbs, 2002]. In this context, research on biodiversity conservation and restoration suggests enhancing the value of urban habitats for native species, connecting fragmented biodiversity hotspots, and mitigating the adverse impacts of urbanization. Conserving and restoring native habitats in urban areas also brings social and educational benefits. Therefore, paying special attention to landscape design in residential and institutional areas is recommended. This concept is embodied in the EU's environmental policy, which focuses on preserving endangered species and their habitats while incorporating biodiversity into urban planning [COM, 2004].

Since 2002, Romania has registered a steady increase in the percentage of the urban population. According to World Bank statistics, in 2023, 55% of the population lived in urban areas, a considerably lower proportion than in other European countries. The lack of an appropriate urban structure and the rapid expansion of the built environment generate significant problems within the urban fabric. This situation worsens exponentially as built-up areas are increasingly dominated by turf.

One of the most prominent features of contemporary urban landscapes is the lawn. According to the Oxford Companion to the Garden, published in 2006, the modern concept of a lawn as an area of closely mown turf, originated in the early 18th century from the French term "pelouse, defined as a community of plants, especially grasses from the *Poaceae* family, artificially created for ornamental purposes [Taylor, 2006]. Over time, the lawn became one of the most cherished features of English gardens, thanks to the region's moist maritime climate, which was especially conducive to its cultivation. From there, the lawn has spread

globally, becoming in the 21st century the most common element of urban green spaces and a symbol of the modern lifestyle.

Because of the general public's view of lawns' aesthetic value and easy maintenance and management, lawns are frequently incorporated into urban landscape designs [Ignatieva *et al.*, 2015]. However, observing in detail the evolution of an ornamental lawn over a year, it becomes evident that its maintenance involves intensive management. It includes monthly mowing, irrigating, fertilizing, and frequent application of herbicides, all generating high financial and ecological costs. An alternative for these lawn spaces, especially in the institutional environment, where the lawn has a predominantly ornamental and not recreational role, is to replace the lawn monoculture with a greater diversity of perennial species.

MATERIAL AND METHOD

This study aims to propose a design for a perennial plant meadow to replace the 129 square meters of space in front of the “Prof. Univ. Dr. Cristian Dragomir” Simulation Center, which is part of the Faculty of Biomedical Engineering within the “Grigore T. Popa” University of Medicine and Pharmacy (figure 1 and figure 2).

Fig. 1. “Prof. Univ. Dr. Cristian Dragomir” Simulation Center, front view

The research area was divided into three plots: P1, P2, and P3 (Figure 3). The planting design was created using AutoCAD software, and the visualizations were generated through Lumion.

Tables 1, 2, and 3 show the plant material used to design the future meadow, which included ornamental grasses (Table 1), spring-blooming bulbs (Table 2), and perennial plants with decorative value in spring, summer, and autumn (Table 3). All plants were chosen to best adapt to the existing site conditions and provide staggered visual interest from March to October, with ornamental grasses adding aesthetic value even during the winter.

Fig. 2. "Prof. Univ. Dr. Cristian Dragomir" Simulation Center, existing lawn

Table 1

The ornamental grasses proposed in the design

Scientific Name
Calamagrostis x *acutiflora* `Overdam`
Carex oshimensis `Everlime`
Deschampsia caespitosa `Goldtau`
Hakonechloa macra
Ophiopogon planiscapus `Nigrescens`
*Pennisetum alopecuroide*s `Little Bunny`
Sesleria autumnalis
Stipa tenuissima `Ponytails`

Table 2

The spring-blooming bulbs proposed in the design

Scientific Name	Period of decor
Allium aflatunense `Purple Sensation`	Apr-Iun(Jul-Nov)
Crocus tommasinianus	Febr-Mart
Muscari armeniacum	Mart-May
Narcissus poeticus	Mar-Apr

Table 3

The perennial plants proposed in the design

Scientific Name	Period of decor
Achillea millefolium `Milly Rock Red`	May-Sept
Achillea filipendulina `Cloth of Gold`	May-Sept (Sept-Febr)
Actaea simplex atropurpurea	May-Oct (Nov-Dec)
Ajuga reptans `Chocolate Chip`	Jan-Dec
Alchemilla mollis	Apr-Oct
Aster x *frikartii* `Monch`	Jun-Nov
Bergenia cordifolia `Rotblum`	Jan-Dec
Brunnera macrophylla `Jack Frost	Apr-Oct
Echinacea purpurea	Apr- Sept (Oct- Dec)

Echinops ritro	Apr- Sept (Oct- Dec)
Eremurus stenophyllus	May- Aug (Sept- Dec)
Eupatorium maculatum	May-Sept (Oct-Dec)
Euphorbia amygdaloides subsp. *robbiae*	Jan-Dec
Gaura lindheimeri	Apr-Nov
Geranium sanguineum	Apr-Oct
Hemerocallis sp.	Apr-Oct
Heucherra sp.	Jan-Dec
Iris germanica	Apr-Oct
Nepeta x *faassenii* `Purrsian Blue`	Apr-Oct
Perovskia atriplicifolia `Blue Spire`	May-Oct (Nov-Mar)
Salvia nemorosa `Caradonna`	Apr-Oct
Spiraea japonica `Goldflame`	Apr-Oct
Rudbeckia fulgida var. *sullivantii* `Goldsturm`	Apr-Oct (Nov-Dec)

RESULTS AND DISCUSSIONS

For ease of study management and design proposal execution, the land has been divided into planting plots: P1, P2, and P3 (Figure 3). Additionally, each of the respective plots has a different level of sunlight exposure, with P1 having the highest level of shading and P2 the lowest. This aspect was important in selecting the quantities of plants that were more or less tolerant/resistant to shade or sunlight for each plot. Regarding the design, the main goal was to ensure decoration for the longest possible period.

Secondly, the aim was to avoid monotony by using plants of varying heights to create a dynamic interplay across different structural levels. Repeating the same plant groups provides a specific rhythm to the design, unifying all the plots into a cohesive whole. Regarding the plant species, only six *Spiraea japonica* `Goldflame` specimens were used from the shrub category to create focal points that will serve as the framework and anchor points for the future meadow. Apart from these, only herbaceous perennial species were proposed.

Fig. 3. Planting plot distribution

Considering the site's location and the predominant period of use for the institutional university space is from autumn to spring - while summer, when many plant species reach their peak ornamental value, is less utilized - the aim was to create decorative accents throughout each season.

In March - April (Column A), the decorative effect is predominantly supported by bulbous plant species such as *Crocus* and *Narcissus*, set against the backdrop of emerging green foliage from species like *Alchemilla mollis* and *Brunnera macrophylla*, which by late April begin to delight the eye with their yellow and blue inflorescences, respectively. Among the bulbous plants in May (Column B), *Allium aflatunens*e stands out with its striking presence alongside *Iris germanica* (Figure 4).

Of course, the peak months for decoration are those from June to September (Columns C & D) (Figure 4). Most proposed species contribute to the display through foliage and flowers during this period. However, the diversity of plant material allows for staggered blooming, with each species providing a visual spectacle during its peak period, most producing new inflorescences every one to two weeks.

Fig. 4. The decorative effect from March to May.

During the colder months of the year, from October to February (Column E & F) (Figure 5), the main decoration will be provided by the ornamental grasses used in the design, as well as the dry structural inflorescences or the decorative branches of plants such as *Rudbeckia fulgida, Echinacea purpurea, Echinops ritro, Perovskia atriplicifolia, Eupatorium maculatum*, and *Actaea simplex.*

Fig. 5. The decorative effect from June to September.

In addition to their decorative properties, these plants are also used as food sources for birds, thus supporting and enhancing biodiversity.

The project's first stage, the design implementation, took place in October 2024, with plots 2 and 3 planted (Figure 6), while plot 1 is scheduled to be planted in the spring of 2025. A new approach to implementation involved planting the vegetation directly into the existing lawn without processing the soil layer through traditional operations such as plowing, harrowing, or aerating.

Fig. 6. The decorative effect from October to February.

Regarding removing the lawn, the method used was covering it with pieces of cardboard (Figure 7), placed individually around each plant. This procedure has been successfully used in other studies, simplifying weed removal operations, such as the lawn, thus reducing implementation costs.

Fig. 7. The implementation of the design.

At the same time, it contributes to an effective and sustainable method of soil processing without disrupting it through repetitive mechanical work (Goncalves et al., 2021). To contribute to the decomposition of the cellulose layer, the cardboard was covered with a layer of soil (Figure 8).

Fig. 8. The placement of the cardboard and covering it with soil.

CONCLUSIONS

The presented work represents the first phase of a larger study. In this stage, the goal was to develop a dynamic design that successfully combines various species of perennials and ornamental grasses, providing decoration throughout as much of the year as possible, which has been achieved.

The implementation in multiple stages allows for adapting the design to any difficulties or issues that may arise along the way. Additionally, the rooting progress of the planted plants can already be observed before completing all the plots.

The design and the list of selected plants demonstrate the goal of supporting local biodiversity by providing aesthetic decoration and fostering a healthy ecosystem.

Covering with cardboard reduced the time required for lawn removal, promoting an ecological process that is friendly to the soil ecosystem while also being a more financially optimal solution.

The study's following stages aim to monitor the evolution of the selected perennial species, assess their impact on urban biodiversity, and highlight the aesthetic and comfort benefits they provide to the academic community and space users.

REFERENCES

1. Commission of the European Communities, 2004 - *Towards a thematic strategy on the urban environment (COM (2004) 60). Publications Office of the European Union,*

Brussels. Strategy on the urban environment, COM (2004) 60, Publications Office of the European Union, Brussels.

2. **Goncalves F. S., Aximoff I., Resende A. S. de, & Chaer G. M., 2021** - *Efficiency of Cardboard Crowning on the Suppression of Invasive Alien Grasses*. Floresta e Ambiente, 28(3).
3. **Ignatieva M., Ahrné K., Wissman J., Eriksson T., Tidåker P., Hedblom M., Kätterer T., Marstorp H., Berg P.G., Eriksson T. & Bengtsson J., 2015 - *Lawn as a cultural and ecological phenomenon: A conceptual framework for transdisciplinary research*. Urban Forestry & Urban Greening, 14, 383-387.**
4. **Kowarik I., 2011 -** *Novel urban ecosystems, biodiversity, and conservation*. Environmental Pollution, Aug-Sep,159(8-9):1974-83.
5. **Miller J.R. & Hobbs, R. J., 2002** - *Conservation Where People Live and Work*. Conservation Biology, 16, 330-337.
6. **Taylor P. (Ed.), 2006 -***The Oxford Companion to the Garden,* Oxford University Press.
7. **World Bank, 2023** - *Urban population (% of total population)*. Retrieved from https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?

USING FRUIT GROWING SPECIES IN GREEN RESTORATION OF THE CITIES PUBLIC SPACES FOR IMPROVING URBAN RESILIENCE AND SUSTAINABILITY

FOLOSIREA SPECIILOR POMICOLE ÎN RESTAURAREA VERDE A SPAȚIILOR PUBLICE ALE ORĂȘELOR, PENTRU ÎMBUNĂTĂȚAREA REZILIENTEI ȘI DURABILITĂȚII URBANE

ZLATI Cristina[1], PAȘCU Roxana[1]*

*Corresponding author e-mail: roxana.pascu@iuls.ro

Abstract.
The prasent paper aims to provide a comprehensive overview of the sustainability of urban gardens, highlightening their numerous benefits while also acknowledging the challenges and proposing potential solutions to ensure their long-term success. The importance of revitalizing and renewing residential spaces is essential to create an urban environment that meets the aesthetic, but also functional needs of the inhabitants. By integrating plant elements, a closer connection with nature is promoted, contributing to the creation of a friendlier and more harmonious space for the community. The focus is on the modernization of old and neglected residential neighborhoods by introducing fruit treee species in the landscape design. The objective is the rehabilitation and revitalization of urban public spaces in Orăștie municipality.
Key words: urban gardens; sustainability; green spaces; environment; reabilitation.

Rezumat.
Prezenta lucrare își propune să ofere o imagine de ansamblu cuprinzătoare asupra durabilității grădinilor urbane, subliniind numeroasele beneficii ale acestora, recunoscând totodată provocările și propunând soluții potențiale pentru a le asigura succesul pe termen lung. Importanța revitalizării și reînnoirii spațiilor rezidențiale este esențială pentru a crea un mediu urban care să răspundă nevoilor estetice, dar și funcționale ale locuitorilor. Prin integrarea elementelor vegetale se promovează o legătură mai strânsă cu natura, contribuind la crearea unui spațiu mai prietenos și mai armonios pentru comunitate. Accentul este pus pe modernizarea cartierelor rezidențiale vechi și neglijate prin inroducerea speciilor pomicole. Obiectivul este reabilitarea și revitalizarea spațiilor publice urbane din municipiul Orăștie.
Cuvinte cheie: grădini urbane; sustenabilitate; spații verzi; mediu, reabilitare.

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania

INTRODUCTION

Urban gardening is a hot topic in sustainability. It's a necessity in today's rapidly urbanizing modern world. As urban areas expand beyond the cities, the need for green spaces becomes more and more critical. Sustainable gardening in urban areas offers numerous benefits, not only for the environment but also for the well-being of city dwellers, offer a wealth of benefits, from environmental to social to economic.

Urban gardens can involve many forms, from rooftop farms to community plots to vertical hydroponic systems, allotments and green walls. They involve cultivating, processing, and distributing food in or around urban areas, integrating innovative gardening techniques, tools and materials. Urban gardens together with urban residents have the potential to make our cities more sustainable, resilient, and equitable, createing relaxing environment, productive spaces even in the most limited areas [Schippa et al., 2018].

By addressing the challenges and implementing innovative solutions, there could be unlock the full potential of urban gardens and create a greener, healthier future for all. Building sustainable gardens in cities is crucial for several reasons. Firstly, where cities experience higher temperatures than the surrounding areas, due to extensive contructions and asphalt, it helps combat urban heat island effects [Thierry et al., 2023]. It can be seen as a plant based solution for this matter as greenery cool these areas, improving air quality and also reducing energy consumption for cooling [Alevizos et al., 2017].

Using fruit trees species for urban gardens promote biodiversity by providing habitats for pollinators like bees and butterflies, which are essential for a healthy ecosystem [Antić et al., 2021; Smyth, 2023]. It also promotes the use of native plants, well-adapted to local climates. These species require less water, are low maintenance and make gardens more sustainable.

The best thing is that the benefits are not only environmental. Urban gardens enhance mental and physical health as well. Studies show [Carney et al., 2012] that interacting with plants can significantly reduce stress, anxiety, and depression. Gardening also provides a moderate-intensity physical activity, contributing to overall fitness especially for seniors and children. Through well-planned and integrated interventions, such neighborhoods can be transformed into vibrant communities, offering a healthy and comfortable living environment [Ippolito et al., 2018]. Nevertheless, growing your own food ensures access to fresh, organic produce, hch is healthier and reduces the carbon footprint associated with food transportation.

MATERIAL AND METHODS

The aim of this proposal was the integrated rehabilitation and revitalization of urban public spaces in Orăștie municipality, Hunedoara County.

Opportunities for these kinds of aproaches are multiple, both for environment and community, from improving the quality of infrastructure, creating modern public spaces, promoting social cohesion and increasing real estate values, to the increasing the quality of life, access to recreational areas, reducing pollution and improving safety. Such projects contribute to the social and economic revitalization of the city.

The location of the site is Pricazului street, identified by nr. CF 68678, 68679, 68680, 68681, 68682 and 60636, nr. Cad. 68678, 68679, 68680, 68681, 68682 and 60636, municipality of Orăștie, county of Hunedoara (Figure 1). In Figure 2 can be seen the existing situation at the site level and the need for intervention is indisputable.

Modernizing the old and neglected residential neighborhoods is a key priority in the process of integrated rehabilitation and revitalization of urban public spaces. These areas, often marked by deteriorated infrastructure, undeveloped green spaces and lack of modern amenities, have immense potential to become attractive, functional and friendly spaces for residents.

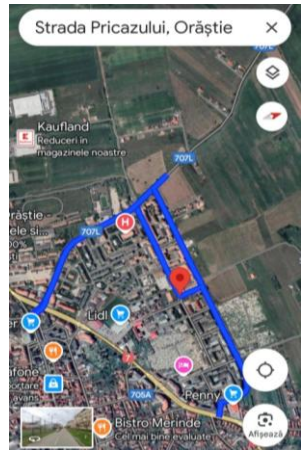

Fig 1. Site location, satellite view (maps.google.com)

Fig. 2. Current situation of the site

The focus was using fruit trees species for urban gardens. This promotes biodiversity by providing habitats for pollinators like bees and butterflies, which are essential for a healthy ecosystem. Plant composition proposed in the project is varied and lively, offering an attractive landscape the year long. The carefully chosen species complement the existing vegetation, bringing color and texture accents that beautify the spaces.

RESULTS AND DISCUSSIONS

Green restoration of the cities public spaces by using fruit growing species is a sustainable and gratifying way to introduce these species in urban gardens design wich will improve the quality of life in cities, bringing urban resilience and sustainability.

The sustainability of this approach lies in combining economic, aesthetic and functional aspects, especially of such areas, making them the primary aspects anchored in determining the choice of the most suitable crop systems.

Fruit trees with ornamental value are well represented by a great diversity of species and varieties that find, in our country, favorable climatic conditions for growth and prosperity, while ensuring decor spread throughout the year.

Fruit trees and shrubs add contrast to the landscape, becoming a central decorative element. In addition, the white-pinkish flowers, which appear in the flowering season, create an elegant contrast with the dark foliage, amplifying its visual decorative effects. In full bloom branches are slightly arched, adding a touch of elegance to the landscape composition.

General plan of the proposed solution can be seen in Figure 3.

Fig. 3. General plan of the proposed solution

In Table 1 there is the list of proposed tree, shrub and annual species. The fruit trees species as *Malus, Mespilus, Sorbus, Cornus* and *Corilus* were used to complete the plant compositions. Species are varied, offering an attractive interest the year long, from impresing flowering in early spring till colered or contortuos branches during winter time.

Table 1

List of proposed tree and shrub species

Nr. crt.	Specie name	Quantity
1	*Abies concolor Compacta*	17
2	*Acer palmatum Trompenburg*	24
3	*Acer platanoides Crimson King*	5
4	*Acer platanoides Drumondii*	16
5	*Betula pendula*	16
6	*Larix decidua Pendula*	8
7	*Picea omorika*	13
8	*Berberis thunbergii Harlequin*	39
9	*Buxus sempervirens "bila"*	37
10	*Chamaecyparis lawsoniana Ivonne*	53
11	*Cupressocyparis leylandii Gold rider "Spiral"*	16
12	*Hosta sp.*	76
13	*Hybiscus syriacus*	26
14	*Hydrangea arborenscens Annabelle*	25
15	*Juniperus Old Gold*	115
16	*Juniperus sabina*	67
17	*Juniperus scopulorum*	14
18	*Juniperus scopulorum Skyrocket*	38
19	*Juniperus squamata Blue Carpet*	66
20	*Nephrolepsis exaltata*	98
21	*Physocarpus opulifolius Diablo*	28
22	*Picea pungens glauca Globosa*	38
23	*Pinus mugo var. pumilio*	51
24	*Pinus mugo Winder Gold*	27
25	*Salix integra Hakuro - Nishiki*	20
26	*Spiraea japonica Goldflame*	104
27	*Syringa vulgaris*	18
28	*Thuja plicata Fluffy*	11
29	*Cotoneaster horizontalis*	82
30	*Euonymus fortunei Emerald Gold*	26
31	*Malus floribunda*	12
32	*Mespilus germanica*	20
33	*Prunus cerasifera Nigra*	20
34	*Cornus alba Sibirica Variegata*	36
35	*Corylus avellana Contorta*	10
36	*Sorbus aucuparia*	15
37	*Lonicera kamtschatika* var *aedulis*	25

Fig. 4. Proposal for landscaping – plant compositions details

Fig. 5. Health benefits of using fruit growing species in urban gardens

The benefits of green restauration of urban spaces extend far beyond the aesthetic pleasure of outdoor activities. They are involved in crucial aspects of human life and linking in social structures, such as physical and mental health, community building, and environmental sustainability and resilience (figure 5). As urban areas continue to extend, faceing tremendous challenges, the value of these urban oases will only become increasingly significant. Therefore, urban gardens with all activities they involve are not just for leisure, it's a multifaceted solution to some of the most pressing issues of the present global situation.

The importance of revitalizing and renewing residential spaces is essential to create an urban environment that meets the aesthetic, but also functional needs of the inhabitants. By integrating fruit growing species, a closer connection with nature is promoted, contributing to the creation of a friendlier and more harmonious space for the community.

CONCLUSIONS

Revitalizing and renewing residential spaces are of essential importance for create a sustainable urban environment that meets the aesthetic, but also functional needs of the inhabitants. By integrating fruit growing species is promoted a closer connection with nature, creating a friendlier and more harmonious space for the entire community and nevertheless new sources of food while assuring biodiversity.

Research on the sustainability of urban gardens typically arrives at several important conclusion linked to environmental benefits. One of the positive aspects is the improved quality of air and water. Urban gardens influence the air quality by

absorbing pollutants and reducing urban heat island effects. They also help improve water quality by reducing stormwater runoff and increasing infiltration. Climate change mitigation by sequestering carbon dioxide is another positive aspect.

Not in the end, the social and economic benefits derive from community building aspect. Green urban spaces foster a sense of community by bringing people together at diferent events and share knowledge. Neverthe less, it is well known the aspects linked to improvement of population health and well-being.

Activities that involves working outdoors with plants provides physical and mental health benefits, such as increased physical activity, stress reduction, and improved mental well-being. This could also bring oportunities and create jobs in areas like gardening, landscape, food processing, distribution etc.

REFERENCES

1. **Alevizos, I., Paraskevopoulou, A.T., Kamoutsis, A., Psychogiou, M. and Londra, P., 2017** - *The impact of design on the environmental contribution of street trees in Kallithea, Athens.* Acta Hortic. 1189, 251-256 DOI: 10.17660/ActaHortic.2017.1189.48 https://doi.org/10.17660/ActaHortic.2017.1189.48.
2. **Antić, M., Đurić, G. and Bosančić, B., 2021** - *Wild fruit trees in the Forest Park of Starčevica, Banja Luka, Bosnia and Herzegovina*. Acta Hortic. 1308, 13-18 DOI: 10.17660/ActaHortic.2021.1308.3 https://doi.org/10.17660/ActaHortic.2021.1308.3.
3. **Carney PA, Hamada JL, Rdesinski R, et al., 2012** - Impact *of a community gardening project on vegetable intake, food security and family relationships: a community-based participatory research study*. J Community Health. 2012;37(4):874-881.
4. **Ippolito, A., Macaione, I., Rizzi, C., Montanaro, G., Mininni, A.N. and Dichio, B., 2018** - *A preliminary assessment of green areas of Matera city and their potential role in climate change*. Acta Hortic. 1215, 45-48 DOI: 10.17660/ActaHortic.2018.1215.7 https://doi.org/10.17660/ActaHortic.2018.1215.7.
5. **Schippa, G., Interlandi, S., Russo, P. and Branca, F., 2018** - *Green restoration of the industrial area of the city of Catania for improving urban resilience and sustainability*. Acta Hortic. 1215, 307-310 DOI: 10.17660/ActaHortic.2018.1215.56 https://doi.org/10.17660/ActaHortic.2018.1215.56.
6. **Smyth, N., 2023** - *Shades of green – wildflowers" and biodiversity urban planting considerations*. Acta Hortic. 1374, 221-228 DOI: 10.17660/ActaHortic.2023.1374.28 https://doi.org/10.17660/ActaHortic.2023.1374.28.
7. **Thierry, J., Herpin, S., Rodriguez, F., Renard, M., Gantois, M. and Bournet, P.E., 2023** - *Climatic benefits of street trees on the microclimate and thermal comfort: an in-situ experiment in Paris*. Acta Hortic. 1374, 197-204 DOI: 10.17660/ActaHortic.2023.1374.25 https://doi.org/10.17660/ActaHortic.2023.1374.25
8. *****,** www.maps.google.com.

THE IMPACT OF TERROIR ON THE PHYSICO-CHEMICAL SPECIFICITY OF INDIGENOUS AND INTERNATIONAL WHITE WINES CULTIVATED IN ROMANIA

IMPACTUL TERROIR-ULUI ASUPRA SPECIFICITĂȚII FIZICO-CHIMICE A VINURILOR ALBE AUTOHTONE ȘI INTERNAȚIONALE CULTIVATE ÎN ROMÂNIA

***BEDREAG (REBIGAN) Ioana Cristina*[1], *SCUTARAȘU Elena Cristina*[1,2], *CIOROIU Ionel-Bogdan*[2]*, *NICULAUA Marius*[2], *COTEA V. Valeriu* [1,2]**

*Corresponding author e-mail: bogdan.cioroiu@acadiasi.ro

Abstract.
This study examines the influence of terroir on the physico-chemical characteristics of white wines, focusing on both local and international varieties grown in Romania. The research compares Sauvignon blanc (SB) and Fetească albă (FA) wines from various Romanian viticultural regions, highlighting how the growing conditions, soil-climate characteristics, and vinification methods from 2019 and 2021 impacted the wines' properties. Physico-chemical parameters were assessed to establish quality benchmarks. Findings revealed a wide range of quality parameters, with alcohol strength varying from 11.04 % vol. alc. (FA, 2019) to 14.6 % vol. alc. (SB, 2021), volatile acidity ranging from 0.1 g/L acetic acid (FA, 2019) to 0.63 g/L acetic acid (SB, 2019), and reducing substances from 0.31 g/L (FA, 2019) to 12.00 g/L (SB, 2021). Total acidity ranged from 5.05 to 7.39 g tartaric acid/L, correlating with wine treatments and initial grape values.
Key words: terroir, Fetească albă, Sauvignon blanc, physico-chemical parameters

Rezumat.
Acest studiu analizează influența terroir-ului asupra caracteristicilor fizico-chimice ale vinurilor albe, concentrându-se pe soiuri locale și internaționale cultivate în România. Astfel, a fost analizată influența condițiilor de cultivare, a caracteristicilor pedo-climatice, precum și a metodelor de vinificare specific anilor 2019 și 2021 asupra calității vinurilor obținute din soiurile Sauvignon Blanc (SB) și Fetească Albă (FA) în diverse regiuni viticole românești. Parametrii fizico-chimici au fost evaluați pentru a stabili repere de calitate. Probele au prezentat caracteristici fizico-chimice diferite, cu o concentrație alcoolică variind de la 11,04 % vol. alc. (FA, 2019) la 14,6 % vol. alc. (SB, 2021). Aciditatea volatilă a prezentat valori între 0,1 g/L acid acetic (FA, 2019)

[1] "Ion Ionescu de la Brad" Iași University of Life Sciences, Romania
[2] Romanian Academy, Iasi Branch, Research Centre for Oenology, Iași

și 0,63 g/L acid acetic (SB, 2019), pe când conținutul total de substanțe reducătoare a fost între 0,31 g/L (FA, 2019) și 12,00 g/L (SB, 2021). Aciditatea totală a vinurilor analizate a înregistrat variații între 5,05 și 7,39 g/L acid tartric, corelându-se cu tratamentele vinului și valorile inițiale ale strugurilor.

Cuvinte cheie: Fetească albă, Sauvignon blanc, terroir, parametric fizico-chimici

INTRODUCTION

Terroir, the complete natural environment influencing wine production, significantly shapes a wine taste and flavor. It includes climate, soil, topography, and winemaking techniques, which interact to form a unique ecosystem.

Climate impacts wine through macro- and microclimatic variations, including temperature, rainfall, and sunlight [Vaudour et al., 2015]. Temperature affects the timing of vine growth stages and grape ripening, while sunlight impacts photosynthesis and the development of secondary compounds in grapes [Van Leeuwen et al., 2020].

Soil contributes via composition, fertility, and drainage, while topography affects sunlight exposure and water flow through factors like slope direction and altitude. Soil provides essential nutrients to vines, especially nitrogen (N), which plays a key role in yield, vine vigor, and the composition of ripe grapes. The water status of the vine depends on both soil characteristics and root depth (affecting soil water retention) and on climate (determined by rainfall and evapotranspiration). Vine water status, in turn, influences shoot growth, yield, grape maturation, and fruit composition [Van Leeuwen et al., 2020].

Winemaking particularities, such as yeast selection and fermentation methods, can further emphasize or soften terroir influences [Van Leeuwen et al., 2018]. In France, the concept of *appellation d'origine contrôlée* (AOC) legally defines wine regions, acknowledging the unique qualities each terroir brings to wine. According to the OIV (OIV/VITI 333/2010), "viticultural terroir" refers to an area unique combination of physical, biological, and viticultural knowledge, shaping wines with distinctive qualities [Brillante et al., 2020].

This study examines how terroir affects the physico-chemical properties of Romanian white wines, analyzing local and international varieties to explore the environmental and human factors that contribute to each wine's unique characteristics.

MATERIAL AND METHOD

Representative samples were taken from the Fetească albă (FA) and Sauvignon blanc (SB) varieties. The study was conducted over two years, with sampling carried out in 2019 and 2021.

The geographic distribution follows vineyards and wineries across five major Romanian wine regions. In Dealurile Munteniei și Olteniei Wine Region, the Dealu Mare Vineyard (V) is represented by Vișinescu Winery (W), Davino W. and Ceptura W. Banat

Wine Region features the Dealurile Silagiului V. and Aramic W. For Colinele Dobrogei Wine Region, wines were sourced from the Sarica Niculițel V. and Murfatlar V., specifically Sarica Niculițel W. and Viișoara W. The Podișul Transilvaniei Wine Region includes samples from the Târnave V., Aiud V., Lechinta V. with Jidvei W., Domeniile Boieru W., and Jelna W respectevely. Dealurile Moldovei Wine Region is represented by the Dealu Bujorului V. and Panciu V., through Bujoru Viticulture Bujoru Viticulture and Winemaking Research and Development Station (SCDVV Bujoru) and Panciu W.

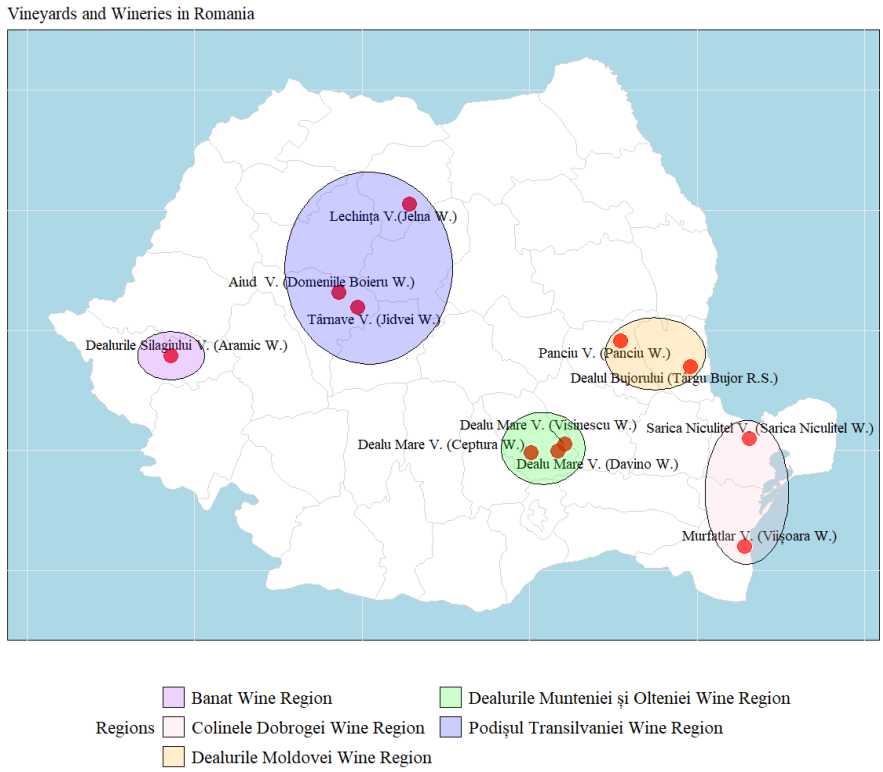

Fig. 1. Distribution of the analysed Vinyards and Wineries included in the study

To assess the physico-chemical characteristics of the wines, the following OIV-standardized methods were employed: reducing substances (g/L), total acidity (g/L tartaric acid), density and specific gravity at 20°C (g/mL), alcoholic strength by volume (%vol_alc), volatile acidity (g/L acetic acid), sulfur dioxide (free and total) (mg/L) [OIV, 2023].

RESULTS AND DISCUSSIONS

The physico-chemical characteristics are presented in table 1. The results exhibited a range of variations, from negligible differences in relative density to significant modifications with high variability. These changes may be influenced by oenological practices as well as specific characteristics determined by natural factors.

Figure 2 illustrates regional variations in the physico-chemical profiles of wines from diverse Romanian vineyards. Differences are noticeable when comparing wines from several regions which indicate terroir-specific influences, including vineyard location and winemaking techniques. The analysis of parameter variations based on the origin of wine samples involved testing the correlation between longitude (º) and latitude (º) as determining factors.

Table 1

Physico – chemical characteristics for the wines from Fetească albă and Sauvignon blanc

Sp*	AS (% vol.)	TA (g/L)	VA (g/L)	F_SO_2 (mg/L)	T_SO_2 (mg/L)	RS (g/L)	Density (g/mL)
Feteasca alba (FA)							
L1	13.1±0.07	6.5±0.23	0.11±0.16	35±4.3	93±13.8	2.11±1.70	0.991±0.002
L2	13.6±0.30	6.6±0.12	0.44±0.08	26±4.5	123±9.2	2.03±0.70	0.991±0.001
L3	11.9±0.42	6.4±0.58	0.23±0.03	33±7.0	92±18	2.45±0.29	0.992±0.001
L4	11.7±0.95	5.7±0.93	0.26±0.06	47±3.5	99±8.8	2.04±2.44	0.992±0.001
L5	14.4±0.80	7.1±0.53	0.56±0.50	37±0.9	93±0.9	0.92±0.13	0.990±0.003
L6	12.5±0.42	5.8±0.78	0.44±0.15	28±4.2	155±7.1	3.80±0.00	0.991±0.003
L7	13.1±0.28	7.1±1.17	0.40±0.03	29±7.7	62±2.8	4.12±1.04	0.993±0.003
L8	12.9±0.71	5.7±0.43	0.26±0.04	57±4.3	107±12.3	3.06±1.02	0.993±0.001
L9	12.6±0.14	7.1±0.13	0.36±0.01	23±2.7	65±6.4	1.75±0.64	0.992±0.003
L10	13.5±0.60	6.1±0.80	0.28±0.72	38±5.1	51±0.5	0.38±0.20	0.989±0.005
Sauvignon blanc (SB)							
L1	13.5±0.64	6.2±0.13	0.28±0.10	42±7.8	135±12.8	1.16±1.09	0.991±0.002
L2	14.7±0.24	6.2±0.12	0.63±0.12	40±5.8	49±2.5	7.38±3.09	0.992±0.001
L3	12.4±0.28	6.6±0.02	0.30±0.03	30±7.8	79±5.2	2.38±1.59	0.992±0.002
L4	13.1±0.44	6.8±0.78	0.48±0.04	44±5.3	94±8.8	2.70±1.27	0.991±0.001
L5	13.6±0.20	7.1± 0.25	0.52±0.18	27±2.5	114±5.7	1.04±0.69	0.989±0.005
L6	14.0±0.14	6.1±0.78	0.57±0.08	32±0.7	141±12.7	8.70±4.67	0.992±0.001
L7	14.2±0.64	7.7±0.49	0.52±0.03	35±4.2	82±11.5	2.35±0.49	0.990±0.003
L8	13.5±0.52	6.5±0.36	0.36±0.13	57±2.5	111±13.5	3.28±0.52	0.992±0.003
L9	13.1±0.14	7.3±0.18	0.36±0.04	26±6.3	76±8.5	2.45±0.78	0.991±0.004
L10	13.0±0.52	6.7±0.46	0.28±0.08	38±10.2	60±14.5	0.35±0.70	0.989±0.002
L11	13.6±0.07	6.4±0.14	0.42±0.02	55±1.6	79±6.1	2.92±0.04	0.992±0.001

** (Sp - sample) L1 - Dealu Mare V. (Ceptura W.), L2 - Dealurile Silagiului V. (Aramic W.), L3 - Tarnave V. (Jidvei W.), L4 - Aiud V. (Domeniile Boieru W.), L5 - Lechinta V. (Jelna W.), L6 - Dealu Bujorului V. (SCDVV Bujoru); L7 - Panciu V. (Panciu W.); L8 - Dealu Mare V.(Visinescu W., Artizan Wine); L9 - Sarica Niculitel V. (Viisoara W.); L10 - Târnave V. (Jidvei W.); L11 - Dealu Mare V. (Visinescu W., Karakter Wine).*

AS - Alcoholic strength (% vol.); TA - total acidity (g tartaric acid/L); VA - volatile acidity (g acetic acid/L); F_SO_2 - Content of free SO_2 (mg/L); T_SO_2 - Content of total SO_2 (mg/L); RS - Residual sugars (g/L); Density (g/mL)

The analysis of reducing sugars and density across various Romanian vineyards shows a positive correlation, where higher sugar levels lead to increased density. For example, the Panciu V. has the highest reducing sugars for SB at 8.70±4.67 g/L, indicating a likely density above 0.992 g/mL. In contrast, Lechinta Vineyard (Jelna W.) has lower sugars (1.04±0.69 g/L for SB) and a density of 0.989 g/mL, reflecting that lower sugar content correlates with reduced density.

Some correlations between alcohol strength (Figure 2a), reducing sugars (Figure 2b) and geographic factors in FA and SB wines were considered. Generally,

higher alcohol content is associated with lower reducing sugar levels [García-Martín et al., 2010]; for instance, Lechinta V. (Jelna W.) shows high alcoholic strength (14.4±0.80 % vol. for FA) alongside low reducing sugars (0.92±0.13 g/L). Latitude appears to impact alcohol content (figure 2(b)), with higher-latitude regions like Târnave V. exhibiting lower alcohol for FA (11.7±0.95 % vol. alc.) due to cooler climates that limit sugar accumulation. In contrast, southern locations like Dealu Mare V. (Ceptura W.) with 13.1±0.07 %vol. (FA) and 13.5±0.64 %vol. (SB) and Vişinescu W. 12.9±0.71 %vol. (FA) and 13.5±0.52 % vol. (SB)) produce wines with higher alcohol levels, indicating warmer climates which favor greater sugar and alcohol potential [Jordão et al., 2015].

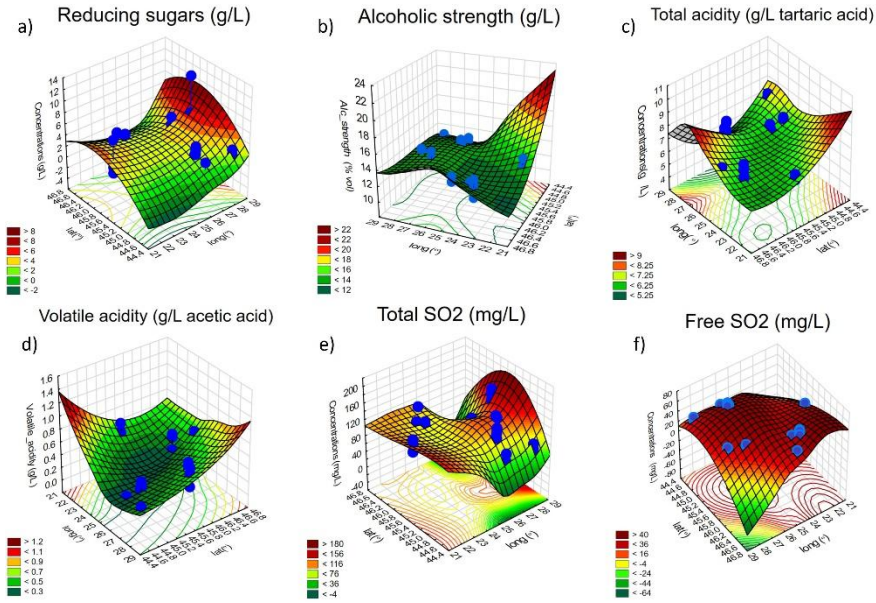

Fig. 2. Distribution of physico-chemical parameters according to longitudine (º) and latitude (º) corresponding to position in romanian teritory of the wineries

Latitude shows a weaker correlation with reducing sugars, though certain eastern regions, such as Dealu Bujorului V., display higher residual sugars in SB (8.70±4.67g/L), possibly due to specific regional practices or microclimate influences (figure 2b).

Optimal acidity gives wine freshness; lower values result in a flat taste without personality, while an excess produces a particular harshness to the wine [Koone et al., 2014] Acidity does not vary greatly, oscillating between 7.7±0.49 g/L tartaric acid for the sample from Panciu W. and 6.2±0.13 g/L tartaric acid in the Dealurile Silagiului V. (Aramic W.). The analysis of total acidity (TA) (figure 2(c)) and volatile acidity (VA) (figure 2(d)) for the samples from Romanian vineyards reveals distinct patterns based on latitude and varietal differences for FA

and SB. In FA, TA ranges from 5.7±0.43 g/L tartaric acid in Dealu Mare V. (45.0° latitude) to 7.1±0.53 g/L tartaric acid in cooler, higher-latitude locations like Lechința V. (46.6°) and Panciu V. (45.9°). In this situation, cooler northern climates enhance acidity retention. Similarly, SB shows TA values ranging from 6.1±0.78 g/L tartaric acid in Dealu Bujorului V. (45.7°) to a high of 7.7±0.49 g/L tartaric acid in Panciu V. (45.9°), underlining possible acidity concentrations, particularly at higher latitudes.

For VA, FA varies between 0.11±0.16 g acetic acid/L and 0.56±0.50 g acetic acid/L, with the highest value in Lechința V. In SB, VA ranges from 0.28±0.10 g acetic acid/L in Dealu Mare V. (Ceptura W.) to 0.63±0.12 g acetic acid/L in Dealurile Silagiului V. (Aramic W.), reflecting varietal differences in VA production.

Examining Total_SO_2 (mg/L) (figure 2(e)) and Free_SO_2 (mg/L) (figure 2(f)) levels across Romanian vineyards, this shows distinct varietal responses for FA and SB, as well as geographic clustering based on SO_2 content. FA shows free SO_2 (mg/L) levels ranging from 23±2.7 mg/L in Sarica Niculițel V. to 57±4.3 mg/L in Dealu Mare V., while SB ranges from 26±6.3 mg/L to 57±2.5 mg/L, indicating significant regional influence on SO_2 management. Total SO_2 levels vary more dramatically, with FA from 51±0.5 mg/L in Târnave V. to 155±7.1 mg/L in Dealu Bujorului V., while SB ranges from 60±14.5 mg/L to 141±12.7 mg/L. Identified clusters reflect these variations. In these conditions Cluster 1 with high values of SO_2 includes Dealu Bujorului V. and Dealu Mare V.– Vișinescu W., where intensive preservation practices and warmer climates may necessitate higher SO_2 levels, as stated in other papers [Morgan et al*.,* 2017]. Also, moderate values of SO_2 (Cluster 2) includes Lechința V., Aiud V. and Sarica Niculițel V., suggesting a higher role of winemaking procedures for antioxidant and microbiological preservation; and Cluster 3 represented by low SO_2 levels in Târnave V. may indicate a minimal intervention because of cooler natural conditions that allow for natural acidity retention.

Regarding the variance of data as function of period of monitorization (Figure 3), acidity and pH levels have remained stable, with slight acidity reductions in some areas by 2021, helping preserve freshness and aging potential. Box plots highlight year-to-year differences, particularly in volatile acidity and free SO_2, with grape type and vintage (notably for FA and SB) impacting composition. Terroir distinctions are evident in SO_2 levels (Figure 3a), volatile acidity (Figure 3b) and alcoholic strength (Figure 3c).

Previous relations were confirmed for SB, alcohol levels have generally risen from 2019 to 2021, likely influenced by climate change, as regions like Lechința V. (Jelna W.) and Aiud V. (Domeniile Boieru W.) shows consistently higher alcohol.

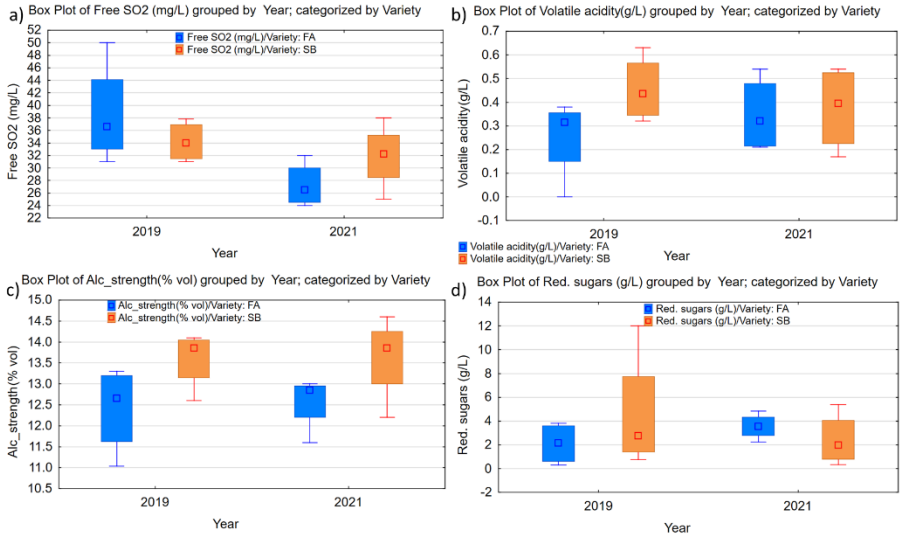

Fig. 3. Comparison of Free SO_2 (a), Volatile Acidity (b), Alcohol Strength (c), and Reducing Sugars (d) in Fetească albă and Sauvignon blanc Wines by Year

FA displays higher reducing sugars than SB, with a slight increase in reducing sugars correlating with rising alcohol [Goold et al., 2017]. Volatile acidity remains stable due to controlled vinification, showing minor reductions from 2019 to 2021. Other shifts include a slight increase in total acidity, a decrease in free SO_2 (potentially reducing oxidation protection), and an increase in total SO_2, possibly due to more sulfur additions. Reducing sugars at 20 °C have decreased, indicating more complete fermentation (Figure 3d). Overall, Romanian Sauvignon blanc wines show quality improvements, with higher alcohol and lower volatile acidity, although further study is needed to understand the impact on flavor and stability [Scutarașu et al., 2022].

CONCLUSIONS

This study reveals distinct correlations between physico-chemical properties and terroir in Romanian white wines, specifically Fetească albă (FA) and Sauvignon blanc (SB) from diverse vineyards. Higher reducing sugar content generally increases wine density, while elevated alcohol content correlates with lower sugar levels, particularly in warmer, lower-latitude regions like Dealu Mare, which fosters greater sugar accumulation.

Latitude influences alcohol content, with cooler, northern areas like Târnave yielding lower alcohol due to limited sugar development. Total acidity (TA) and volatile acidity (VA) display regional variability, with cooler climates supporting acidity retention, crucial for freshness.

The clustering of SO_2 levels by vineyard suggests that both regional climate conditions and winemaking practices significantly impact SO_2 concentrations in

Romanian wines. Vineyards in warmer regions, such as Dealu Bujorului and Dealu Mare (Vișinescu W.), exhibit higher SO_2 levels, likely due to the need for greater preservation measures. In contrast, cooler areas like Târnave show lower SO_2 concentrations, indicative of minimal intervention practices.

Stability in acidity and pH by 2021 indicates aging potential, while annual variations in VA and free SO_2 underscore the impact of grape type and vintage. Terroir distinctions are pronounced in alcohol, SO2, and VA levels, highlighting unique profiles shaped by both natural conditions and winemaking practices across regions.

REFERENCES

1. **Brillante L., Bonfante A., Bramley R.G.V., Tardaguila J., Priori S., 2020 -** *Unbiased Scientific Approaches to the Study of Terroir Are Needed!* Frontiers in Earth Science, 8, 539377.
2. **García-Martín N., Perez-Magariño S., Ortega-Heras M., González-Huerta C., Mihnea M., González-Sanjosé M.L., Palacio L., Prádanos P., Hernández A., 2010 -** *Sugar reduction in musts with nanofiltration membranes to obtain low alcohol-content wines.* Separation and Purification Technology, 76, p. 158–170.
3. **Goold H.D., Kroukamp H., Williams T.C., Paulsen I.T., Varela C., Pretorius I.S., 2017 -** *Yeast's balancing act between ethanol and glycerol production in low-alcohol wines.* Microbial Biotechnology, 10, p. 264–278.
4. **Jordão A., Vilela A., Cosme F., 2015 -** *From Sugar of Grape to Alcohol of Wine: Sensorial Impact of Alcohol in Wine.* Beverages 1, p. 292–310.
5. **Koone R., Harrington R.J., Gozzi M., McCarthy M., 2014 -** *The role of acidity, sweetness, tannin and consumer knowledge on wine and food match perceptions.* Journal of Wine Research, 25, p. 158–174.
6. **Morgan, S.C., Scholl, C.M., Benson, N.L., Stone, M.L., Durall, D.M., 2017.** *Sulfur dioxide addition at crush alters Saccharomyces cerevisiae strain composition in spontaneous fermentations at two Canadian wineries.* International Journal of Food Microbiology, 244, p. 96–102.
7. **OIV, 2023 -** *Compendium of international methods of wine and must analysis*, Dijon.
8. **Scutarașu, E.C., Luchian, C.E., Vlase, L., Nagy, K., Colibaba, L.C., Trinca, L.C., Cotea, V.V., 2022.** *Influence Evaluation of Enzyme Treatments on Aroma Profile of White Wines.* Agronomy, 12, 2897.
9. **Van Leeuwen C., Barbe J.C., Darriet P., Geffroy O., Gomès E., Guillaumie S., Helwi P., Laboyrie J., Lytra G., Le Menn N., Marchand S., Picard M., Pons A., Schüttler A., Thibon C., 2020 -** *Recent advancements in understanding the terroir effect on aromas in grapes and wines.* OENO One, 54(4): 985–1006.
10. **Van Leeuwen C., Roby J.-P., De Rességuier L., 2018 -** *Soil-related terroir factors: a review.* OENO One, 52, p. 173–188.
11. **Vaudour E., Costantini E., Jones G.V., Mocali S., 2015 -** *An overview of the recent approaches to terroir functional modelling, footprinting and zoning.* SOIL, 1, p. 287–312.

HEAVY METAL IDENTFICATION IN WINERY WASTEWATER

IDENTIFICAREA METALELOR GRELE ÎN APELE UZATE DIN CRAMĂ

GABUR Georgiana-Diana[1]*, TEODOSIU Carmen[2], PLĂVAN Oana[2], MOROȘANU Irina[2], FIGHIR Daniela[2], CARA Irina Gabriela[1], COTEA V. Valeriu[1]

*Corresponding author e-mail: diana.gabur@iuls.ro

Abstract.
Wastewater is generated at every stage of wine production, mostly from cleaning equipment, floors, tanks, barrels and bottles. Wastewater contains heavy metals and other toxic compounds that can pose environmental hazards risks. This study quantified the concentrations of key heavy metals (lead, chromium, manganese, copper, and iron) in wastewater from a winery at different stages of the winemaking process. The results showed that all heavy metal concentrations were consistently below the maximum permitted limits, in compliance with environmental regulations. Lead concentrations decreased significantly from 24.03 µg/L after pressing stage to 9.44 µg/L after bottling stage. Manganese showed fluctuations throughout the process, while copper concentrations decreased significantly, indicating effective removal of residues. Overall, the findings suggest that the winemaking process effectively reduces heavy metal concentrations in wastewater, ensuring compliance with environmental standards.
Key words: wastewater, heavy metals, winemaking stages, environmental impact.

Rezumat.
Apele uzate sunt generate în fiecare etapă a vinificației, în special în urma spălării echipamentelor, podelelor, tancurilor de oțel, baricurilor și a sticlelor. Apele uzate conțin metale grele și alți compuși toxici care pot prezenta riscuri pentru mediu. În acest studiu s-au cuantificat concentrațiile principalelor metale grele (plumb, crom, mangan, cupru și fier) din apele uzate provenite dintr-o cramă, în diferite etape ale procesului de vinificație. Rezultatele au arătat că toate concentrațiile de metale grele au fost constant sub limitele maxime permise, în conformitate cu reglementările de mediu. Concentrațiile de plumb au scăzut semnificativ de la 24,03 µg/L după etapa de presare la 9,44 µg/L după etapa de îmbuteliere. Manganul a prezentat fluctuații pe parcursul procesului de vinificație, în timp ce concentrațiile de cupru au scăzut semnificativ, indicând o îndepărtare eficientă a urmelor de metale. În

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania
[2] "Gheorghe Asachi" Technical University of Iasi, Romania

general, rezultatele sugerează că procesul de vinificație reduce eficient concentrațiile de metale grele din apele uzate, contribuind astfel la respectarea standardelor de mediu

Cuvinte cheie: ape uzate, metale grele, etapele vinificației, impact asupra mediului

INTRODUCTION

The wine industry plays a vital role in many countries, contributing significantly to the economy, local communities, and tourism. The winery industry plays a major role in the global food-processing sector, with the wine market valued at $340 billion in 2020 and anticipated to grow to $460 billion by 2028.

The winemaking process involves several stages, like as: grape harvesting, destemming and crushing, pressing, fermentation, clarification, ageing, filtration, and bottling. Throughout these stages, large amounts of wastewater, also known as winery wastewater or process effluent, are generated. Wine production uses a considerable amount of resources, which in turn leads to the creation of large quantities of wastewater (from 0.2 to 4 liters per liter of wine produced) [Holtman et. al., 2022]. This wastewater includes spilled wine or juice, wash water, cooling water, cleaning chemicals and leachate from solid byproducts.

Winery effluent concerns include heavy metals, biodegradable organics, solids and nitrogen. While the land application of winery wastewater can improve soil fertility and nutrient availability for plants, excessive application may lead to nitrate leaching, groundwater contamination, unpleasant odors, and anaerobic conditions, which can release metals like iron and manganese under acidic conditions. The quality of winery wastewater varies depending on the stage of winemaking (vintage, racking, bottling), the winemaking techniques employed (such as producing red, white, or special wines), the operation of the winery, and the cleaning chemicals used [Amor et al., 2019].

Given the significant environmental impact associated with the improper disposal of winery wastewater, it is essential to monitor its quality throughout the winemaking process. The purpose of this study is to investigate the concentrations of heavy metals in winery wastewater at various stages of the winemaking process, with the aim of enhancing wastewater management practices and contributing to the sustainability of the wine industry.

MATERIAL AND METHOD

For this study, red wine was collected from the 2023 vintage at the Iasi vineyard in Romania. The grapes were hand-harvested at optimal maturity and under ideal sanitary conditions. Standard winemaking procedures were followed at the pilot scale at the "Ion Ionescu de la Brad" Iasi University of Life Sciences. The complete winemaking process, along with wastewater sample collection, occurred after the following stages: pressing, aging, filtration, and bottling. The study focused on five key heavy metals: manganese (Mn), iron (Fe), copper (Cu), lead (Pb), and chromium (Cr).

The procedure for determining heavy metals was based on methods previously described by Dumitriu Gabur et al. [2021].

RESULTS AND DISCUSSIONS

The quality of winery wastewater depends on various factors, including the operational setup of the winery, water management practices, sanitation protocols, seasonal changes, and the winemaking stage. These variables lead to a wide range of wastewater characteristics. Winery wastewater is typically acidic and contains high levels of total solids (TS), volatile solids (VS), dissolved solids (DS), 5-day biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), total Kjeldahl nitrogen (TKN), and total phosphorus (TP) (Table 1). The low pH is primarily due to the acidic nature of grape juice, alcoholic compounds, and organic acids released from the crushed fruit and fermentation by-products. The elevated BOD concentration is attributed to biodegradable components such as alcohols (mainly ethanol), sugars (glucose and fructose), organic acids (such as lactic, tartaric, citric, malic, and succinic acids), and glycerin. In contrast, COD reflects more persistent organic substances, including polyphenols, tannins, and lignins.

Improper discharge or land application of winery wastewater into receiving waters can lead to several environmental issues. Oxygen depletion may occur due to the microbial breakdown of organic carbon and nitrogen, resulting in a decrease in dissolved oxygen levels, which can harm aquatic and amphibious life. Additionally, this process can cause odor issues, increase concentrations of nitrites and nitrates, promote eutrophication, and lead to higher emissions of nitrous oxide as ammonia is oxidized and nitrate is reduced. Releasing untreated wastewater can cause significant harm to ecosystems, including water contamination, soil degradation, and damage to vegetation [Chatzilazarou et al., 2010]. Uncontrolled wastewater discharge contributes to the eutrophication of water bodies (such as rivers, wetlands, and natural streams) by rapidly consuming dissolved oxygen, which depletes oxygen levels and threatens aquatic life.

While winery wastewater can be reused for irrigation, improper monitoring can alter soil properties, such as pH, color, and electrical conductivity, due to the release of inorganic and organic ions. The high acidity of the wastewater can negatively affect plant growth by reducing essential nutrients like calcium and phosphorus and by decreasing the population of beneficial microbes. Additionally, previous studies have shown that winery wastewater contains high concentrations of phenolic compounds, which can cause significant environmental damage. These compounds can be toxic to animals, humans, and microorganisms even at low concentrations and are highly resistant to biodegradation [Strong et al., 2008].

In most treatment cases, the presence of heavy metals in winery wastewater is often overlooked, with the focus primarily on reducing the organic load. This is because, in many instances, the concentrations of heavy metals in winery wastewater are relatively low.

Table 1

Properties of winery wastewater

Parameters	Johnson and Mehrvar [2020]	Remmas [2022]	Ngwenya et al. [2022]	Vlotman et al. [2022]	Latessaa et al. [2023]
pH	2.80 - 11.0	3.6 - 4.9	3.4 - 6.9	3.0 - 12.9	2.50 - 9.38
Total solids (TS), g/L	0.75 - 188	-	0.03 - 154	1.60 - 79.6	0.00 - 82.0
Volatile solids (VS), g/L	0.3 - 128	-	0.01 - 130	0.13 - 55.0	0.00 - 69.0
Total suspended solids (TSS), g/L	0.007 - 84.4	0.08 - 2.4	0.14 - 65.6	0.1 - 30.3	0.00 - 9.00
Conductivity, mS/cm	0.36 - 1.17	-	-	-	-
Chemical oxygen demand (COD), g/L	0.04 - 360	0.5 - 15.9	2.60 - 273	0.34 - 296	0.15 - 45.6
5-day biochemical oxygen demand (BOD_5), g/L	0.15 - 96.0	0.15 - 8.0	-	0.13 - 130	0.12 - 16.5
Total nitrogen (TN), mg/L	-	60 - 200		10 - 415	1.4 - 328
Total Kjeldahl nitrogen (TKN), mg/L	0.51 - 14300	-	6 - 1350	-	3.2 - 374
Ammonia-N, mg/L	0.20 - 395	-	-	-	0.22 - 24.0
Total phosphorus (TP), mg/L	0.70 - 1120	10 - 55	7.0 - 250	3.3 - 188	0.29 - 106
Phenols, mg/L	-	30 - 200	-	-	0.19 - 268
Na, mg/L	1.0 - 1160	-	-	29 - 460	0.2 - 396
K, mg/L	12.4 - 8000	-	-	7 - 1000	205 - 1445
Ca, mg/L	1.8 - 1910	-	-	-	-
Mg, mg/L	1.1 - 530	-	-	-	-
Fe, mg/L	0.17 - 335	-	-	-	-

The concentrations of the main heavy metals in the wastewater collected from a winery were quantified, and the results are summarized in Table 2. All concentrations of heavy metals identified in the wastewater from winemaking were below the maximum permitted limits, in compliance with legislative requirements.

The concentrations of lead (Pb) decrease consistently from 24.03 µg/L after pressing to 9.44 µg/L after bottling. This suggests a reduction in lead contamination throughout the winemaking process, which is good, as it is significantly below the maximum permitted limits for wastewater discharges.

Chromium (Cr) concentrations are relatively low throughout the process, with a slight decrease from 0.60 µg/L after pressing to 0.27 µg/L after filtration, followed by a sharp increase to 3.17 µg/L after bottling. This behavior could indicate the accumulation of chromium in the wine during last stage, possibly from

contamination sources that were not fully removed. However, the concentration is low, below the maximum allowed limit.

Manganese (Mn) shows large fluctuations during the winemaking process, from 521.12 µg/L in pressing to 534.61 µg/L in bottling. These fluctuations may suggest that manganese is both absorbed and released during the different winemaking stages.

Table 2

Heavy metal concentrations in wastewater at different stages of winemaking

Parameters	Pressing	Aging	Filtration	Bottling
Pb (µg/L)	24.03 ± 0.39	16.67 ±0.18	13.54 ± 0.13	9.44 ± 0.04
Cr (µg/L)	0.60 ± 0.03	0.47 ± 0.01	0.27 ± 1.67	3.17 ± 0.01
Mn (µg/L)	521.12 ± 0.86	156.39 ± 0.06	310.04 ± 2.86	534.61 ± 5.48
Cu (µg/L)	629.85 ± 0.63	95.30 ± 0.44	44.24 ± 2.52	82.38 ± 0.29
Fe (µg/L)	169.23 ± 0.68	209.29 ± 0.72	236.36 ± 9.84	254.75 ± 0.63

Copper (Cu) concentrations decrease significantly from 629.85 µg/L after pressing to 82.38 µg/L after bottling. The reduction of copper over the stages of winemaking suggests that some impurities are removed, which likely benefits the wine's quality and environmental safety.

Iron (Fe) concentrations slightly increase from 169.23 µg/L after pressing to 254.75 µg/L after bottling. This could indicate a gradual accumulation of iron in the wine as it passes through various stages, which could affect the taste and stability of the wine, as iron is involved in oxidation processes.

The maximum allowable concentrations of heavy metals in wastewater discharges in Romania are 0.2 mg/L for copper (Cu), 1 mg/L for nickel (Ni), 0.3 mg/L for cadmium (Cd), 1.5 mg/L for chromium (Cr), and 0.5 mg/L for lead (Pb) when discharging into the sewerage system, and 0.1 mg/L for copper (Cu), 0.5 mg/L for nickel (Ni), 0.2 mg/L for cadmium (Cd), 1 mg/L for chromium (Cr), and 0.2 mg/L for lead (Pb) when discharging into rivers, as per NTPA002/2002 and NTPA001/2002 regulations.

CONCLUSIONS

Winery wastewater is generated in large volumes due to the need for sanitation of the facilities in order to maintain wine quality. The concentrations of heavy metals in wastewater decrease during most stages of winemaking, with some fluctuations observed, particularly in manganese and iron levels. The final concentrations at the bottling stage remain low, well below the maximum allowable limits for wastewater discharges. This indicates that the winemaking process effectively reduces the environmental impact, making the wastewater safe for disposal and minimizing potential harm to the environment.

Future efforts should focus on monitoring wastewater flow rates and pollutant concentrations, as these are essential for accurately assessing pollutant

mass loading, optimizing treatment processes, designing efficient wastewater management systems, and ensuring the sustainability of the winery.

ACKNOWLEGMENTS

This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS-UEFISCDI, project number PN-IV-P2-2.1-TE-2023-0333, within PNCDI IV.

REFERENCES

1. **Amor C., Marchao L., Lucas M.S., Peres J.A., 2019** - *Application of advanced oxidation processes for the treatment of recalcitrant agro-industrial wastewater: a review*. Water 11 (2), 205.
2. **Chatzilazarou A., Katsoyannos E., Gortzi O., Lalas S., Paraskevopoulos Y., Dourtoglou E., Tsaknis J., 2010** - *Removal of Polyphenols from Wine Sludge Using Cloud Point Extraction.* J. Air Waste Manag. Assoc, 60, 454–459.
3. **Dumitriu (Gabur) G.-D., Teodosiu C., Morosanu I., Plavan O., Gabur I., & Cotea V. V., 2021** - *Heavy metals assessment in the major stages of winemaking: Chemometric analysis and impacts on human health and environment.* Journal of Food Composition and Analysis, 100, 103935. doi:10.1016/j.jfca.2021.103935.
4. **Holtman G.A., Haldenwang R., Welz P.J., 2022** - *Calcite dissolution and bioneutralization of acidic wastewater in biosand reactors*, Water (Switzerland) 14.
5. **Johnson M.B., Mehrvar M., 2020** - *Winery wastewater management and treatment in the Niagara Region of Ontario, Canada: a review and analysis of current regional practices and treatment performance.* Can. J. Chem. Eng. 98 (1), 5–24.
6. **Latessaa H. S., Hanleyb L., Taob W., 2023** - *Characteristics and practical treatment technologies of winery wastewater: A review for wastewater management at small wineries.* Journal of Environmental Management, 342, 118343.
7. **Ngwenya N., Gaszynski C., Ikumi D., 2022** - *A review of winery wastewater treatment: a focus on UASB biotechnology optimisation and recovery strategies.* J. Environ. Chem. Eng. 10 (4), 108172.
8. **Remmas N., 2022** - *Biotreatment potential and microbial communities in aerobic bioreactor systems treating agro-industrial wastewaters*. Processes 10 (10), 1913. https://doi.org/10.3390/pr10101913.
9. **Strong P.J., Burgess J.E., 2008** - *Treatment Methods for Wine-Related and Distillery Wastewaters: A Review*. Bioremediat. J. 2008, 12, 70–87.
10. **Vlotman D.E., Key D., Bladergroen B.J., 2022** - *Technological advances in winery wastewater treatment: a comprehensive review.* South Afr. J. Enol. Vitic. 43 (1), 62–84.

STUDY ON THE ENRICHMENT OF THE NUTRITIONAL VALUE OF DEHYDRATED APPLES

STUDIU PRIVIND ÎMBOGĂȚIREA VALORII NUTRITIVE A MERELOR DESHIDRATATE

BUȚERCHI Ioana[1*], ENACHE Iuliana-Maria[1], CIURLĂ LUCESCU Liliana[1], PATRAŞ Antoanela[1], IRIMIA Liviu Mihai[1]

*Corresponding author email: liviu.irimia@iuls.ro

Abstract

In order to preserve a horticultural product for as long as possible, various preservation methods can be used to extend its shelf life and preserve its nutritional value. Drying food is one of the oldest methods of preserving food for later use, being simple, safe, low cost and preserves nutrients after process. Dried fruits are well-known for their nutritional and dietary properties, such as natural and concentrated sources of sugars, vitamins A, C, niacin, riboflavin and folic acid, potassium, iron and copper, as well as organic acids, phytonutrients with antioxidant properties. Most commercially available dried apple slices are not enriched, leading to an underrating of this healthy and natural snack.

The aim of this study was to enrich the nutritional value of sliced apple dried used only natural products: fresh lemon juice, beetroot peel powder and cinnamon. The product represents the perfect combination of sweet and sour, with an interesting balanced taste, being an alternative healthy snack for consumers.

Keywords: dehydration process, nutritional, quality, healthy snack.

Rezumat

Pentru a păstra un produs horticol cât mai mult timp, se pot folosi diferite metode de conservare cu scopul de a prelungi durata de depozitare și de a păstra valoarea nutritivă a acestuia. Deshidratarea este una dintre cele mai vechi metode de conservare a alimentelor pentru utilizare ulterioară, fiind simplă, sigură, cu costuri reduse prin intermediul căreia se conservă substanțele nutritive după proces. Fructele deshidratate sunt bine cunoscute pentru proprietățile lor nutriționale și dietetice, cum ar fi surse naturale și concentrate de zaharuri, vitaminele A, C, niacină, riboflavină și acid folic, potasiu, fier și cupru, precum și acizi organici, fitonutrienți cu proprietăți antioxidante. Majoritatea feliilor de mere deshidratate existente în comerț nu sunt îmbogățite nutritiv, ceea ce duce la o subestimare a acestei gustări sănătoase și naturale. Scopul acestui studiu a fost de a îmbogăți valoarea nutritivă a feliilor de mere deshidratate folosind doar produse naturale: suc proaspăt de lămâie, pudră de coajă de sfeclă roșie și scorțișoară. Produsul reprezintă combinația perfectă

[1] ”Ion Ionescu de la Brad” Iași University of Life Sciences, Romania

între dulce și acrișor, echilibrată și interesantă, fiind o alternativă de gustare sănătoasă pentru consumatori.
Cuvinte cheie: deshidratare, nutritiv, calitate, gustare sănătoasă.

INTRODUCTION

In areas with a temperate climate, apple culture is very widespread and well-known, with apples occupying the first place in terms of production volume, their demand on the market and, last but not least, their qualitative-food value.

One of the first techniques for storing food for later use is drying it. It can be either an alternative to preserving or freezing, or to supplement these methods, being simple, safe and a low-cost method that preserves nutrients after finished process [Beceanu, 2010; Beceanu, 2011].

Apples are cultivated extensively around the world, and there is a great market for the wide range of types. The tastes and textures of apples are what consumers appreciate most about them. Apple consumption has been associated with the prevention of chronic diseases [Jakopic *et al*., 2009] due to their high antioxidant capacity and important source of polyphenols [Lotito and Frei, 2004].

Recovery of plant byproducts (fruits and vegetables) such as peels, seeds or pomace, can fulfill the requirements for production of natural pigments at industrial level for food potential.

These byproducts are a rich source of natural pigments (anthocyanins, betalains, carotenoids, chlorophylls, etc.) being an important source of nutrients for consumer health [Sharma et al, 2021].

Fresh apples have a high nutritional value due to their very balanced composition and biochemical components being easily accessible to the human body and organoleptic, visual, sensory and taste characteristics.

The main components of *apple (Malus domestica)* are represented by: water 80-85%, total sugars 6.5-17%, proteins 0.3%, lipids 0.4%, minerals 0.32%, organic acids 0.65%, minerals 0.32%, vitamin C 4.6 mg/100g product, vitamin A 3 µg., vitamin B1 0,017 mg., vitamin B_2 0.026 mg., vitamin B_3 0.091 mg., Ca 6 mg., 0.12 mg. Fe, 5 mg Mg, 11 mg P, 107 mg. K, 1 mg Na, 0.04 mg Zn, etc. [Irimia, 2013].

Apple fruits can be consumed fresh for a long time when stored properly or can also be processed into products like dried apples, apple sauce, marmalades, jelly, etc. Also, apple fruits are known for their taste attributes, nutritional, medicinal, and prophylactic values [Irimia, 2013].

Beetroot *(Beta vulgaris L.)* is famous crop with an important phytochemical compound, for its juice value and medicinal properties, having a bright crimson color. The intense red color of beetroots derives from high concentrations of betalains [Gandia et al. 2010], which are used as natural colorants in the food industry. Also, it is an important vegetable due to benefits in humans' health, especially for their anti-inflammatory properties [Georgiev et al., 2010], important antioxidant capacity and anti-bacterial activity [Mello et al, 2014; Sharma et al, 2021].

Cinnamon *(Cinnamomum zeylanicum,* and *Cinnamon cassia)* primarily contains vital oils and other derivatives, such as cinnamaldehyde, cinnamic acid, and cinnamate. In addition to being an antioxidant, anti-inflammatory, antidiabetic, antimicrobial, anticancer, lipid-lowering, and cardiovascular-disease-lowering compound [Rao and Gan, 2014].

Cinnamon is mainly used in the aroma and essence industries due to its fragrance, which can be incorporated into different varieties of foodstuffs, perfumes, and medicinal products [Huang et al, 2007].

Lemon (*Citrus limon*). The biologically activity of lemon fruit is determined by its high content of phenolic compounds, mainly flavonoids (e.g, diosmin, hesperidin, limocitrin) and phenolic acids (e.g., ferulic, p-hydroxybenzoic acids). The essential oil is rich in bioactive monoterpenoids such as D-limonene, β-pinene, γ-terpinene. It has recently been scientifically proven that the therapeutic activities of *C. limon* include anti-inflammatory, antimicrobial, anticancer and antiparasitic activities [Szczykutowicz et al, 2019].

Therefore, the aim of this research was undertaken to explore natural and safe food ingredients such as natural pigments by using byproducts of fruits or vegetables with potential health benefits.

MATERIALS AND METHODS

Experimental protocol for obtain dried apples slices. The base for the product were fresh and healthy apples, with the right size and degree of maturation. Product uses only natural ingredients which consists in sliced healthy apples dipped in fresh lemon juice combined with beetroot peel powder and seasoned with cinnamon powder.

Drying process. To produce dried fruits was used simple hot air dehydration equipment, with optimized work efficiency and performance in a reasonable time. The dehydrated fruits were kept in the dehydrator for 6 hours at 37 degrees Celsius in order not to affect the chemical composition.

Chemical parameters. The following chemical parameters have been evaluated: soluble solids concentration, total sugar, humidity, total dry matter, total acidity, *p*H, ascorbic acid content, antioxidant activity in concordance with standards of fruits and vegetables [Beceanu, 2010; Irimia, 2013; Murariu et al., 2017].

The antioxidant capacity of the samples in this study was assessed using methanol, 6-hydroxy-2,5,7,8-tetramethylchromane-2-carboxylic acid, and 2,2-Diphenyl-1-picrylhydrazyl (analytical grade, Sigma Aldrich, Germany) as reagents and the DPPH method, which is briefly described by Vasile *et al*., (2020). express as mMol Trolox Equivalents (TE)/ gram dry weight (g D.W.)

Chromatic parameters. The colorimetric parameters were evaluated using a HunterLab colorimeter (MiniScan® XE Plus). Lastly, the display of the scientific equipment indicates three variables: L* (brightness) and two-color characteristics (a* and b*):

L*: 0 for black, 100 for white;

a*: negative values for green shades or positive values for red shades;

b*: shades of blue (negative values) or yellow (positive values).

In addition, c* (chroma), h*(tone) and ΔE* (tone difference) were calculated by using L*, a* and b* parameters with equation (1), (2) and (3).

$c^*=\sqrt{(a^{*2}+b^{*2})}$ (1) [Pătraşcu et al., 2013]

$h^*=\arctg(b^*/a^*)$ (2) [Patsilinakos et al., 2018]

$\Delta E^*=\sqrt{(L^{*2}+a^{*2}+b^{*2})}$ (3) [Hanbury and Serra, 2011]

RESULTS

The dried apples slices have been analyzed in terms of chemical and colorimetric parameters according to the standards applied in food industry.

The results shown in Tables 1 and 2 confirm that product present considerable nutritional values due to the chemical compounds and antioxidant capacity especially.

Table 1

Chemical parameters of dried apples slices

	Parameters	Quantity	Unit
1	Dry matter soluble content	56±0.2	°Bx
2	Total sugars	23.88±0.15	g
3	Water content	19.8±0.12	%
4	Dry matter total content	80.2±0.05	%
5	Total acidity	2.14±0.2	g malic acid/100 g product
6	*p*H	4.1±0.5	*p*H units
7	Ascorbic acid content	44.88±0.2	mg/100 g product
8	Antioxidant activity	151.90±1.03	mMol TE/g D.M.

Table 2

Colorimetric parameters

	Parameters	Quantity	Unit
1	L*	4.98±0.30	CieLab parameters
2	a*	20.4±0.11	
3	b*	6.02±+0.02	
4	c*	23.01±3.18	
5	h*	0.26±0.00	
6	ΔE*	14.26±3.50	

According to Irimia, 2013, fresh apples contain 12-14% total dry matter (depending on the variety) and dehydrated apples slices obtained a value of 56% due to the other ingredients used.

Also, fresh apples water content varies between 80-85% while dehydrated apples slices obtain 19.8% due to the drying process. In general, dehydrated fruits should have a low water content, between 4-20%.

The total antioxidant activity (TAA) of beetroot is significantly correlated with the concentration of vitamins (e.g., ascorbic acid) and bioactive chemicals (e.g., betalains, etc.). The samples in this research had notably high antioxidant levels 151.90 mMol TE/g D.W.). Using the DPPH approach, Bucur *et al*. [2016] demonstrated that TAA red beetroot can be as much as 35.88% IC50 if the test sample is fresh rather than frozen. Due to the complexity of the food matrix (fresh

apples, red beet peels, lemon juice and cinnamon powder), which include natural antioxidants, it can be observed that there is an enrichment of the nutritional value of the product.

The results acquired for the L* parameter (4.98±0.30) showed a light product (brightness) with yellow (related with positive value for b* parameter 6.02±+0.02) and red (due to positive values obtained for a* parameter, 20.4±0.11) colors.

Additionally, there is a correlation between red color of dried apples slices test and its bioactive components, including betalains, which are significant sources of red pigments found in beetroot or beetroot peel.

CONCLUSIONS

To enhance the quality and color of products, vegetable waste can be valued and used to generate natural colors.

The beetroot coloring improves quality of the sliced apple due to its intense red color, as evidenced by colorimetric analysis, but also by the contribution of bioactive compounds with benefits on the human body.

Dried apple slices shown high antioxidant activity due to the high nutritional value of the by-products used and also due to chemical compounds of the other components used in technology.

The modern consumer's demand for such products and their attractiveness to the market will also have a significant impact.

Recent research indicates that apples, when compared to other common fruits, are a great source of bioactive phenolic phytochemicals, which may have unique nutraceutical effects.

The results contribute to the enrichment of the literature and to the optimization of the technology to obtain nutritionally enriched dehydrated fruit.

The dehydrated apples slice meets the requirements of the consumer for a quick and healthy snack for all ages.

ACKNOLEDGEMENT

The authors are grateful for the technical support provided by the Horticultural Research Centre of the Faculty of Horticulture of the University for Life Sciences "Ion Ionescu de la Brad" Iasi (http://www.uaiasi.ro/horticultura/centru_cercet.php).

REFERENCES

1. **Beceanu D., 2011** - Tehnologia produselor horticole 2, Ed. Pim, Iași.
2. **Beceanu. D., 2010** - Tehnologia prelucrării legumelor și fructelor. Cunoștiințe de bază și aplicații practice, Ed. Pim, Iași.
3. **Bucur L., Ţarălungă G., Schroder V., 2016** -The betalains content and antioxidant capacity of red beet (Beta vulgaris L. subsp. vulgaris) root, Farmacia, 64 (2), 198-201
4. **Gandia F, Escribano J, Garcia F., 2010** - Structural implications on color, fluorescence, and antiradical activity in betalains. An International Journal of Plant Biology. 2010; 232(2):449-460.
5. **Georgiev VG, Weber J, Kneschke EM, Denev PN, Bley T, Pavlov AI., 2010 -** Antioxidant activity and phenolic content of betalain extracts from intact plants and

hairy root cultures of the red beetroot (*Beta vulgaris*). Journal of Plant Foods for Human Nutrition. 2010; 65(2):105-111.

6. **Hanbury A., Serra J., 2011 -** Mathematical morphology in the CIELAB space. Image Analysis & Stereology, 21 (3), (2011), 201–206. https://doi.org/10.5566/ias.v21.p201-206
7. **Huang T.-C., H.-Y. Fu, C.-T. Ho, D. Tan, Y.-T. Huang, and M.-H. Pan, 2007 -** Induction of apoptosis by cinnamaldehyde from indigenous cinnamon Cinnamomum osmophloeum Kaneh through reactive oxygen species production, glutathione depletion, and caspase activation in human leukemia K562 cells," Food Chemistry, vol. 103, no. 2, pp. 434–443, 2007.
8. **Irimia L., 2013** - Controlul și expertiza calității legumelor, fructelor și produselor derivate, Ed. "Ion Ionescu De La Brad", Iași.
9. **Jakopic J., Stampar F., Veberic, R., 2009 -**The influence of exposure to light on the phenolic content of 'Fuji' apple. Scientia Horticulturae 123:!234G239.
10. **Lotito S., Frei B., 2004** - Relevance of apple plyphenols as antioxidants in human plasma: contrasting in vitro and in vivo effects. Free Radical Biology & Medicine 36: 201G211.
11. **Mello FR, de Bernardo C, Dias CO, et al., 2014** - Antioxidant properties, quantification and stability of betalains from pitaya (Hylocereus undatus) peel. Cienc Rural. 2014;45(2):323–328.
12. **Murariu Otilia Cristina, Liviu Mihai Irimia, Teodor Robu, 2017 -** Analiza și controlul calității produselor din fructe și legume, îndrumător de lucrări practice. Editura Ion Ionescu de la Brad. Iași.
13. **Pătraşcu L., Dobre I., Alexe P., 2013** - Effect of tumbling time, injection rate and k-carrageenan addition on processing, textural and color characteristics of pork Biceps femoris muscle. Annals of the University Dunarea de Jos of Galati, Fascicle VI: Food Technology, 37 (1), (2013), 69–84
14. **Patsilinakos A., Ragno R., Carradori S., Petralito S., Cesa S., 2018** - Carotenoid content of Goji berries: CIELAB, HPLC-DAD analyses and quantitative correlation. Food Chemistry, 268 (1), 49–56. https://doi.org/10.1016/j.foodchem.2018.06.013
15. **Rao P. V. and Gan S. H., 2014** - Review article: Cinnamon: A Multifaceted Medicinal Plant. Evidence-Based Complementary and Alternative Medicine, Article ID 642942, http://dx.doi.org/10.1155/2014/642942.
16. **Sharma Minaxi, Zeba Usmani, Vijai Kumar Gupta & Rajeev Bhat, 2021** - Valorization of fruits and vegetable wastes and byproducts to produce natural pigments, Critical reviews in Biotechnology 2021, vol. 41, no. 4, 535–563, https://doi.org/10.1080/07388551.2021.1873240.
17. **Szczykutowicz Klimek Marta, Agnieszka Szopa, Halina Ekiert, 2019** - Review Citrus limon (Lemon) Phenomenon-A Review of the Chemistry, Pharmacological Properties, Applications in the Modern Pharmaceutical, Food, and Cosmetics Industries, and Biotechnological Studies. Plants 2020, 9, 119.
18. **Vasile, M.A.; Milea, Ș.A.; Enachi, E.; Barbu, V.; Circiumaru, A.; Bahrim, G.E.; Râpeanu, G.; Stănciuc, N., 2020 -** Functional Enhancement of bioactives from black beans and lactic acid bacteria into an innovative food ingredient by comicroencapsulation. Food and Bioprocess Technology. 2020, 13, 978-987. https://doi.org/10.1007/s11947-020-02451-8.

THE EFFECT OF SUPPLEMENTAL OXYGENATION AND LED LIGHTING ON ROOT DEVELOPMENT AND CARBOHYDRATE CONTENT IN LETTUCE GROWN IN THE NFT SYSTEM (NUTRIENT FILM TECHNIQUE)

EFECTUL OXIGENĂRII SUPLIMENTARE ŞI AL ILUMINĂRII CU LED ASUPRA DEZVOLTĂRII RĂDĂCINILOR ŞI CONŢINUTULUI DE CARBOHIDRAŢI LA SALATA CRESCUTĂ ÎN SISTEMUL NFT (NUTRIENT FILM TECHNIQUE).

NIŢU Oana Alina[1], IVAN Elena Ştefania[2], GHEORGHEMarinela[1]
*Corresponding author e-mail elena.ivan@qlab.usamv.ro

Abstract.
The NFT system is a type of hydroponics where a thin layer of nutrient solution constantly circulates over the plant roots. This ensures continuous access to water, nutrients, and oxygen, which promotes rapid and healthy plant growth. Controlling the conditions in this system, such as oxygen levels and lighting, plays a crucial role in the efficiency of photosynthesis and, implicitly, in carbohydrate content.
Oxygen is essential for plant growth, especially for the roots, as it aids in root respiration. In hydroponic systems like NFT, water and nutrients are recirculated, and the oxygen level in the nutrient solution can affect plant metabolism, including carbohydrate synthesis. Supplemental oxygenation of the nutrient solution can improve nutrient uptake and photosynthesis, which could increase carbohydrate levels in lettuce.
LED lights are frequently used in plant cultivation because they are energy-efficient and can be adjusted to provide the light spectrum necessary for photosynthesis.
Key words: Oxygen, roots, nutrients, respiration, carbohydrates

Rezumat.
Sistemul NFT este un tip de hidroponie în care un strat subțire de soluție nutritivă circulă constant peste rădăcinile plantelor. Acest lucru asigură accesul continuu la apă, nutrienți și oxigen, ceea ce promovează o creștere rapidă și sănătoasă a plantelor. Controlul condițiilor din acest sistem, cum ar fi nivelurile de oxigen și iluminarea, joacă un rol crucial în eficiența fotosintezei și, implicit, în conținutul de carbohidrați.
Oxigenul este esențial pentru creșterea plantelor, în special pentru rădăcini, deoarece ajută la respirația acestora. În sistemele hidroponice precum NFT, apa și nutrienții sunt recirculați, iar nivelul de oxigen din soluția nutritivă poate afecta metabolismul plantelor, inclusiv sinteza carbohidraților. Oxigenarea suplimentară a soluției nutritive poate

[1] University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Land Reclamation and Environmental Engineering, Romania
[2] Research Center for Studies of Food Quality and Agricultural Products, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania

îmbunătăți absorbția nutrienților și fotosinteza, ceea ce ar putea crește nivelul de carbohidrați din salată.
Lămpile LED sunt frecvent utilizate în cultivarea plantelor deoarece sunt eficiente din punct de vedere energetic și pot fi ajustate pentru a furniza spectrul de lumină necesar pentru fotosinteză.
Cuvinte cheie: Oxigen, rădăcini, nutrienți, respirație, carbohidrați.

INTRODUCTION

Lettuce, scientifically known as *Lactuca sativa* L., is a vegetable plant belonging to the Asteraceae (Compositae) family. This family includes numerous genera and species spread across the globe. Other plants in the same family include chicory (*Cichorium intybus* L.), sunflower (*Helianthus annuus*), and dandelion (*Taraxacum officinale*). According to opinions expressed by Ciofu et al. (2004) and Stan et al. (2003), the varieties of lettuce that belong to the Compositae family include the following types: head lettuce (which forms heads at maturity - *Lactuca sativa convar. capitata*), leaf lettuce (which does not form heads at maturity - *Lactuca sativa convar. secalina*), and romaine lettuce (which is distinguished by forming elongated heads - *Lactuca sativa convar. longifolia*). Depending on the variety, lettuce requires 8 to 10 hours of direct sunlight daily, especially during the vegetative growth phase. Optimal yields are achieved when light intensity is between 12-17 mol/m², combined with adequate ventilation. Too much light intensity can negatively affect plant development. Some varieties require higher light intensity, and when grown under insufficient light conditions, they struggle to grow. Therefore, the choice of varieties should be made according to the season and the intended use—whether for greenhouse, tunnel, or open field cultivation. During winter, the additional use of light for periods of 16 to 24 hours, at an intensity of 100-200 µmol/m²/s (17 mol/m²/day), promotes plant biomass growth and shortens the crop cycle by approximately 25%. At the same time, extending light exposure reduces the nitrate content in lettuce by 10-26% (Gaudreau et al., 1994). LED lighting allows for adjusting the light spectrum according to the plants' needs. Red (R) and blue (B) lights play an important role in stimulating photosynthesis. Research has highlighted the influence of R and B spectral components on the physiology, biochemistry, and resource use efficiency of lettuce plants (Drăghici et al., 2012) The research conducted by Pennisi et al. (2019) compared the effects of red and blue (RB) spectrum provided by LED lamps with the light from fluorescent control lamps (RB = 1) in six experimental variants under controlled conditions (PPFD = 215 µmol m−2 s−1), with a day length of 16 hours. The results showed that using LEDs increased bioyield by 1.6 times and improved energy efficiency by 2.8 times compared to fluorescent lamps. Experiments conducted by researchers such as Meng & Runkle (2019) on different *Lactuca sativa* L. varieties, under controlled conditions in a climate chamber, revealed that partially or fully replacing blue light (B) with green light (G) led to an increase in the average plant mass. Conversely, replacing green light (G) with blue light (B) resulted in poor leaf pigmentation, especially in "Rouxai" type red-leaf lettuce

varieties, such as oak leaf lettuce. Although the study demonstrated clear advantages of green light (G) in crop growth, it is uncertain whether these results are due to the increase in green light (G), the reduction of blue light (B), or a combination of both.

MATERIAL AND METHOD

The research was conducted at the University of Agronomic Sciences and Veterinary Medicine of Bucharest, in the greenhouse block of the Research Center for the Study of the Quality of Agri-Food Products. The varieties of lettuce, Lugano and Carmesi, were cultivated in the experiment, using certified seeds for the quality of the biological material. Cultivation was carried out in an NFT (Nutrient Film Technology) system between March 21 and May 8, 2024. Additional oxygenation of the nutrient solution was provided by a SERA AIR 550 R PLUS pump, which ensures low energy consumption of 8W, an air flow rate of 9.2 l/min, and 55 l/h.

The LED lighting system used in the experiment was configured for specific wavelengths and photoperiod, with a power of 100W, a water resistance rating of IP67, a frequency of 50 Hz/60 Hz, and an input voltage of AC 220V, featuring a full spectrum of wavelengths ranging from 380 to 840 nm. The experiment was a 2 x 2 factorial design with three repetitions. Factor A represented the two lettuce varieties, Lugano and Carmesi, while Factor B represented the cultivation technology with the following levels: b1 - natural oxygenation, b2 - additional oxygenation, b3 - additional oxygenation plus LED lighting. No external oxygen sources were used in the experiment. Planting in the NFT system took place on March 21, 2024. Throughout the entire growth cycle, climatic factors such as light, atmospheric humidity, and air temperature, as well as the temperature of the nutrient solution, were monitored. After 48 days from planting, the plants were harvested, and for the tested variants, the root length and volume were measured using an EPSON Flatbed Expression 11000X scanner. The carbohydrate content was determined at harvest using a refractometer for measuring carbohydrates.

RESULTS AND DISCUSSIONS

The roots were scanned using an EPSON Flatbed Expression 11000X scanner. For the Lugano lettuce variety (a1), the average root length was 31.70 cm, while for the Carmesi variety, it was 32.83 cm.

Fig. 1 Root measurements of Lugano and Carmesi

The difference in root length between the two varieties is 1.13 cm, not being statistically significant (Table 1).

Table 1

Table 1. Morphometric analysis of root length in lugano and carmesi lettuce varieties)

Factor A	Average Root Length (cm))	Difference from Mt	Significance
a_1Lugano	31.70	Mt	
a_2Carmesi	32.83	1.13	-

DL 5 % DL 1 % DL 0.1 %
4.0 5.6 7.9

Morphometric analysis of the average root length indicates a significant influence of additional oxygenation and led lighting on lettuce root development. Compared to the control (b1 - natural oxygenation), the application of additional oxygenation (b2) increased the average root length by 5.05 cm, suggesting that extra oxygen promotes better water and nutrient absorption, leading to more robust root development.

Additionally, the addition of led lighting (b3) further increased the average root length by 11.50 cm over the control, indicating that improved photosynthesis and growth stimulation provided by artificial light, combined with additional oxygenation, optimize conditions for plant growth. Thus, the combination of these two technologies represents an advanced system for enhancing yield (Table 2).

Table 2

Table 2. Morphometric analysis of average root length in lettuce under different cultivation technologies

Factor B	Average Root Length (cm)	Difference from Ct	Significance
b_1 natural oxygenation	26.75	Ct	
b_2 additional oxygenation	31.80	5.05	**
b_3 additional oxygenation plus LED Light	38.25	11.50	***

DL 5 % DL 1 % DL 0.1 %
3.3 4.6 6.5

Analyzing the impact of cultivation technologies on the average root length for lettuce varieties, it is observed that for the Lugano variety, under natural oxygenation conditions (b1), the average root length is 28.67 cm.

Additional oxygenation (b2) had a negative effect on root length, reducing it to 24.83 cm, a difference of -3.83 cm compared to the control (Ct). This indicates that additional oxygenation may not be ideal for this variety under certain conditions.

Under additional oxygenation plus LED lighting (b3), the root length was nearly similar to the control, at 28.27 cm, suggesting that the extra LED lighting may compensate for the decrease in root length caused by additional oxygenation.

For the Carmesi variety, under natural oxygenation (b1), the root length was greater at 35.33 cm, showing a significant increase compared to Lugano.

Additional oxygenation (b2) increased the length to 38.17 cm, indicating a positive reaction of the Carmesi variety to this technology.

Adding LED lighting to additional oxygenation (b3) resulted in a root length of 38.33 cm, the highest among all tested technologies, demonstrating that this variety responds well to the combination of additional oxygenation and LED lighting (Table 3).

Table 3

Table 3. Impact of cultivation technologies on the average root length in Lugano and Carmesi lettuce varieties

Factor B	Factor A	Average Root Length (cm)	Difference from Ct	Significance
b_1 natural oxygenation	a_1 Lugano	28.67	Ct	
b_2 additional oxygenation	a_1 Lugano	24.83	-3.83	-
b_3 additional oxygenation plus LED Light	a_1 Lugano	28.27	-0.40	-
b_1 natural oxygenation	a_2 Carmesi	35.33	6.67	***
b_2 additional oxygenation	a_2 Carmesi	38.17	9.50	***
b_3 additional oxygenation plus LED Light	a_2 Carmesi	38.33	9.97	***

DL 5 %	DL 1 %	DL 0.1 %
3.36	4.61	6.31

The average root volume of the two lettuce varieties was also determined by scanning, with the following results: for the Lugano lettuce variety, the average root volume was 11.29 cm³, considered the control (Ct) in this experiment.

The Carmesi variety had an average root volume of 10.62 cm³, which is a decrease of 0.66 cm³ compared to Lugano; however, this difference was not statistically significant.

The root volume for Carmesi was smaller than that for Lugano, but the difference is not large enough to be considered significant. This suggests that, under the applied cultivation conditions, both varieties exhibit similar behavior regarding root volume (Table 4).

Table 4

Table 4. Analysis of the average root volume in Lugano and Carmesi lettuce

Factor A	Average Root Volume (cm^3)	Difference from Ct	Significance
a_1Lugano	11.29	Ct	
a_2Carmesi	10.62	- 0.66	-

DL 5 % DL 1 % DL 0.1 %
1.9 2.7 3.8

Analyzing the average root volume for the two lettuce varieties shows that natural oxygenation (b1) serves as the control (Ct), with an average root volume of 9.92 cm^3. Supplemental oxygenation (b2) led to an increase in root volume to 11.10 cm^3, a positive difference of 1.18 cm^3 compared to the control, indicating a beneficial impact of supplemental oxygenation on root development. With supplemental oxygenation combined with LED lighting (b3), the average root volume increases to 11.85 cm^3, with a difference of 1.93 cm^3 compared to the control. The combined effect of supplemental oxygenation and LED lighting shows an even more pronounced increase in root volume, suggesting synergy between additional lighting and increased oxygen availability. LED lighting stimulates photosynthesis and, therefore, the overall metabolism of the plant, including root growth, which is essential for absorbing the resources necessary for development. LEDs, being an efficient light source, enhance photosynthesis, leading to greater production of sugars and other carbohydrates, which are transported to the roots, thus supporting their growth (Table 5).

Table 5

Table 5. Analysis of the average root volume in Lugano and Carmesi lettuce under different cultivation technologies

Factorul B	Average Root Volume (cm^3)	Difference from Ct	Significance
b_1 natural oxygenation	9.92	Ct	
b_2 additional oxygenation	11.10	1.18	
b_3 additional oxygenation plus LED Light	11.85	1.93	***

DL 5 % DL 1 % DL 0.1 %
1.6 2.2 3.1

Analyzing the impact of cultivation technologies on the average root volume in lettuce varieties shows that for the Lugano variety, natural oxygenation (b1) served as the control, with an average root volume of 10.17 cm^3. In the case of supplemental oxygenation (b2), there was a slight decrease in root volume to 9.67

cm³, with a negative difference of -0.49 cm³ compared to the control. This suggests that supplemental oxygenation does not have a significantly positive effect for this variety in the absence of other factors.

The technology combining supplemental oxygenation with LED lighting (b3) had a significantly positive effect, leading to an increase in root volume to 12.03 cm³, with a difference of 1.87 cm³ compared to the control. This increase suggests that LED lighting, along with supplemental oxygenation, improves growing conditions for this variety.

For the Carmesi lettuce variety, natural oxygenation (b1) resulted in the same root volume as for Lugano, 10.17 cm³, with no difference from the control. Supplemental oxygenation (b2) led to an increase in root volume to 11.67 cm³, with a positive difference of 1.50 cm³, statistically significant. This result indicates that the Carmesi variety responded better to supplemental oxygenation than the Lugano variety.

The technology with supplemental oxygenation and LED lighting (b3) resulted in a root volume of 11.03 cm³, with an increase of 1.87 cm³ compared to the control, which is significant. As with Lugano, the combination of supplemental oxygenation and LED lighting is the most effective (Table 6).

Table 6

Table 6. The impact of cultivation technologies on root volume in Lugano and Carmesi lettuce varieties

Factor B	Factor A	Average Root Volume (cm^3)	Difference from Ct	Significance
b_1 natural oxygenation	a_1 Lugano	10.17	Ct	
b_2 additional oxygenation	a_1 Lugano	9.67	-0.49	
b_3 additional oxygenation plus LED Light	a_1 Lugano	12.03	1.87	***
b_1 natural oxygenation	a_2 Carmesi	10.17	0.00	
b_2 additional oxygenation	a_2 Carmesi	11.67	1.50	***
b_3 additional oxygenation plus LED Light	a_2 Carmesi	11.03	1.87	***

DL 5 % DL 1 % DL 0.1 %
0.69 0.94 1.29

For the Lugano variety, under natural oxygenation conditions (b1), the average carbohydrate content was 4.05 g/100g, considered the control (Ct). Supplemental oxygenation (b2) slightly increased this content to 4.38 g/100g, indicating an improvement in carbohydrate synthesis, although this difference is

not statistically significant. In contrast, the combination of supplemental oxygenation and LED lighting (b3) had a significant effect on carbohydrate content, increasing it to 4.87 g/100g (a difference of +0.82 g/100g), marking a statistically significant improvement. This increase can be explained by the stimulation of photosynthesis under the influence of LEDs, which enhances the efficiency of carbohydrate production in the Lugano plant.

In the case of the Carmesi variety, the carbohydrate content under natural oxygenation conditions (b1) was 4.34 g/100g, with a positive difference of +0.29 g/100g compared to the Lugano control, which is statistically significant. This higher value suggests superior metabolic efficiency of the Carmesi variety under baseline conditions. However, with the application of supplemental oxygenation (b2), the carbohydrate content decreased to 3.86 g/100g, suggesting possible metabolic stress caused by excessive oxygenation, which negatively affects carbohydrate synthesis in this variety. Nevertheless, with the technology combining supplemental oxygenation and LED lighting (b3), the carbohydrate content increased again to 4.48 g/100g, with a difference of +0.42 g/100g compared to the control. This increase signifies an improvement in carbohydrate metabolism under the influence of LED lighting, which stimulates photosynthesis and helps the plant recover the metabolic efficiency previously affected by supplemental oxygenation (Table 7).

Table 7

Table 7. The impact of cultivation technologies on the carbohydrate content in Lugano and Carmesi lettuce varieties.

Factor B	Factor A	Average carbohydrate g/100g	Difference from Ct	Significance
b_1 natural oxygenation	a_1 Lugano	4.05	Ct	
b_2 additional oxygenation	a_1 Lugano	4.38	0.33	
b_3 additional oxygenation plus LED Light	a_1 Lugano	4.87	0.82	***
b_1 natural oxygenation	a_2 Carmesi	4.34	0.29	***
b_2 additional oxygenation	a_2 Carmesi	3.86	-0.19	
b_3 additional oxygenation plus LED Light	a_2 Carmesi	4.48	0.42	

DL 5 %	DL 1 %	DL 0.1 %
0.36	0.50	0.68

CONCLUSIONS

Supplemental oxygenation combined with LED lighting is the most effective technology for both varieties, significantly stimulating root volume growth. The Carmesi variety responds better to supplemental oxygenation compared to the Lugano variety. Lugano benefits significantly from the addition of LED lighting, overcoming the negative effect of simple supplemental oxygenation. LED lighting, in combination with supplemental oxygenation, has proven to be the most effective technology for increasing carbohydrate content in both lettuce varieties, demonstrating a synergy between enhanced photosynthesis and carbohydrate metabolism.The Lugano variety responded favorably to this combination, showing a significant increase in carbohydrate content. Although the Carmesi variety is sensitive to supplemental oxygenation alone, it also benefited from the additional stimulation provided by LEDs, which allowed for optimized carbohydrate synthesis.

ACKNOWLEGMENTS

This work was supported by a grant of the University of Agronomic Sciences and Veterinary medicine of Bucharest, project number 2023-0004, ctr.nr. 848/30.06/2023, within ipc 2023

REFERENCES

1. Ciofu, R., Stan, N., Popescu, V., Chilom, P., Apahidean, S., Horgoş, A., ... & Atanasiu, N. - 2004 Tratat de legumicultură, Ed. Ceres, Bucureşti, p.129-136.

2 Drăghici E.M., Pele M., 2012 - Evaluation some new hybrids for cultivation in conventional system in spring climatic conditions of Romania. International Journal of Agriculture Sciences, ISSN: 0975-3710& e-ISSN:0975-9107, 4(7): 299-305. http://dx,doi,org/10,9735/0975-3710,4,7,299-305

3. Gaudreau, L., Charbonneau, J., Vézina, L. P., & Gosselin, A. 1994 - Photoperiod and photosynthetic photon flux influence growth and quality of greenhouse-grown lettuce. HortScience, 29(11), 1285-1289.

4. Meng, Q., & Runkle, E. S. 2019 - Far-red radiation interacts with relative and absolute blue and red photon flux densities to regulate growth, morphology, and pigmentation of lettuce and basil seedlings. Scientia Horticulturae, 255, 269-280.

5. Pennisi, G., Blasioli, S., Cellini, A., Maia, L., Crepaldi, A., Braschi, I., ... & Gianquinto, G. 2019 - Unraveling the role of red: blue LED lights on resource use efficiency and nutritional properties of indoor grown sweet basil. Frontiers in plant science, 10, 305.

INFLUENCE OF TREATMENTS WITH GROWTH RETARDANTS ON THE ORNAMENTAL PROPERTIES OF *LAGERSTROEMIA INDICA* L. PLANTS

INFLUENȚA TRATAMENTELOR CU RETARDANȚI ASUPRA ÎNSUȘIRILOR ORNAMENTALE ALE PLANTELOR DE *LAGERSTROEMIA INDICA* L.

BARBU Alis-Valentina[1], APOSTOL Maria[1*], LUPOAE Paul[2], AMIȘCULESEI Petronica[1], CANTOR Maria[3], DRAGHIA Lucia[1]

*Corresponding author e-mail: maria.apostol@iuls.ro

Abstract.
The behavior of the species Lagerstroemia indica under the ecological conditions of the south-eastern part of Romania has been studied for several years at the Botanical Garden of Galati. The present experiment analyzed the effect of treatment with Alar 85 SG (growth retardant based on daminozide) on L. indica plants obtained from seeds and grown in pots under unprotected conditions. Based on the observations it was found that the reduction in plant height, the increase in the number of branches, the earliness of flower buds and flowering initiation, and the prolongation of flowering time of the plants were directly proportionally influenced by the concentration of the growth retardant used as 0.3% and 1%. The results recommend the treatment with Alar 0.3% as efficacious, considering that the effect on other characters ensuring flowering quality (inflorescence length, number of inflorescences / plant, number of flowers/inflorescence, density of flowers in inflorescences and flowering capacity of plants) was diminished by increasing the concentration to 1%.
Key words: daminozide, plants growth regulator, Indian lilac, ornamental characters

Rezumat.
Comportarea speciei Lagerstroemia indica în condițiile ecologice din zona de sud-est a României a fost studiată de mai mulți ani la Grădina Botanică Galați. Experiența de față a analizat efectul tratamentului cu Alar 85 SG (retardant de creștere pe bază de daminozidă) asupra plantelor de L. indica obținute din semințe și cultivate la ghivece, în condiții neprotejate. Pe baza observațiilor s-a constatat că reducerea înălțimii plantelor, creșterea numărului de ramificații, timpurietatea apariției bobocilor florali și a începutului înfloririi, precum și prelungirea duratei de înflorire a plantelor au fost influențate direct proporțional de concentrația retardantului de creștere, 0,3% și 1%. Rezultatele recomandă ca eficient tratamentul cu Alar 0,3%, având în vedere că la alte caractere care asigură calitatea înfloririi

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania
[2] Natural Sciences Museum Complex "Răsvan Angheluță" Galați, Romania
[3] University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania

(lungimea inflorescențelor, numărul de inflorescențe/ plantă, numărul de flori / inflorescență, densitatea florilor în inflorescențe și capacitatea de înflorire a plantelor) efectul s-a diminuat prin creșterea concentrației la 1%.

Cuvinte cheie: daminozida, regulator de creștere pentru plaante, liliac indian, caractere ornamentale

INTRODUCTION

Lagerstroemia is a genus of the family Lythraceae, with over 50 woody species native to tropical and subtropical regions of Southeast Asia and Australia [De Wilde and Duyfjes, 2013; Hao et al., 2024; Liu et al., 2008], but also widespread in other mild-climate habitats of North, Central and South America [Liu et al., 2013]. Due to their longevity, relatively good resistance to biotic and abiotic factors, abundant and long-lasting flowering etc., many species of the genus are valued as ornamental plants in garden landscaping or as pot plants [Riddle and Mizell, 2016; Saensouk and Saensouk, 2023; Wang et al., 2023].

Lagerstroemia indica L. (summer lilac, Indian lilac, crepe myrtle), one of the most popular species of the genus, is a medium to tall shrub native to southern China, the Himalayas and Indochina. It is among the few species of *Lagerstroemia* that exhibits better cold hardiness and can be cultivated in temperate regions [Pounders et al., 2007]. It is also drought resistant and resistant to air and soil pollution [Qiao et al., 2024; Wang et al., 2023]. In China and other Southeast Asian countries, it has been used for over 1500 years in traditional medicine, with almost all parts of the plant containing compounds with hypoglycemic, antimicrobial, analgesic, hepatoprotective, antimicrobial, anti-Alzheimer etc. [Liu et al., 2013; Li et al., 2024; Riddle and Mizell, 2016; Yue et al., 2024; Wang et al., 2023]. From an ornamental point of view, it is considered one of the most valuable species, in addition to numerous cultivars (with brightly colored flowers, beautifully colored foliage, long flowering period, diverse architectural forms etc.), many obtained by interspecific hybridization [Ju et al., 2018; Yu et al., 2014].

For ornamental purposes, *L. indica* is also cultivated in pots or containers, in which case, plant size control becomes an important aspect in cultivation technology and can be achieved by genetic, ecological, cultural or chemical methods [Malik et al., 2017]. The use of growth retardants is one of the effective strategies in reducing growth. Most plant growth retardants act by inhibiting gibberellin synthesis, reducing cell division in the shoot subapical meristem and elongation of cells, which results in plants with compact habit, improved leaf color, flower production and quality, flowering earliness etc. [Carvalho-Zanão et al., 2017; El-Sheibany et al., 2007; Warner and Erwin, 2003]. Studies have shown that plant response to the action of retardants can be influenced by a number of factors: plant particularities (taxonomic classification, developmental stage, endogenous hormonal balance etc.), environmental conditions, type of retardant and its concentration [Carvalho-Zanão et al., 2017; Tedila, 2022]. For example, at low concentrations retardants usually reduce cell elongation, while at high concentrations they further reduce cell division [Warner and Erwin, 2003]. Daminozide (succinic acid 2,2-dimethyl hydrazide) is a chemical inhibitor commonly used in horticultural practice, with

different names (Alar, Kylar, B-Nine, B-995) [Abbas and Al-Bakkar, 2023]. Alar is a highly mobile compound plants, and foliar application is one of the common and effective methods [Abbas and AL-Bakkar, 2023; Velasco-Ramírez et al., 2022].

The aim of this study was to analyze the influence of daminozide (Alar-85) on some morpho-decorative characters of *Lagerstroemia indica* plants grown in pots.

MATERIAL AND METHOD

The experiments were conducted from February to October 2024, in the Botanical Garden of the Galati Museum Complex. Since 2011, the Botanical Garden of Galati has specimens of *L. indica* (Fig. 1) with extremely rich flowering in the summer-autumn season and very well adapted to the specific climatic conditions of the area (average annual temperature 10^0C, minimum temperature in the last 10 years of -16.7^{0}C and maximum of +38.3^{0}C, with an average rainfall in the last 10 years of 412.4 L/m^2). In this study, the biological material consisted of Indian lilac (*Lagerstroemia indica*) obtained from seeds and grown in pots.

Fig. 1. Botanical Garden of Galați - *L. indica* flowering (original)

Seeds were collected from specimens existing in the botanical garden collection and sowing was carried out under warm greenhouse conditions on February 19, 2024. After seedlings were planted, the seedlings were repotted in 50 mm diameter alveolar pallets, and at the end of May, the plants were transferred to 3 L pots in a substrate consisting of garden soil, manure and sand, in a 1:1:1 ratio. The most vigorous, well-rooted and uniformly growing plants were selected (Fig. 2) and transferred to the experiment field in a sunny place.

Fig. 2. *L. indica* seedlings (from alveolar pallets) before planting in pots (original)

Treatments with Alar 85 SG were applied foliar, in three stages, set at intervals of about 14 days (15 June, 2 July and 16 July). The experiment was monofactorial, the experimental factor being the concentration of retardant used. Three experimental variants resulted: V_1 - untreated plants (control); V_2 - plants treated with Alar 0.3%; V_3 -

plants treated with Alar 1%. The variants were arranged in randomised blocks with 3 replicates (5 plants/replication). With the exception of the treatments specific to each variant, the other maintenance works were applied in a unitary way and the amount of water administered to each pot was identical.

Monitoring of the plants until the end of the growing season included observations and determinations not only in terms of vegetative growth (stem height and branching degree), but also flowering (flowering capacity and flowering phenology, number of inflorescences / plant, inflorescence length and number of flowers/inflorescence). The results obtained were statistically interpreted using analysis of variance LSD [Săulescu and Săulescu, 1967] and were compared with the control (V1 – plants not treated with growth retardant).

RESULTS AND DISCUSSIONS

Observations carried out on *Lagerstroemia indica* plants grown from seed and treated with Alar 85 SG approximately four months after sowing and two weeks after transfer of the transplanted seedlings to 3 litre pots, respectively, revealed the effect of the retardant depending on the concentration used. The three treatments carried out at 2-weekly intervals, starting on 15 June, influenced both vegetative growth (height, branching degree) and the quantity and quality of flowering.

Table 1 presents values of stem height and number of branches of plants, as differences between the values recorded at the first treatment and at the end of the growing season. The height difference had values between 10.0 and 32.4 cm. In the control, untreated plants (V_1), the difference in height between the two specified times was 32.4 cm. Compared to the control, the difference in height growth was reduced by 50% in treatments with Alar 0.3% (V_2) and by approx. 70% at concentrations of 1% (V_3). From a statistical point of view, the differences from the control were very significant positive. The branching capacity of the stems was directly proportional to the concentration of the growth retardant (Table 1). In untreated plants, the number of main branches was 5.6; treatment with Alar 0.3% increased the number of branches by 10.7%, and at concentrations of 1% the number of branches increased by 28.6%. Compared to the control, the differences were distinctly significant positive and very significant positive.

The results obtained are in line with the trend also reported in other species treated with daminozide-based retardants (reduced plant height, increased number of branches), such as in roses [Carvalho-Zanão et al., 2017], *Chrysanthemum morifolium* [El-Sheibany et al., 2007; Roepke et al., 2013; Sitawati and Ni'mah, 2018], *Dahlia variabilis* [Malik et al., 2017], *Pelargonium peltatum* [Tedila, 2022], *Eustoma grandiflorum* [Velasco-Ramírez et al., 2022], *Hibiscus radiatus* [Warner and Erwin, 2003].

Table 1

The difference in height growth and branching of plants stem

Variants	Height (cm)			Number of branches/ plant (pc)		
	Abs. val.	Diff.	Signif.	Abs. val.	Diff.	Signif.

V_1	**32.4**	**-**	**control**	**5.6**	**-**	**control**
V_2	16.2	-16.2	000	6.2	0.6	xx
V_3	10.0	-22.4	000	7.2	1.6	xxx

$LSD_{5\%}$ = 1.0 $LSD_{5\%}$ = 0.3
$LSD_{11\%}$ = 1.7 $LSD_{1\%}$ = 0.6
$LSD_{0.1\%}$ = 3.2 $LSD_{0.1\%}$ = 1.1

From an ornamental point of view, characters related to flowering are very important elements in the judgement of the ornamental value of plants. Unlike other woody plants obtained from seeds that bloom after 2-3 years, the Indian lilac can flower from the first year.

In our study, both flowering capacity and inflorescence quality were favoured by Alar treatments.

The length and number of inflorescences/plant (Table 2) had maximum values in plants treated with 0.3% Alar 85 SG. Compared to the control plants, which formed, on average, a single inflorescence with a length of 2 cm, in the V_2 variant obtained 5.6 inflorescences/plant with a length of 4.5 cm, with very significant positive differences. In variant V_3, although the results exceeded the control (3.6 inflorescences/plant, 3.1 cm long), they did not reach the level of those in V_2. The phenomenon of a reduction in the number of flowers or inflorescences/plant (even if exceeding the control) with increasing daminoside concentration was also reported in other ornamental species, such as *Dahlia variabilis* `Charmit` [Malik et al., 2017], *Eustoma grandiflorum* [Velasco-Ramírez et al., 2022].

Table 2

Influence of Alar 85 SG treatment on the length and number of inflorescences

Variants	Inflorescence length (cm)			Number inflorescences/ plant (pc.)		
	Abs. val.	Diff.	Signif.	Abs. val.	Diff.	Signif.
V_1	**2.0**	**-**	**control**	**1.0**	**-**	**control**
V_2	4.5	2.5	xxx	5.6	2.6	xxx
V_3	3.1	1.1	xx	3.6	4.6	xxx

$LSD_{5\%}$ = 0.4 $LSD_{5\%}$ = 0.3
$LSD_{11\%}$ = 0.6 $LSD_{1\%}$ = 0.4
$LSD_{0.1\%}$ = 1.2 $LSD_{0.1\%}$ = 0.8

The trend was similar for the number of flowers / inflorescence, four times higher than the control at 0.3% Alar and 2.3 times higher at 1% Alar (Table 3).

Table 3

Influence of Alar 85 SG treatment on the number of flowers per inflorescence and the density of flowers in the inflorescence

Variants	Number flowers/inflorescence (pc.)			Inflorescences density (flowers/1 cm inflorescence)		
	Abs. val.	Diff.	Signif.	Abs. val.	Diff.	Signif.
V_1	**3.0**	**-**	**control**	**1.5**	**-**	**control**
V_2	12.3	9.3	xxx	2.7	1.2	xxx

V_3	6.6	3.6	xxx	2.1	0.6	xx

$LSD_{5\%} = 0.3$ $LSD_{11\%} = 0.6$ $LSD_{0.1\%} = 1.1$

$LSD_{5\%} = 0.2$ $LSD_{1\%} = 0.4$ $LSD_{0.1\%} = 0.7$

The quality of inflorescences was also analysed in terms of the density of flowers in the inflorescence, by the number of flowers per 1 cm inflorescence (table 3). With 2.7 flowers/cm, the inflorescences of V_2 had the most compact appearance. In the control version, the inflorescences were looser, with 1.5 flowers/cm, and in the Alar 85 SG 1% treated version the values were intermediate (2.1 flowers/cm).

There were also differences between the variants in terms of the number of flowering plants. All the plants treated with Alar at concentration of 0.3% (V_2) have blossomed (100%). At higher concentrations (1%), the growth retardant had an inhibitory effect, reducing the number of flowering plants by 40% compared to the V_2 variant. Untreated plants (V_1) flowered only 40% (Fig. 3).

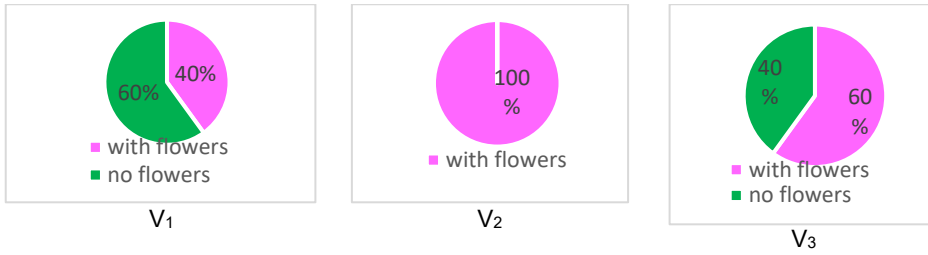

Fig. 3. Proportion of plants with flowers and without flowers

Monitoring of the main flowering phenophases revealed the earliness of flower buds and the onset of flowering in *L. indica* plants treated with retardant. From sowing to flower bud emergence the control plants took more than 6 months (192 days), 24-27 days longer than the Alar 85 SG-treated plants (Fig. 4). Delayed flower bud emergence has also been reported in some pot-grown varieties of *Chrysanthemum morifolium* (`Time Jewel`) [Sitawati and Ni'mah, 2018], but the literature also indicates situations where daminozide treatment resulted in delayed flower bud emergence in dahlia [Malik et al., 2017]. Flowering started 18-21 days earlier in both retardant-treated variants (Fig. 4). Regardless of the concentration of retardant used, the effect was similar, with a difference of 2-3 days between V_2 and V_3.

The decorative effect of the plants, as assessed by the length of time the flowers were maintained on the plant, was improved by Alar treatment, with the period extended to 47 days compared to only 29 days in the control (Fig. 5).

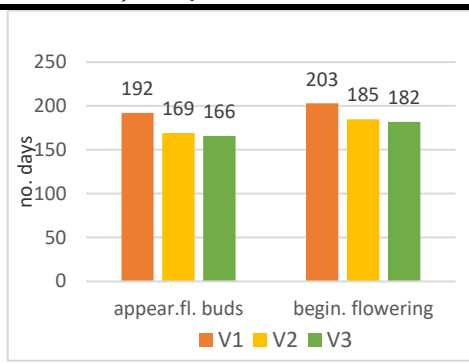

Fig. 4. No. days from sowing to the appearance of flower buds and the beginning of flowering

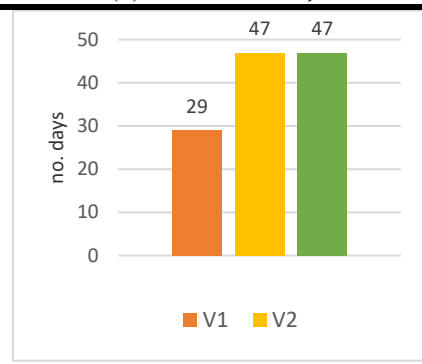

Fig. 5. Flowering duration (no. days)

CONCLUSIONS

Foliar treatments with daminozide (Alar 85 SG) 0.3% and 1% in Indian lilac (*Lagerstroemia indica*) grown in pots induced some changes in characters influencing the ornamental value of the plants.

The effect of Alar treatments was directly proportional to the increase of concentration, in terms of reduction of plant height, increase of number of branching, earliness of flower buds and onset of flowering and prolongation of flowering duration of the plants.

Other characters, such as inflorescence length, number of inflorescences / plant, number of flowers/inflorescence, density of flowers in inflorescences and flowering capacity of plants were favoured by treatments with Alar 85 SG 0.3% concentrations, with a tendency to decrease the effect at higher concentrations.

The results recommend that treatment with Alar 85 SG 0.3% (V_2).

REFERENCES

1. **Abbas A.A., AL-Bakkar A.H.A.Q., 2023 -** *Effect of ALAR and light intensity on some vegetative growth characteristics of juniper plant (Juniperus Sabina L.).* ICCMAT-2023, IOP Conf. Series: Earth and Environmental Science, DOI:10.1088/1755-1315/1252/1/012092.
2. **Carvalho-Zanão M.P., Grossi J.A.S., Zanão L.A.Jr., Ventrella M.C., Pereira N., 2017** - *Production and leaf plasticity of rose plants sprayed with paclobutrazol and daminozide.* Semina: Ciências Agrárias, Londrina, 38(6): 3481-3490, DOI: 10.5433/1679-0359.2017v38n6p3481.
3. **De Wilde W.J.J.O., Duyfjes B.E.E., 2013** - *Miscellaneous information on Lagerstroemia L. (Lythraceae)*. Thai Forest Bulletin (Botany), 41:90–101.
4. **El-Sheibany O.M., El-Malki N.A., Barras-Ali A., 2007** - *Effect of application of growth retardant ALAR on some foliage characters of local cultivar of Chrysanthemum.* Journal of Science and Its Applications, 1(2):15-20.
5. **Hao S., Zhang D., Wen, Y., 2024 -** *Potential geographical distribution of Lagerstroemia excelsa under climate change*. Agriculture, 14, 191. DOI:10.3390/agriculture14020191.

6. Ju Y.-Q., Hu X., Jiao Y., Ye Y.-J., Cai M., Cheng T.-R., Wang J., Pan H.-T., Zhang Q.-X., 2018 - *Fertility analyses of interspecific hybrids between Lagerstroemia indica and L. speciosa.* Czech J. Genet. Plant Breed., DOI:10.17221/174/2017-CJGPB.

7. Li S., Yin M., Wang P., Gao L., Lv F., Yang R., Li Y., Wang Q., Li L., Liu Y., Wang S., 2024 - *Phenolic Compounds and antioxidant capacity comparison of wild-type and yellow-leaf gl1 mutant of Lagerstroemia indica*. Plants, 13, 315. DOI: 0.3390/plants13020315.

8. Liu Y.S., Zetter R., Ferguson K.D., Zou C., 2008 - *Lagerstroemia (Lythraceae) pollen from the miocene of eastern China*. Grana, 47(4):262-271, DOI: 10.1080/00173130802457255.

9. Liu Y., He D., Cai M., Tang W., Li X.Y., Pan H.T., Zhang Q.X., 2013 - *Development of microsatellite markers for Lagerstroemia indica (Lythraceae) and related species.* Applications in Plant Sciences, 1(2):1200203.

10. Malik A.S., Rather Z.A., Wani A.H., Din A., Nazki I.T., 2017 - *Effect of growth regulators on plant growth and flowering in Dahlia (Dahlia variabilis) cv. Charmit.* Journal of Experimental Agriculture International, 15(3):1-7.

11. Pounders C., Rinehart T., Sakhanokho H., 2007 - *Evaluation of interspecific hybrids between Lagerstroemia indica and L. speciosa*. HortScience, DOI: 10.21273/HORTSCI.42.6.1317.

12. Qiao Z., Deng F., Zeng H., Li X., Lu L., Lei Y., Li L., Chen Y., Chen J., 2024 - *MADS-Box family genes in Lagerstroemia indica and their involvement in flower development*. Plants, 13, 709, DOI: 10.3390/plants13050709.

13. Riddle T.C. and Mizell F.R.III, 2016 - *Use of crape myrtle, Lagerstroemia (Myrtales: Lythraceae), cultivars as a pollen source by native and non-native bees (Hymenoptera: Apidae) in Quincy, Florida.* Florida Entomologist, 99(1):38-46, DOI: 10.1653/024.099.0108.

14. Roepke J., Jean T., Perkel K.J., Blom T., Bozzo G.G., 2013 - *Daminozide alters anthocyanin metabolism in ray florets of bronze chrysanthemum (Chrysanthemum morifolium Ramat.).* J. Plant Growth Regul., 32:453–460, DOI: 10.1007/s00344-012-9315-3.

15. Saensouk S., Saensouk P., 2023 - *Palynology of the genus Lagerstroemia (Lythraceae) in Thailand.* Biodiversitas, 24(6):3222-3229, DOI: 10.13057/biodiv/d240616.

16. Săulescu N.A. and Săulescu N.N., 1967 – *Câmpul de experiență.* Ed. Agro-Silvică, București.

17. Sitawati and Ni'mah A.N., 2018 - *Improvement in quality of chrysant pot (chrysanthemum sp.) with daminozide anddisbudding application.* Bioscience Research, 15(1):491-497.

18. Tedila K., 2022 - *Effect of Alar, Cycocel and Bonzi on growth performance of ivy geranium (Pelargonium peltatum).* Advances in Crop Science and Technology, 10(4), 1000506.

19. Velasco-Ramírez A., Villegas-Lozano M., Velasco-Ramírez A.P., Hernández-Herrera R.M., Hernández-Pérez A.R., García-Sahagún M.L., Torres-Morán M.I., 2022. *Effect of daminozide on the growth and flowering of Eustoma grandiflorum propagated in potted.* Acta Sci. Pol. Hortorum Cultus, 21(3), 75–82. DOI: 10.24326/asphc.2022.3.7.

20. Wang J., He W., LiaoX., Ma J., Gao W., Wang H., Wu D., Luke R. Tembrock R.L., Wu Z., Gu C., 2023 - *Phylogeny, molecular evolution, and dating of divergences in Lagerstroemia using plastome sequences*. Horticultural Plant Journal, 9 (2): 345-355, DOI: 10.1016/j.hpj.2022.06.005.

21. Warner M.R., Erwin E.J., 2003 - *Effect of Plant Growth Retardants on Stem Elongation of Hibiscus Species.* HortTechnology, 13(2):293-296.

22. Yu C., Ding Z., Yuan T., Yu C., Qin J., Lu D., Wei H., Zhong F., Liu G., Chen Y., Zhang J., 2014 - *Morphological, physiological, and molecular bases of salt tolerance in crape myrtle (Lagerstroemia indica).* Agriculture,14, 2267, DOI: 10.3390/agriculture14122267.

23. Yue Z., Xu Y., Cai M., Fan X., Pan H., Zhang D., Zhang Q., 2024 - *Floral elegance meets medicinal marvels: traditional uses, phytochemistry, and pharmacology of the genus Lagerstroemia L.* Plants, 13, 3016, DOI: 10.3390/ plants13213016.

SUSTAINABLE FARMING MODEL FOR VEGETABLE CULTIVATION. CASE STUDY

MODEL DE EXPLOATARE SUSTENABILĂ PENTRU CULTURA LEGUMELOR. STUDIU DE CAZ

ANTON Doru Relu[1], STOLERU Vasile[1], TELIBAN Gabriel-Ciprian[1*], COJOCARU Alexandru[1], CIUBOTĂRIȚA Anamaria[1], POPA Lorena-Diana[2], MUNTEANU Neculai[1**]

[*]Corresponding author e-mail: gabriel.teliban@iuls.ro
[**]Coordinator author e-mail: neculai.munteanu@iuls.ro

Abstract.
The paper presents a case study conducted in Matca commune, Galați county, with the aim of analyzing the sustainability of a family vegetable farm. The study included the assessment of technical-agronomic, economic, and biological factors, as well as the identification of risks that may influence production stability. The farm uses modern technology, based on two crop cycles in protected areas, with drip irrigation and fertigation systems. Production is competitive, reaching 160–180 t/ha for tomatoes and 100–150 t/ha for cucumbers. The main disruptive factors are climate variations, diseases, pests, and high input and energy costs. The SWOT analysis highlighted the technological advantages and economic risks. The farm is emerging as a model of sustainable small-scale vegetable farming, where efficient management and the use of high-performance hybrids contribute to maintaining competitiveness and long-term economic viability.
Key words: sustainable vegetable farming, disruptive factors, SWOT analysis

Rezumat.
Lucrarea prezintă un studiu de caz realizat în comuna Matca, județul Galați, având ca obiectiv analiza sustenabilității unei exploatații legumicole familiale. Studiul a inclus evaluarea factorilor tehnico-agronomici, economici și biologici, precum și identificarea riscurilor ce pot influența stabilitatea producției. Ferma utilizează o tehnologie modernă, bazată pe două cicluri de cultură în spații protejate, cu sisteme de irigare prin picurare și fertirigare. Producțiile sunt competitive, atingând 160–180 t/ha la tomate și 100–150 t/ha la castraveți. Principalii factori perturbatori sunt variațiile climatice, bolile, dăunătorii și costurile ridicate ale inputurilor și energiei. Analiza SWOT a evidențiat avantajele tehnologice și riscurile economice. Ferma se conturează drept un model de legumicultură sustenabilă la scară mică, unde

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania
[2] Agricultural Research and Development Station Secuieni-Neamt, Romania

managementul eficient și utilizarea hibrizilor performanți contribuie la menținerea competitivității și viabilității economice pe termen lung.
Cuvinte cheie: legumicultură sustenabilă, factori perturbatori, analiza SWOT

INTRODUCTION

Vegetable growing is one of the most intensive agricultural activities, based on mechanization, chemicalization, irrigation, and the use of high-performance cultivars [Stan and Munteau, 2003]. The most modern methods, techniques, and technologies are used in vegetable growing [Stoian, 2005]. The technologies used must be as environmentally friendly as possible in order to avoid degradation of the vegetable growing ecosystem [Stoleru, 2008; Popa, 2010; Teliban, 2011]. These technologies must also ensure unpolluted harvests in sufficient quantities to ensure economic efficiency [Dobay, 2005; Munteanu et al., 2008].

Currently, there are several agricultural systems in Romania: the conventional system (classical or traditional, intensive or extensive), the unconventional system (with several variants: biodynamic, biological, organic, or ecological agriculture) [Stoleru, 2013]. Between these two systems lies sustainable agriculture, considered to be a compromise between conventional and unconventional agriculture [Munteanu, 1999]. Vegetable farms in Romania include all the systems mentioned above, but it is important to know the means by which these farms withstand the test of time or, more precisely, how these farms have ensured their sustainability.

In this context, the purpose of this paper is to conduct a case study that will present in concrete terms how to run family vegetable farms that are characterized by a high degree of sustainability.

MATERIAL AND METHOD

To achieve the proposed goal, namely the case study, the research protocol provided for technical and agronomic analyses of a family association, A.F. Condrache. To carry out this case study, information was collected on the model of organization of the micro-farm's activity, technical equipment, crops grown on the farm, and cultivation technologies. Factors favoring vegetable cultivation and, in particular, disruptive factors were also analyzed [Munteanu 1999]. A comprehensive analysis of the technical and agronomic factors impacting sustainability was made possible thanks to the results and statistics provided by farmers.

The case study concludes with a SWOT analysis that highlights the strengths, weaknesses, opportunities, and threats specific to family micro-farms.

RESULTS AND DISCUSSIONS

Presentation of the agricultural farm

Condrache Farm is a family-run vegetable farm located in Matca, Galați County, one of the most famous vegetable-growing areas in Romania.

The vegetable farming activity carried out on the farm has a tradition of over a decade, with a clear focus on growing vegetables in protected areas (greenhouses). The farm exploits a total area of 35 acres of greenhouses, of which approximately 10-15 acres are dedicated to growing cucumbers, and the rest of the area is occupied by tomatoes. This division of land allows for diversification of production, but also for more efficient management of both human and technical resources.

Technical and economic resources

The greenhouse, made of wood and covered with triple-layered, UV-resistant foil, features a drip irrigation system, buffer tanks for irrigation water, and a side opening system that facilitates natural ventilation.

The family that runs the farm is directly involved in all stages of production, from sowing, maintenance, and phytosanitary treatments to harvesting and marketing, which allows for direct quality control and a significant reduction in labor costs.

The farm is equipped with the following essential technical resources: partially automated drip irrigation systems that allow for precise dosing of water and fertilizers (fertigation); buffer tanks for water (1,000 and 2,000 liters), located in the immediate vicinity of the greenhouse; heating system used for the first crop cycle (January-April); small agricultural machinery and tools suitable for working in protected areas (small motor hoes, atomizers, water pumps, alveolar trays, thermometers).

The farm also has a small greenhouse, used mainly between December and February to grow its own seedlings. This helps to reduce crop establishment costs and allows for better control over the quality of the biological material.

The farm also has a rudimentary but efficient sorting and packaging area, where tomatoes and cucumbers are prepared for sale. Packaging is done in standardised crates, and selection by quality category is done manually.

The variety of species and hybrids

The crop assortment chosen by the Condrache farm consists of high-performance hybrids adapted to local soil and climate conditions, as well as market requirements. Thus, for tomato cultivation, the Melanet F1 hybrid is used, known for its uniform fruits, exceptional taste, and high productivity. For cucumber cultivation, the Ilonara F1 hybrid is grown, a parthenocarpic variety with increased disease resistance and good yield in controlled microclimate conditions.

In 2020, the farmer cultivated only 10 acres of cucumbers and 25 acres of tomatoes, and starting in 2021, he began to increase the area cultivated with cucumbers to 15 acres, to the detriment of tomatoes. This was due to the increasing demand for cucumbers over the last two years.

Cultivation technology

A defining feature of this farm is the cultivation technology organized into two distinct cycles, adapted to climatic conditions and market requirements. The first cycle begins in December, with the sowing of seeds in seedbeds, followed by

the planting of seedlings in greenhouses starting in February. The second cultivation cycle begins in early June with the planting of seedlings, also obtained in-house. This system of successive cultivation ensures optimal use of protected areas and contributes to ensuring a constant flow of products to the market.

For the first cycle of cultivation, tomato and cucumber seeds are sown in alveolar trays, using professional peat-based substrate enriched with perlite and starter fertilizers. These are kept in a heated greenhouse at a temperature of 18-20°C, with a relative humidity of 70-80%, and germination takes place in 10-15 days.

Foliar fertilization with macro and microelements is applied after the first true leaves appear, alternating with preventive disease protection treatments (*Pythium*, *Fusarium*) at intervals of 10-14 days.

At the same time, the greenhouses are prepared for planting: plant debris is removed, the soil is disinfected (using fungicides), and then the soil is loosened by light tilling. At this stage, basic fertilization is administered using well-fermented manure (40-60 t/ha) together with chemical fertilizers, followed by the installation of a drip irrigation system.

Depending on the hybrid, the planting distances for tomatoes are 70 cm between rows and 40 cm between the two rows, and 40-45 cm between plants in a row. For cucumbers, the distances are 70 cm between rows and 40 cm between the two rows, and 30-35 cm between plants in a row. The distances between rows and between strips are designed so that both vegetables can be grown on the same area in the case of crop rotation, as far as the crop cycle allows.

Seedlings are planted in the second half of January – early February, depending on weather conditions and the stage of development of the seedlings (6-7 true leaves). Planting watering and root biostimulants are applied to stimulate plant rooting. During this period, greenhouses are carefully monitored to maintain a minimum temperature of 14-16°C for optimal development of vegetable plants in the greenhouse.

Maintenance work at the Condrache microfarm includes:

- Pruning tomato and cucumber plants;
- Tomatoes and cucumbers are staked using clips on a single string**;**
- Pruning plants is an operation performed on tomatoes in order to remove the growing tip of the main stem after 5-6 clusters, thus redirecting all the plant's energy to the fruits, accelerating their development and ripening;
- Defoliation of plants is carried out for better aeration and illumination of the vegetative mass;
- Drip irrigation is performed daily or every two days, followed by fertigation with balanced formulas (NPK + microelements) depending on the plant's stage of development. Fertigation is applied separately to tomatoes and cucumbers, usually on different days;
- Integrated phytosanitary treatments are applied according to biological pressure: alternating biological insecticides with selective chemicals;

• Daily ventilation of greenhouses to control humidity and prevent fungal diseases in spring; in summer, keep the greenhouse windows open at all times for ventilation;

• The greenhouse usually gets too hot at the start of summer when it's really warm outside, and the plants in the greenhouse start to suffer.

The first fruits are harvested from mid-March for cucumbers, continuing until mid-May, and for tomatoes from the second half of April until June.

The produce is harvested by hand, sorted, and sold immediately. In favorable years, each harvest can yield 100–150 kg of tomatoes and 500–600 kg of cucumbers.

The second crop cycle at the Condrache farm is carried out under the same conditions as the first crop cycle, with the same preparation of the greenhouse and crop maintenance work. The difference lies in the sowing period, which begins in late May-early June, in order to ensure summer-autumn production. This cycle is characterized by more intensive use of natural resources (heat, light), but it is also more vulnerable to extreme weather conditions. Germination occurs more quickly, in 8-15 days, due to high ambient temperatures. Seedlings are kept under shade cloth or diffused foil to avoid sunburn.

Planting in greenhouses takes place between June 25 and July 5, depending on the speed of plant development and weather conditions. The seedlings are of superior quality, with a well-developed root system, which allows for rapid establishment and vigorous regrowth.

The other greenhouse preparation work, namely crop care and harvesting, is carried out in the same way as in the first crop cycle and under the same conditions.

The products obtained are sold wholesale on the local market in Matca or are taken over by intermediaries who supply fresh vegetables to supermarkets and wholesale warehouses in Bucharest or abroad.

We can say that the Condrache farm is a model of a small but efficient vegetable farm, with management adapted to the current needs of sustainable vegetable growing. Crop diversification, the use of high-quality hybrids, and customized technology have led to increased yields and strengthened the farm's position in the regional vegetable market.

Disruptive factors in tomato and cucumber crops

The agricultural activity carried out at the Condrache farm in Matca is not without challenges and disruptive factors that negatively affect production, economic efficiency, and long-term stability. Identifying and analyzing these risks is an essential step in strengthening the farm's sustainability and adapting crop technology.

Natural factors

One of the main disruptive factors in the 2020-2022 period was marked climate variability. Although crops are protected in greenhouses, they remain exposed to the indirect influence of weather conditions:

• very cold winters or long periods of overcast skies, which limit seedling development in cycle I;

• strong winds (especially in March and April), which can damage the structure of greenhouses;

• scorching temperatures in July–August, which affect cycle II, causing heat stress, flower abortion, and reduced fruit quality;

• high atmospheric humidity, which favors the development of fungal diseases such as rot and powdery mildew.

Biological factors

The last two years have been characterized by increased phytosanitary intensification, especially in the case of pests such as the greenhouse whitefly (*Trialeurodes vaporariorum*), thrips (*Frankliniella occidentalis*), red spider mites (*Tetranychus urticae*) – common in cycle II, but also pathogens such as fusarium or verticillium wilt, especially in tomatoes, as a result of monoculture or inadequate crop rotation.

To combat these problems, integrated measures were applied: partial crop rotation, treatments with systemic and contact products, and the introduction of natural predators (especially to combat thrips and whiteflies).

Economic factors

In 2022, the farm faced significant increases in production costs, driven by higher electricity prices (used to heat greenhouses in winter), higher input prices (seeds, fertilizers, plant protection products), and additional costs for seasonal labor during peak season.

At the same time, market volatility, especially during peak production months, created difficulties in optimizing product sales. During some periods, prices fell below production costs, especially for cucumbers.

Technical and organizational factors

Although the farm is adequately equipped, certain limitations remain: lack of an automated climate control and shading system, which limits control over the microclimate during the summer; insufficient storage space, which reduces the capacity to store the harvest in the short term; limited access to alternative energy sources (e.g., solar panels), which maintains dependence on the conventional electricity grid.

The farm relies mainly on family labor, which ensures good control of the technological process, but during peak periods (harvesting, planting), it is necessary to hire temporary workers. In recent years, there has been a declining availability of local agricultural workers, which has led to increased labor *costs.*

Economic analysis and farm sustainability

The agricultural activity carried out on the Condrache farm has generated consistent and profitable yields in recent years, reflecting the efficiency of the technology applied and the farm's ability to adapt to climatic conditions and the market. Analysis of the yields obtained and economic parameters reveals a number of trends and factors that are decisive for the economic sustainability of the farm.

During the three years analyzed, 2020, 2021, and 2022, the farm cultivated tomatoes annually on an area of approximately 20-25 acres and cucumbers on 10-

15 acres. The crops were divided into two technological cycles, which allowed for harvesting in two stages and maximizing the marketability period.

The Melanet F1 tomato hybrid has an average yield per cycle of between 8,000 and 10,000 kg/1,000 m², with an annual productivity of between 16,000 and 18,000 kg for 20 acres.

The Ilonara F1 cucumber hybrid has an average yield per cycle of between 10,000 and 12,000 kg/1,000 m², with an annual productivity of between 10,000 and 15,000 kg for 15 acres.

To assess economic efficiency, the following key indicators were considered: production costs, revenues, and net profit. Costs include expenses for seeds, seedlings, greenhouse plastic, irrigation, phytosanitary treatments, labor, and electricity.

Estimated production costs (RON/cycle): Melanet F1 tomatoes: ~ 20,000–25,000 RON; Ilonara F1 cucumbers: ~ 17,000–20,000 RON.

Revenue (RON/cycle): Tomatoes: 36,000–45,000 RON (average selling price: 2.5–3.5 RON/kg); Cucumbers: 30,000–37,000 RON (average selling price: 1.5–2.0 RON/kg)

Estimated net profit/cycle: Tomatoes: between 16,000 and 20,000 RON; Cucumbers: between 13,000 and 17,000 RON

The total annual profit (both cycles and crops) varies between 55,000 and 75,000 RON, depending on the year, market prices, and direct costs incurred.

The rate of return frequently exceeds 40-45%, which places the farm in the high profitability zone for a small-scale operation. This performance is supported by the choice of high-quality hybrids, marketing during periods of high prices (May-June, August-October), and cost reduction through the direct involvement of the family in the production process.

During the period analyzed, 2020 was the most favorable year, with both high yields and good prices, especially for tomatoes. The year 2021 was affected by extreme weather events (strong winds, sudden temperature variations), which reduced cucumber production. In contrast, 2022 was marked by high input costs, but high market prices offset potential losses.

The main strengths, weaknesses, opportunities, and threats identified are summarized in Table 1:

Table 1

SWOT Analysis of the Condrache Farm

Strengths	Weaknesses
- two-cycle cultivation technology - alternating tomato and cucumber crops reduces economic risk - high-yield hybrids - location in a recognized vegetable-growing area - irrigation systems and controlled microclimate	- relatively small total surface area - high costs for maintaining multiple cycles - sensitivity to temperature fluctuations - lack of own brand on the market

Opportunities	Threats
- increased demand for vegetables in the off-season - implementation of smart technologies for climate control - direct sales to HoReCa chains	- new diseases and pests affecting tomatoes/cucumbers - fierce competition on the Matca market - high energy and heating costs - dependence on market conditions in the off-season

CONCLUSIONS

The main advantage of the Condrache farm is its rigorous technological organization: starting cycle I in December allows for early harvest and market access at a favorable time in terms of prices.

Cycle II, with sowing at the beginning of June, makes efficient use of natural light and temperature resources, but involves greater climatic risks, particularly in terms of heat stress during the summer.

The Condrache farm is an example of good small-scale agricultural practices, where combining technological knowledge with practical experience leads to better use of available resources.

To strengthen long-term sustainability, additional investments are needed in automation, energy efficiency, and diversification of marketing channels, including through digitization and direct marketing.

REFERENCES

1. **Dobay K.M., 2005 –** *Eco-farm management and marketing of organic products*. Ed. „Terra Nostra", Iasi.
2. **Munteanu, N., 1999 HACCP –** *Modern method for studying risk factors in vegetable crops*. Scientific papers, series Horticultura, 42. USAMV Iasi.
3. **Munteanu, N., Stoleru, V., Stoian, L., Falticeanu, M., 2008 –** *Technological bases of organic vegetable growing*. Ed. "Ion Ionescu de la Brad", Iasi.
4. **Popa, L., 2010** – Studies of the possibilities of sustainable practice of vegetable growing in Braila county. *Doctoral thesis, U.S.A.M.V. Iasi.*
5. **Stan N., Munteanu N., 2003 –** *Vegetable growing, vol. II*. Ed. „Ion Ionescu de la Brad", Iasi.
6. **Stoian, L., 2005 –** *Practical guide to organic vegetable growing*. Ed. TipoActiv, Bacau.
7. **Stoleru, V., 2008** – *Studies of the opportunity of vegetable growing in a sustainable agricultural system.* Doctoral thesis, U.S.A.M.V. Iasi.
8. **Stoleru, V., 2013 –** *Management of organic vegetable systems*. Ed. "Ion Ionescu de la Brad", Iasi.
9. ***Teliban, G.C., 2011 –*** *Researches regarding the technical opportunities for the implementation of ecologic agriculture system in the vegetable enterprises from Iasi County.* Doctoral thesis, U.S.A.M.V. Iasi.

PRELIMINARIES TO PROMOTING SUSTAINABLE VEGETABLE FARMING

PREMISE PENTRU PROMOVAREA AGRICULTURII SUSTENABILE ÎN LEGUMICULTURĂ

TELIBAN Gabriel-Ciprian[1], ANTON Doru Relu[1*], STOLERU Vasile[1], COJOCARU Alexandru[1], CIUBOTĂRIȚA Anamaria[1], POPA Lorena-Diana[2], MUNTEANU Neculai[1**]

[*]Corresponding author e-mail: ing.antondoru@yahoo.com
[**]Coordinator author e-mail: neculai.munteanu@iuls.ro

Abstract.
The paper presents a theoretical analysis of the premises, strategies, and principles that can support the development of sustainable vegetable farming in Romania. The study highlights existing advantages, such as soil fertility, pedoclimatic diversity, labor availability, and tradition in vegetable farming. The necessary strategic directions are analyzed, including innovation, investments oriented towards sustainable practices, access to financing, and the role of associative forms. The fundamental principles of sustainability - environmental protection, economic viability, and social stability, along with maintaining productivity, form the basis of a resilient vegetable growing system adapted to current challenges.
Key words: sustainable vegetable farming, development premises; sustainable strategies; principles of sustainability

Rezumat.
Lucrarea prezintă o analiză teoretică asupra premiselor, strategiilor și principiilor care pot susține dezvoltarea legumiculturii sustenabile din România. Studiul evidențiază avantajele existente, precum fertilitatea solurilor, diversitatea pedoclimatică, disponibilitatea forței de muncă și tradiția în cultura legumelor. Sunt analizate direcțiile strategice necesare, incluzând inovația, investițiile orientate către practici sustenabile, accesul la finanțare și rolul formelor asociative. Principiile fundamentale ale sustenabilității - protecția mediului, viabilitatea economică și stabilitatea socială, alături de menținerea productivității - constituie baza unui sistem legumicol rezilient adaptat provocărilor actuale.
Cuvinte cheie: legumicultură sustenabilă, premise de dezvoltare; strategii sustenabile; principii ale sustenabilității

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania
[2] Agricultural Research and Development Station Secuieni-Neamt, Romania

INTRODUCTION

Sustainable agriculture is, in the current context, one of the key strategic directions for ensuring a balance between the need to increase agri-food production and the conservation of natural resources. The concept has evolved in response to increasing environmental pressures and the challenges posed by climate change, and is defined as a system capable of maintaining productivity without compromising resources for future generations [Velten et al., 2015; Reganold and Wachter, 2016].

Due to its intensive nature, vegetable farming is sensitive to climate change, soil degradation, and economic pressure on farmers. Therefore, the transition to sustainable production systems is no longer just an option, but a fundamental condition for maintaining the sector's viability in the medium and long term [Pretty et al., 2018; Lal, 2015].

In Romania, vegetable growing has a number of natural and traditional advantages that can facilitate the implementation of sustainability principles: fertile soils, favorable pedoclimatic diversity, and a wealth of knowledge passed down from generation to generation. However, the development of sustainable vegetable growing is influenced by multiple constraints, such as climate variability, limited access to financial and technological resources, and labor migration [Gadanakis et al., 2015].

At European level, common agricultural policies promote the adoption of resource-efficient, resilient and environmentally friendly production systems, objectives that are also integrated into recent strategies such as "Farm to Fork". In this context, the Romanian vegetable sector must identify ways in which it can correlate these directions with local realities in order to ensure long-term competitiveness [European Commission(a)].

Although the literature offers numerous perspectives on the principles of sustainable agriculture, there is still a need for an integrated synthesis that highlights the premises, strategic directions, and fundamental principles applicable to the national context. Such an analysis allows for a better understanding of the current opportunities and challenges in Romanian vegetable farming.

The purpose of this paper is to conduct a conceptual analysis of the opportunities and directions for the development of sustainable agriculture in vegetable growing, based on the favorable premises identified in Romania, the strategies necessary to consolidate this system, and the principles that define its functionality. By structuring these elements into a unified framework, the paper contributes to informing decisions for farmers, researchers, and decision-makers, supporting the transition to a more competitive vegetable sector that is adapted to future challenges [Khoury et al., 2014].

MATERIAL AND METHOD

This paper is a synthesis and theoretical analysis based on relevant literature on sustainable agriculture and its application in the vegetable sector. The documentation

process aimed to identify and select scientific sources published between 1990 and 2024, including scientific articles, specialized volumes, technical guides, institutional reports, and European strategic documents.

The sources consulted came from international scientific databases (Google Scholar, Scopus, Web of Science), national specialist literature, and official European Union documents, in line with the practice used in assessments of sustainable agricultural systems [FAO, 2019].

The selection of materials was based on the following criteria: relevance to the field of vegetable growing, applicability of the information in the context of sustainable agriculture, timeliness of the data, and credibility of the source. European policy documents such as the Farm to Fork strategy, which set the current directions for agri-food systems, were also integrated [European Commission(a)].

The information was analyzed using a narrative approach, structuring the key concepts into three major directions: the premises for the development of sustainable agriculture in the national context, the strategies needed to strengthen this system, and the fundamental principles that define the functionality of sustainable agriculture in vegetable growing. This approach is consistent with the methodology used in conceptual studies on sustainable agriculture, which aim to integrate ecological, economic, and social elements in a coherent manner [Munteanu et al., 2008].

RESULTS AND DISCUSSIONS

The premises for the development of sustainable agriculture in Romania

The development of sustainable agriculture in Romanian vegetable farming is supported by favorable natural and structural factors. A first essential element is the high agroecological potential, characterized by fertile soils, varied hydro-pedological resources, and a pedoclimatic diversity favorable to vegetable crops. These conditions allow the use of technologies with low environmental impact, while maintaining productivity and offering a competitive advantage over other European regions [Lal, 2015; Munteanu et al., 2008].

A second major aspect is the availability of labor in rural areas, which is particularly relevant for organic or low-input systems, where a significant part of agricultural work requires manual intervention. The relatively low cost of labor can contribute to increasing the profitability of small and medium-sized farms and facilitate the adoption of sustainable technologies that require greater physical input [Gadanakis et al., 2015; Stoleru, 2008].

In addition, Romania has a strong tradition in vegetable cultivation, reflected in practical knowledge accumulated over generations and adapted to local conditions. This cultural background provides valuable support for the implementation of sustainable technologies, as many traditional practices coincide with the principles of sustainable agriculture - the use of manure, crop rotation, and the maintenance of biodiversity at the household level [Stoian, 2005].

Taken together, these premises indicate that the vegetable sector has a favorable foundation for integrating sustainability principles. However, turning these advantages into concrete results depends on the ability of farmers and institutions in the agricultural sector to capitalize on existing resources through

technological investments, training, and the adaptation of public policies to national specificities [European Commission(b); FAO, 2019].

Strategies for strengthening sustainable agriculture in vegetable growing

The development of a sustainable vegetable growing system in Romania requires the implementation of integrated strategies aimed at improving resource efficiency, increasing farm competitiveness, and reducing pressure on the environment. A first strategic element is the promotion and transfer of innovation through the introduction of modern cultivation technologies, the use of ecological plant protection methods, and the adoption of computerized resource monitoring systems. Expanding vocational training programs and access to up-to-date information facilitates the adoption of these solutions at the level of small and medium-sized farms [Pretty et al., 2018; Stoleru, 2013].

A second strategic direction is the mobilization and targeting of capital towards sustainable investments. The development of rural infrastructure, the modernization of protected areas, the installation of efficient irrigation systems, and the creation of collection and processing centers contribute to increasing the added value of vegetable production [Gadanakis et al., 2015; Munteanu et al., 2008].

Another fundamental element is facilitating access to finance and strengthening marketing mechanisms. Currently, limited access to credit and tailored forms of financial support constrains farmers' ability to implement sustainable practices. The development of agricultural cooperatives, producer associations, and their integration into supply chains enable competitive prices, reduce risks, and increase economic stability [European Commission(b); FAO, 2019].

At the same time, harnessing rural human resources is essential for a sustainable system. Reducing migration and revitalizing rural communities depend on recognizing the strategic role of the local workforce [Stoleru, 2008; Teliban, 2011].

Finally, planning and regulating the use of natural resources is a mandatory component of sustainability. Responsible management of soil, water, and biodiversity, together with the implementation of clear regulations on the use of inputs and environmental protection, ensures the long-term stability of vegetable agroecosystems [Lal, 2015; Munteanu et al., 2008].

By integrating these strategies, the vegetable sector can evolve towards a sustainable model capable of simultaneously meeting production, environmental protection, and rural community development objectives, in line with European guidelines on the transition to a green economy [European Commission(a)].

Principles of sustainable agriculture in vegetable growing

Sustainable agriculture in the vegetable sector is based on a set of fundamental principles that aim to strike a balance between environmental protection, economic performance, social stability, and productive continuity [Velten et al., 2015; Reganold and Wachter, 2016].

The first principle, which is highly relevant to vegetable production, is the reduction of environmental degradation. Limiting the use of pesticides and chemical fertilizers, adopting minimum tillage, using green crops, and increasing

biodiversity contribute to reducing pollution, maintaining soil fertility, and strengthening the resilience of agroecosystems. These practices reduce dependence on external inputs and promote more efficient management of natural resources [Munteanu et al., 2008; Stoian, 2005].

A second central principle is economic viability, a prerequisite for the functioning and perpetuation of sustainable systems. In vegetable farming, where economic risks are amplified by market volatility and climate vulnerability, the adoption of low-cost technologies, the use of local resources, and the diversification of production can ensure a stable income for farmers [Pretty et al., 2018; Gadanakis et al., 2015].

A third principle, social stability, is closely linked to the role of rural communities in supporting vegetable farming. Sustainable agriculture contributes to the preservation of family farms, the maintenance of the active population in rural areas, and the conservation of agricultural traditions, which are an important part of Romanian cultural heritage [Stoleru, 2008; Teliban, 2011]. By creating jobs and supporting a functional local economy, sustainable systems become a factor of social stability and development.

Finally, ensuring consistent productivity is essential for sustainability. Achieving stable harvests without compromising soil fertility or production capacity for future generations requires the use of agrotechnical practices adapted to local conditions, resource conservation, and careful monitoring of climate developments [Lal, 2015; FAO, 2019].

By integrating these principles, sustainable vegetable farming becomes a production model capable of simultaneously meeting ecological, economic, and social requirements, providing a solid framework for the sustainable development of this sector [Velten et al., 2015; Pretty et al., 2018].

CONCLUSIONS

The sustainability of the vegetable sector is essential for the development of Romanian agriculture, and this analysis highlights the main elements that justify and reinforce this perspective:

1. Romania has favorable conditions for the development of sustainable vegetable farming, thanks to its valuable natural resources, available rural labor force, and tradition of vegetable cultivation. These elements provide a solid foundation for the implementation of sustainable practices.

2. Strategies to strengthen sustainable agriculture must integrate innovation, investments in environmentally friendly technologies, and improved access to finance, especially for small and medium-sized farms. Developing rural infrastructure and strengthening cooperatives are key factors in increasing competitiveness.

3. The principles of sustainable agriculture - environmental protection, economic viability, and social stability, along with consistent productivity, form the foundation of a resilient vegetable farming system capable of responding to

current climatic and economic challenges.

4. The adoption of sustainable practices contributes both to maintaining soil fertility and conserving biodiversity, and to creating stable socio-economic conditions for rural communities, strengthening the role of vegetable growing as a strategic sector.

5. Integrating these directions into a unified vision is essential for aligning the Romanian vegetable sector with European objectives regarding the transition to green agriculture, highlighting the need for public policies adapted to national specificities.

Overall, the analysis highlights that the development of sustainable vegetable farming requires a complex, interdisciplinary, and collaborative approach that leverages existing resources and supports farmers' adaptation to the new requirements of the green economy.

REFERENCES

1. **Food and Agriculture Organization of the United Nations (FAO), 2019** – *The State of Food and Agriculture. Moving forward on food loss and waste reduction.* Rome.
2. **Gadanakis Y., Bennett R., Park J., Areal F.J., 2015** - *Evaluating the sustainable intensification of arable farms*. Journal of Environmental Management, 150.
3. **Khoury C.K., Bjorkman A.D., Dempewolf H., Ramirez-Villegas J., Guarino L., Jarvis A., Rieseberg L.H., Struik P.C., 2014** – *Increasing homogeneity in global food supplies and the implications for food security*. Proceedings of the National Academy of Sciences, 111(11).
4. **Lal R, 2015** – *Restoring soil quality to mitigate soil degradation*. Sustainability, 7(5).
5. **Munteanu N., Stoleru V., Stoian L., Fălticeanu M., 2008** – *Technological bases of organic vegetable growing*. Ed. "Ion Ionescu de la Brad", Iasi.
6. **Pretty J., Benton T.G., Bharucha Z.P., Dicks L.V., Flora C.B., Godfray H.C.J., Goulson D., Hartley S., Lampkin N., Morris C., Pierzynski G., Prasad P.V.V., Reganold J., Rockström J., Smith P., Thorne P., Wratten S., 2018** – *Global assessment of agricultural system redesign for sustainable intensification*. Nature Sustainability, 1(8).
7. **Reganold J.P., Wachter J.M., 2016** – *Organic agriculture in the twenty-first century*. Nature Plants, 2, 15221.
8. **Stoian L., 2005** – *Practical guide to organic vegetable growing*. Ed. TipoActiv, Bacau.
9. **Stoleru V., 2008** – *Studies of the opportunity of vegetable growing in a sustainable agricultural system.* Doctoral thesis*, U.S.A.M.V. Iasi.*
10. **Stoleru V., 2013** – *Management of organic vegetable systems*. Ed. "Ion Ionescu de la Brad" Iasi.
11. **Teliban G.C., 2011** – *Researches regarding the technical opportunities for the implementation of ecologic agriculture system in the vegetable enterprises from Iasi County.* Doctoral thesis, U.S.A.M.V. Iasi.
12. **Velten S., Leventon J., Jäger N., Newig J., 2015** – *What is sustainable agriculture? A systematic review*. Sustainability, 7(6).
13. ******* European Commission(a). Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system. https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en
14. ******* European Commission(b). Common agricultural policy. https://agriculture.ec.europa.eu/cap_en

REHABILITATION OF A PRIVATE GARDEN IN VASLUI CITY USING CERAMIC MATERIALS

REAMENAJAREA UNEI GRĂDINI PRIVATE ÎN ORAŞUL VASLUI UTILIZÂND MATERIALE CERAMICE

GRECU Codrina[1]*, AXINTE Silviu[1]

*Corresponding author e-mail: codrina.grecu@iuls.ro

Abstract.
This paper briefly presents the evolution of the use of ceramic materials over time, two case studies and the solution for the redevelopment of a private garden in the city of Vaslui. As a preparatory stage of the landscaping project, an analysis of the existing situation of the site proposed for development was carried out. The zoning of the site and the images of the details of the proposed furnishings for each of the areas are presented, all of which constitute points of interest of the garden connected to each other with paths made of ceramic tiles.
The described landscaping can be a practical example of landscape analysis and design of a small private garden green space.
Key words: ceramics, landscaping, private garden

Rezumat.
Lucrarea de față prezintă pe scurt evoluția în timp a modalităților de utilizare a materialelor ceramice, două studii de caz, cât și soluția de reamenajare a unei grădini private din orașul Vaslui. Ca etapă pregătitoare amenajării s-a realizat o analiză a situației existente a sitului propus spre amenajare. Sunt prezentate zonificarea sitului și imaginile detaliilor de mobilare propuse pentru fiecare dintre zone, toate acestea constituind puncte de interes ale grădinii conectate între ele cu alei construite din plăci ceramice.
Amenajarea descrisă poate constitui un exemplu practic de analiză și proiectare peisageră a unui spațiu verde a unei grădini private mici.
Cuvinte cheie: materiale ceramice, amenajare peisageră, grădină privată

INTRODUCTION

People have been using bricks to build for thousands of years, dating back to around 7000 BC, making them some of the oldest known building materials. Created by mixing clay or mud with straw, bricks were then dried in the sun to make them harder and stronger.

Among the oldest evidence of these crafts are a series of ceramic objects and figurines found in central Europe, in southern Moravia, which includes our country.

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania

One of the most important artifacts found at the Dolni Vestonice site, dating back some 29000 to 25000 BC, is a well-preserved statuette of a female nude known as the 'Venus of Dolni Vestonice' [https://www.historyofinformation.com/detail.php?entryid=2493].

The Chinese potters were the first to produce high-temperature firings, gradually improving the techniques and composition used, achieving the highest quality of white, translucent porcelain shards during the Tang dynasty (618-907), whose quality, shapes and craftsmanship in the decoration impressed the European elite for a long period [https://www.comuseum.com/ceramics/tang/].

The emergence of European porcelain came at the beginning of the 18th century and led to an extremely rapid development of ceramic processing technologies due to the industrial revolution.

In order to ensure that production was as uniform and high quality as possible, each worker had to carry out a reduced number of operations so that production could fully meet the ever-increasing demands of the market. The advent of industrial production, however, meant a step backwards for traditional craftsmanship, as the working power of classical potters working in the traditional style cannot be compared with that of industrialized ceramics.

Today, ceramic art is considered one of the most dynamic art forms, with bold prospects for the future and in a process of broadening in terms of materials, processing and finishing methods, as well as artistic expressiveness [Hugues, et al., 2008].

The move towards nature is bringing ceramics back into the mainstream, as they are used in terraces, walkways, lawn paths and furniture areas. The wide range of patterns, colors and textures of ceramic derivatives offers homeowners, architects and landscape designers virtually limitless design possibilities.

Over time, the use of ceramics in landscaping has diversified, ranging from their use as pots or supports, to the realization of objects or accessories with aesthetic value in their own.

In landscaping, ceramic tiles are used in terraces, in the construction of brick barbecues and in planters. Regardless of the element to be built, the first step is to create a solid foundation suitable for the structure to be erected.

Paved walkways or driveways are some of the most important elements of a landscaping that can be paved with ceramic materials appropriate to the type of traffic and aesthetic style adopted. Depending on the surface area they occupy and their role in a garden, there are 3 types of walkways:

- Walkways;
- Transit paths;
- Easement paths.

Landscape design has recently developed various ideas about the actual construction of decorative walls and their function in the landscape. Designed to anchor the ground between the different levels of a slope, or when the ground is

unstable or sloping, walls have also gained their place in landscaped spaces because of the aesthetic benefits they bring.

Retaining walls are divided according to a number of characteristics: height, depth, materials used and the way they are erected - free-standing or in conjunction with existing adjacent structures. In terms of the materials used, the range of materials available is wide, from various types of brick, stone and concrete to gabion walls [DETAIL, 2007].

Other elements made of ceramic materials such as grills or fireplaces, arches, arbors, posts, planters, terraces, steps or even fences are also used in landscaping.

The garden to be landscaped within this project is located in the city of Vaslui, near Copou Park. Vaslui is the capital and largest city of the county of the same name, in Romania.

MATERIAL AND METHOD

The main purpose of the present work is the redevelopment of a private garden in Vaslui. The aim of this work is to transform the space with the use of ceramic materials into a place suitable for relaxation and recreation as well as a perfect area to spend time with family and loved ones.

Thus, after the reorganization of the space, several elements were added in an attempt to make the most of the size of the plot.

An important stage in the redevelopment project was the pre-project documentation. This involved studying various redevelopment projects at different stages of the project.

In terms of the objectives of the work, the following requirements had to be met:

- The predominant use of ceramic materials in order to realize the built elements inside the garden;
- The realization of a terrace and a walkway linking the house to the landscaped areas;
- Realization of decorative structures.
- More efficient zoning and division of space within the garden;
- Removal of degraded elements and their replacement with new ones made of ceramic materials.

RESULTS AND DISCUSSIONS

With a surface area of approximately 250 square metres, the garden is entirely intended for future landscaping.

The land inside the garden is slightly uneven, which requires terracing in two areas, joined by a pathway that crosses the two areas of land. According to the data collected on site, the entrance to the garden is easily accessible and overlaps with the alleyway providing the entrance to the house.

As the interior design project had to aim at the most efficient division of the interior space, the rehabilitation and replacement of some degraded elements with ceramic elements as well as the realisation of dedicated areas with various functions, the most appropriate solution was the zoning of the entire space into 4 functional zones (Figure 1).

Fig. 1. Existing situation of the proposed garden

Zone I, or the garden entrance area, is the main access route, which provides a direct link from the street to the landscaped garden space, without the need to enter through the inside of the house (Figure 2.).

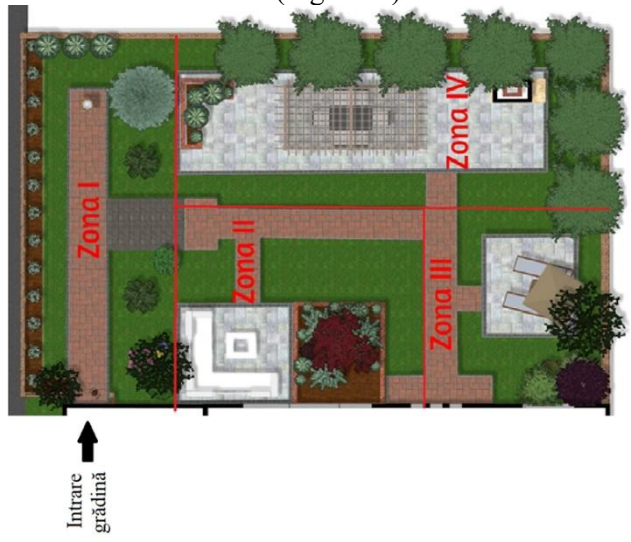

Fig. 2. General zoning (original)

The alley is the element that gives unity to the whole garden, with the birdbath, a structure with both a decorative and practical role, ending in the first area. As the difference in level between the two terraces is 75 centimetres, a set of 5 steps with a height of 15 centimetres each was chosen (Figure 3, right). The walkway was also widened so that at the point of intersection with the steps it reaches 2 metres.

Fig. 3. Garden entrance zone with one birds pond (original)

Zone II is the area of the garden furniture and is dedicated to relaxation and socialising, representing a quiet place with an ambient setting suitable for spending time with loved ones. The structure of the furniture is made of solid brick used in combination with wood and is positioned on its own tiled area of about 15 m2. (Figure 4, left)

Fig. 4. Seating area next to the fire pit and planted jardiniere (original)

Next to the furniture is the main planter, which is also the focal point of the garden. The centrepiece is an Acer palmatum 'Katsura' and a Hibiscus syriacus has been chosen next to it. The plant composition also includes Juniperus horizontalis, *Lavandula officinalis* and dwarf plant species such as *Thuja danica* 'Aurea', *Carex oshimensis* 'Evergold'*, Berberis thunbergii atropurpurea* 'Nana' (Figure 4, right).

Area III is mainly for relaxing, with space for deckchairs. They are positioned on a 13 m2 tiled terrace, which offers a panoramic view of the garden. The plant material in this area is *Betula utilis Jacquemontii, Salix caprea pendula, Betula C*crimson Frost'*, Pyracantha coccinea, Hibiscus siriacus* and *Hidrangea macrophylla* (Figure 5).

Fig. 5. Relaxation area with sun loungers (zone IV)

Area IV is the largest area, approximately 50 metres2, and includes the pergola and dining area. Also inside this area is the brick-built barbecue and at the opposite end of the pergola is the second, smaller planter. Aromatic plants such as *Rosmarinus officinalis, Lavandula officinalis* and *Salvia nemerosa* 'Marcus', as well as *Carex* sp. and *Festuca rubra* have been used to compose the composition inside the planter (Figure 6.).

Fig. 6. Dining area with pergola, barbecue and herb garden

CONCLUSIONS

This paper presents a project for the redevelopment of a private garden in the city of Vaslui, using ceramic materials both in the realization of the paths and in the construction of garden furniture.

Clay soil, along with stone, were the first materials man began to work with. Unlike stone, which withstood the harsh weather, molded clay began to disintegrate, until people discovered the power of fire and clay became pottery, so the shapes created from this material began to stand the test of time.

The landscaping in the project was done in a mixed style, combining elements of both free landscape and geometric styles. The landscaping is based on an asymmetrical design with a part of the surface occupied only by lawn, a part occupied by free-style plant compositions, and a part occupied by furniture pieces mainly constructed of brick and ceramic plywood, in combination with stone and wood elements.

The zoning has been designed to meet the needs of the beneficiaries, ensuring good communication between all 4 zones through alleys.

Both the walkways and the brick-built pieces complement the landscaping and emphasize the vegetal elements, thus harmoniously creating an aesthetical, functional and sanogenic valuable space. The finalization of this project was based on the knowledge of the importance of ceramic materials and the stages and techniques of realization of the constructed pieces of furniture made of ceramic material.

The realization of this research work was possible, based on all the knowledge in the field of landscape architecture, accumulated by the co-author under the guidance of the first author, in the framework of the thesis for the completion of the Bachelor's degree at the Faculty of Horticulture of the University for Life Sciences of Iasi.

REFERENCES

1. Hugues T., Greilich K., Peter C., 2008 - *DETAIL Praxis. Bloques ceramicos*. Gustavo Gili, Barcelona.
2. * DETAIL. 2007**, Review of Architecture and Construction Detail. Brick, Concrete, Stone. Vol. 4.
3. *** https://www.historyofinformation.com/detail.php?entryid=2493
4. *** https://www.comuseum.com/ceramics/tang/).

THE EFFECT OF FOLIAR FERTILIZATION WITH BIOSTIMULANTS ON THE GROWTH PARAMETERS OF EGGPLANT SEEDLINGS

EFECTUL FERTILIZĂRII FOLIARE CU BIOSTIMULATORI ASUPRA PARAMETRILOR DE CREŞTERE LA RĂSADURILE DE PĂTLĂGELE VINETE

DASCĂLU (CONSTANTIN) Delia – Cristina[1,2], PARASCHIV Mihaela[1]*

*Corresponding author e-mail: mihaela1mail@yahoo.ca

Abstract.
The quality of the seedlings used to establish crops directly influences the quality of vegetable production. The experience aimed to study the influence of foliar treatments with different biostimulants and fertilizers on some growth parameters of eggplant seedlings, Belona cultivar. The experiment was monofactorial, in randomized blocks with five repetitions. Four foliar treatments with Razormin, Atonik, Sprintene and Microcat Magnesium were administered at 10-day intervals, starting on the 20th day after emergence. After 60 days from emergence, five plants from each replicate were selected randomly for analysis. The measurements made concerned the height of the plants, the length of the roots and the aerial part, the stem diameter, the fresh and dry weight of whole plants, of the roots, of the aerial parts and of the leaves. There was also count the number of true leaves. The treatments with the Sprintene product proved a significantly positive influence on the eggplant seedlings.
Key words: biostimulant, eggplant, seedling vigor

Rezumat.
Calitatea răsadurilor utilizate pentru înființarea culturilor influențează direct calitatea producţiei vegetale. Prezenta experienţă a vizat studierea influenței unor tratamente foliare cu diferiți biostimulatori și fertilizanți asupra unor parametri de creştere la răsadurile de pătlăgele vinete, soiul Belona. Experiența a fost monofactorială, așezată în blocuri randomizate, în cinci repetiții. Patru tratamente foliare cu Razormin, Atonik, Sprintene și Microcat Magneziu s-au administrat la interval de 10 zile, începând cu a 20-a zi de la răsărire. După 60 de zile de la răsărire, au fost selectate aleator câte cinci plante din fiecare repetiție pentru a fi analizate. Măsurătorile efectuate au vizat înălțimea plantelor, lungimea rădăcinilor și a părții aeriene, grosimea tulpinii la colet, masa proaspătă și masa uscată a plantelor întregi, a rădăcinilor, părților aeriene și a frunzelor. Tratamentele cu produsul Sprintene au dovedit o influenţă semnificativ pozitivă asupra răsadurilor de pătlăgele vinete.
Cuvinte cheie: biostimulator, pătlăgele vinete, vigoarea răsadului

[1] Research and Development Institute for Vegetable and Flower Growing Vidra
[2] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania

INTRODUCTION

In the stages of vegetable production, the seedling production phase is an extremely important activity because the performance of the future crop depends on the quality and health of the seedlings [Costa *et al*., 2013]. A defective seedling can compromise the entire crop development process, prolonging the time required for growth and leading to yield losses [de Moraes Echer *et al*., 2007].

Eggplant (*Solanum melongena* L.) is one of the nontuberous species of the Solanaceae family and is also known as brinjal or aubergine [Kantharajah and Golegaonkar, 2004]. The fruits of *S. melongena* L. present a wide variety of shapes and colors, being ovate, pyriform, spherical or elongated, of black, purple, white, green or striped colors [Munteanu, 2003; Azarpour *et al*., 2012]. They have a low calorie and fat content, but are rich in potassium, magnesium, calcium, iron [Michalojc and Buczkowska, 2008], zinc, manganese, copper and iodine [Temelie, 2020]. Eggplant seedlings are produced in alveolar seed trays, at an optimal temperature of 20-25°C. The plants require sufficient light to avoid etiolation and regular watering to keep the soil moist. Seedlings are ready for transplanting when they have 5-6 true leaves and are well developed, usually 6-8 weeks after sowing [Munteanu, 2003]. Quality seedlings are more likely to withstand the stress associated with transplanting and, through proper crop management, contribute to the production of high quality fruit [Munteanu, 2003; Stan and Stan, 2010].

Aspects such as the types of substrates, the containers used, the growing environment, as well as the irrigation and nutrition methods are techniques of particular importance in maximizing the production potential and the vitality of the plants intended for transplanting in the field [Voican and Lăcătuș, 1998]. Seedlings should be exposed to balanced fertilization to provide them with the necessary nutrients. Practices such as foliar fertilization with various nutrients have proven to be effective methods contributing to healthy seedling growth [Florescu, 1992; Voican and Lăcătuș, 1998]. Foliar fertilizers are administered in the early hours of the morning or at dusk, when temperatures are lower and plants have a better capacity to absorb nutrients. Sprays should be applied evenly to the leaves [Fageria *et al*., 2009].

These substances have shown favorable results in various fields of agriculture, including stimulating plant growth, improving stress tolerance [Wang *et al*., 2019], nutrient content in plant tissue [Ciucu Paraschiv and Hoza, 2022a], increasing crop yield [Grabowska *et al*., 2015; Kopta *et al*., 2018; Ciucu Paraschiv *et al*., 2023] and production quality [Wahba *et al*., 2015; Ciucu Paraschiv and Hoza, 2022b]. These substances also contribute to improving the activity of rhizobacteria [Liu *et al*., 2016], which play an essential role in plant development through mechanisms such as phytohormone production, phosphate solubilization, strengthening systemic plant resistance and suppressing pathogens [Bhattacharyya and Jha, 2012]. As foliar applied biostimulants, amino acids, free peptides [Wang *et al*., 2019; Du Jardin, 2015; Shchetyna *et al*., 2024], humic and fulvic acids, biological phosphorus, seaweed extracts, plant extracts, etc. The process of nitrogen

absorption from amino acids occurs within 3-7 days after spray application and is influenced by their molecular weight, increasing as it decreases [Umemiya and Furuya, 2002].

MATERIAL AND METHOD

The experience was carried out in the experimental greenhouses of the Research and Development Institute for Vegetable and Flower Growing Vidra, between February and May 2024. The experiment carried out is monofactorial, laid out in randomized blocks, in five replications.

The biological material consisted in seedlings of eggplant, *Belona* cultivar. Seeds obtained in 2023 belonging to the cultivar were sown in alveolar seed tray, with 70 cells, each cell having a volume of 50 ml. The seeds were sown on the 26th of February 2024. The air temperature in glasshouses was 22-24 ℃ during the day and 15-18 ℃ during the night. Waterings were carried out at intervals of 2-4 days depending on the moisture level of the substrate. The lighting was done naturally, without additional artificial light. Four foliar treatments were applied with 4 commercial products, with chemical composition shown in table 1. Table 1 also shows the experimental variants and the concentrations of the treatment solutions used.

Table 1

Experimental variants and commercial products used

Experimental variant	Commercial product used	Chemical composition of the product	Concentration
V1	untreated	-	-
V2	Razormin	4% N, 4% P_2O_5, 3% K_2O, 7% free amino acids, 3% polysaccharides, 0.4% Fe, 0.1% Mn, 0.1% B, 0.085% Zn, 0.02% Cu, 0.01% Mo	2 mL/L
V3	Atonik	Sodium Ortho-Nitrophenolate 0.2%, Sodium 4-nitrophenolate 0.3%, Sodium 5-nitroguaiacolate 0.1%	1 mL/L
V4	Sprintene	1% Mn, 1% Zn, 80% organic matter	2 mL/L
V5	Microcat Magnesium	10% MgO; 8% N; 2.6% free amino acids; 7% organic acids	2.5 mL/L

The treatments were applied at 10-day intervals between treatments, starting with the first true leaves (at 20, 30, 40 and 50 days after emergence). After 60 days from emergence, the recommended age for planting eggplants in the field, five plants from each replicate were kept for analysis in the laboratory.

Measurements were made regarding plant height, root and aerial part length, stem diameter, fresh and dry mass of whole plants, roots, aerial parts and leaves, ash content in the roots and aerial organs of seedlings.

Length measurements were made using a digital caliper (Unior 270A). Mass measurements were made using an analytical 4-place balance (Kern ADJ 200-4).

The total dry matter content was determined by the gravimetric method (drying 10 g of plant tissue at 105°C to constant weight) [Krełowska-Kułas, 1993].

RESULTS AND DISCUSSIONS

Table 2 shows the results regarding the influence of foliar treatments on the length measurements of eggplant seedlings.

Table 2

The influence of foliar treatments on the length measurements of eggplant seedlings

Variant	Commercial product used	Stem diameter	Root length	Aerial part length	Total length
		cm	cm	cm	cm
V1	untreated	0.35±0.03^{b}	10.62±2.49^{a}	10.50±1.19^{b}	21.12±3.07^{ab}
V2	Razormin	0.41±0.03^{a}	8.97±2.53^{bc}	10.65±1.28^{b}	19.62±2.37^{bc}
V3	Atonik	0.39±0.04^{a}	8.58±3.08^{c}	10.50±1.32^{b}	19.08±3.78^{c}
V4	Sprintene	0.40±0.03^{a}	10.26±2.66^{ab}	11.70±0.92^{a}	21.96±2.86^{a}
V5	Microcat Magnesium	0.39±0.04^{a}	9.96±2.35^{abc}	10.69±1.21^{b}	20.65±3.12^{abc}

Values followed by different letters within each column are significantly different based on Duncan multiple range test (P≤0.05).

Stem diameter was significantly influenced by all foliar treatments applied to eggplant seedlings. The increases ranged between 11.43 and 17.14%. The most significant increases were observed in the case of treatment with the Razormin rooting stimulator.

An interesting aspect is that the treatments used led to a more or less significant decrease in root length. The longest roots were observed in the untreated variant, and the shortest in the variant treated with the Atonik product. Significant decreases in root length were also observed in the case of foliar treatments with the Razormin product. In the case of treated variants, decreases in length ranged between 3.39% (Sprintene product) and 19.2% (Atonik).

The aerial part of the plants increased significantly only in the case of treatments with the Sprintene product. However, this growth parameter is not desired to be stimulated, because excessive elongation of the seedlings is not desired, which would represent a decrease in its quality [Munteanu, 2023].

The length of the plants varied significantly between an average of 19.08 cm, in the case of the variant treated with Atonik, and an average of 21.96 cm in the case of the variant treated with Sprintene. Compared to the untreated variant, the plants treated with Atonik were significantly shorter than the untreated ones, which is due to the decrease in root length.

Table 3 shows the influence of foliar treatments applied to eggplant seedlings on fresh weight measurements.

Table 3

The influence of foliar treatments on the weight measurements of eggplant seedlings

Variant	Commercial product used	Root weight	Leaf weight	Aerial part weight	Plant weight
		g	g	g	g
V1	untreated	1.06±0.14^{c}	1.79±0.15^{bc}	3.10±0.27^{b}	4.16±0.37^{c}
V2	Razormin	1.17±0.19^{bc}	1.62±0.16^{b}	3.17±0.31^{b}	4.34±0.28^{c}
V3	Atonik	1.47±0.25^{ab}	1.52±0.11^{b}	3.11±0.26^{b}	4.58±0.43^{bc}

V4	Sprintene	1.56±0.31^{a}	2.03±0.25^{ab}	3.85±0.32^{a}	5.40±0.51^{a}
V5	Microcat Magnesium	1.40±0.21^{ab}	2.11±0.32^{a}	3.61±0.45^{a}	5.01±0.44^{ab}

Values followed by different letters within each column are significantly different based on Duncan multiple range test (P≤0.05).

Root weight was positively influenced by some of the foliar treatments used. Even though the roots decreased in length, their weight increased significantly in the case of treatments with Microcat Magnesium, Atonik and Sprintene. The increases determined by these products ranged between 32.08 (Microcat Magnesium) and 47.17% (Sprintene).

Leaf weight increased significantly only after treatments with Microcat Magnesium. It increased by 17.88%, from 1.79 g to 2.11 g. The differences determined by the Sprintene product in leaf mass were not sufficient to be significant. In the case of the Razormin and Atonik products, a decrease in leaf weight was even observed, but without being significant compared to the untreated variant.

The Sprintene and Microcat Magnesium treatments also had conducted to significant increases in both aerial and whole plant weight. Sprintene led to a 29.81% increase in plant weight, and Microcat Magnesium led to a 20.43% increase.

The increase in the weight of different parts of eggplant seedlings has previously been obtained following treatments with different organic or mineral fertilizers [Dascălu Constantin *et al*., 2022].

In Table 4 is presented which was the influence of foliar treatments used on dry weight of roots and aerial organs of seedlings.

Table 4

The influence of foliar treatments on the dry weight of different parts of the plant

Variant	Comercial product used	Root dry weight	Leaf dry weight	Aerial part dry weight	Plant dry weight
		%	%	%	%
V1	untreated	10.71±0.74^{b}	13.39±0.76^{b}	13.21±0.75^{b}	12.48±1.19^{b}
V2	Razormin	14.26±2.93^{a}	14.03±1.72^{ab}	14.28±1.91^{ab}	14.09±1.83^{a}
V3	Atonik	13.08±2.97^{ab}	14.01±1.03^{ab}	14.36±0.93^{ab}	13.63±.74^{ab}
V4	Sprintene	11.57±3.50^{ab}	14.72±1.28^{a}	14.54±1.22^{a}	13.96±1.09^{a}
V5	Microcat Magnesium	11.56±1.93^{ab}	14.63±0.37^{a}	14.61±0.35^{a}	13.49±0.85^{ab}

Values followed by different letters within each column are significantly different based on Duncan multiple range test (P≤0.05).

Root dry weight was significantly influenced by the treatments used with the Razormin product, which determined significant differences of 33.15%.

Leaf and aerial part dry weight increased significantly with Sprintene and Microcat Magnesium treatments. Sprintene had produced an increase of 9.93% of leaf dry weight and Microcat Magnesium, of 9.26%. The same products led to a 10.07-10.60% increase in the dry weight of the aerial part of the plants. Positive results were previously obtained in increasing leaf dry weight by using organic fertilizers on seedlings such as cucumber, melon and zucchini [Sovarel, 2023].

In the whole plant, dry weight varied significantly in the case of treatments with Razormin (an increase of 12.90%) and Sprintene (an increase of 11.96%).

Among the treatments used on eggplant seedlings, it is observed that the best results were obtained in the case of foliar treatments with the products Sprintene (V4) and Microcat Magnesium (V5). Therefore, correlations were made between the parameters measured in the case of these treatment options with those in the untreated variant, and the results are presented in Table 5.

	Variant	Stem diameter	Root length	Aerial part length	Total length	Root weight	Leaf weight	Aerial part weight	Plant weight	Root DW	Leaf Dw	Aerial part DW	Plant DW
Variant	1	0.514*	-0.207	0.101	-0.110	0.472	0.489	0.461	0.527*	0.284	0.652**	0.681**	0.433
Stem diameter		1	0.356	0.554*	0.527*	0.775**	0.652**	0.811**	0.901**	0.162	0.545*	0.731**	0.466
Root length			1	0.267	0.902**	0.224	0.153	0.250	0.271	-0.076	-0.372	-0.006	-0.279
Aerial part length				1	0.622*	0.473	0.516*	0.727**	0.707**	0.239	0.306	0.428	0.583*
Total length					1	0.391	0.367	0.536*	0.541*	0.136	-0.143	0.174	0.085
Root weight						1	0.308	0.546*	0.819**	-0.190	0.587*	0.724**	0.294
Leaf weight							1	0.865**	0.730**	0.553*	0.476	0.710**	0.759**
Aerial part weight								1	0.928**	0.456	0.553*	0.725**	0.747**
Plant weight									1	0.229	0.640*	0.819**	0.642**
Root DW										1	0.258	0.184	0.677**
Leaf DW											1	0.816**	0.683**
Aerial part DW												1	0.658**
Plant DW													1

*. Correlation is significant at the 0.05 level (2-tailed)
**. Correlation is significant at the 0.01 level (2-tailed)

Fig. 1. Correlation matrix (Pearson correlation coefficients, "r") among treatment variants, stem diameter (cm), root length (cm), aerial part length (cm), total length (cm), root weight (g), leaf weight (g), aerial part weight (g), plant weight (g), root dry weight (%), leaf dry weight (%), aerial part dry weight (%) and plant dry weight (%) between variants V1, V4 and V5

In fig. 5 is observed a close interdependence (significant, marked with an asterisk, * probability of error of 5%, and distinctly significant, marked with two asterisks, ** probability of error of 1%) between the characteristics of the analyzed seedlings. Thus, the treatment variant V4 and V5 positively and distinctly significantly influenced the dry weight of the leaves and the dry weight of the aerial part, the correlation coefficients being r=0.652 and r=0.681, respectively. Also, a significant positive relationship is observed between the treatment variant and stem diameter (r=0.514) or plant weight (r=0.527). As the nutrient content available to

plants improves, the plant becomes more robust, which is reflected in the stem size and overall weight.

The interdependence between stem diameter and aerial part length, total length and dry weight of leaves is of lower intensity, but significant, the correlation coefficients being r=0.554; r=0.527 and r=0.543. The correlation between root length and total plant length is ascending, having a very high intensity (r=0.902), meaning that plants with longer roots tend to have a greater total length. A distinctly significant upward interdependence is also observed between root weight and plant weight, as well as between the dry weight content of the extra-radicular part of the seedlings (r=0.819 and r=0.724). This means that plants that develop denser roots generally have a greater total mass. This aspect can be important for the plant's stability and ability to absorb essential resources. The intensity of the correlation between this and the dry weight content of the leaves or the extra-radicular weight of the seedling is lower, but significant. As expected, the increase in leaf weight leads to a distinctly significant increase in the extra-radicular weight of the seedling, the total weight of the plant, the dry weight content of the aerial part of the seedling and, respectively, of the whole plant (the correlation coefficients being r=0.865, r=0.730, r=0.710 and r=0.759).

As expected, the increase in leaf weight leads to a distinctly significant increase in the extra-radicular weight of the seedling, the total weight of the plant, the dry weight content of the aerial part of the seedling and, respectively, of the whole plant (the correlation coefficients being r=0.865, r=0.730, r=0.710 and r=0.759). Increasing the dry weight content of the root also causes an increase in the dry weight content of the whole plant (r=0.677).

The greater the seedling weight, the higher the dry weight content in the extra-radicular area, as well as in the entire plant, the relationship between these characteristics being distinctly significant. The dry weight of a plant represents its mass without water and is an important indicator of the plant's health and development. A higher dry weight content indicates a more robust plant, able to store nutrients more efficiently and better resist external stresses, such as drought or disease.

In conclusion, the nutrient use strategy can significantly influence the development of certain parts of eggplant plants, leading to a healthy and vigorous seedling (Figure 2).

a **b**

Fig. 2. Untreated eggplant seedling (a) and treated with Microcat Magnesium

CONCLUSIONS

Variant V2 (Razormin) determined a significant increase of stem diameter, root and plant dry weight.

Variant V3 (Atonik) conducted to a significant increase of stem diameter, root weight.

Variant V4 (Sprintene) produced a significant increase of stem diameter, aerial part and plant length, root, aerial part and plant fresh weight, leaf, aerial part dry and plant dry weight.

Variant V5 determined a significant increase of stem diameter, root, leaf, aerial part and plant weight, leaf, aerial part dry weight.

The treatments with Sprintene (V4) and Microcat Magnesium (V5) proved a significantly positive influence on the eggplant seedlings.

ACKNOWLEGMENTS

The present work is financed by Ministry of Agriculture and Rural Development, as part of the Sectorial Plan for Rural Research-Development ADER 2026, Project 6.3.8 – "*The influence of innovative technologies for vegetables crop in open field, in order to mitigate the effects of climate change; the foundation of agrophytotechnical methods*", contract no. 6.3.8/21.07.2023.

REFERENCES

1. Azarpour E., Motamed M.K., Moraditochaee M., Bozorgi H.R., 2012 – *Effects of bio, mineral nitrogen fertilizer management, under humic acid foliar spraying on fruit yield and several traits of eggplant (Solanum melongena L.)*. African Journal of Agricultural Research, 7(7), p 1104-1109.

2. Bhattacharyya P.N., Jha D.K., 2012 – *Plant growth-promoting rhizobacteria (PGPR): emergence in agriculture.* World Journal of Microbiology and Biotechnology, 28(4), p 1327-1350.

3. Ciucu Paraschiv M., Hoza D., 2022a – *Effects of organic and inorganic foliar fertilizers on the nutritional and productive parameters of four highbush blueberries cultivars.* Scientific Papers. Series B. Horticulture, 66(1), p 58-66.

4. Ciucu Paraschiv M., Hoza D., 2022b – *Impact of foliar fertilization on the quality parameters of blueberry fruits*. Scientific Papers. Series B. Horticulture, 66(1), p 48-57.

5. Ciucu Paraschiv M., Nicola C., Hoza D., 2023 – *Effect of organic foliar fertilizers on yield and fruit quality of seven highbush blueberry (Vaccinium corymbosum L.) Cultivars*. Scientific Papers. Series B. Horticulture, 67(1), p 68-77.

6. Costa E., Durante L.G.Y., Santos A.D., Ferreira C.R., 2013 – *Production of eggplant from seedlings produced in different environments, containers and substrates*. Horticultura Brasileira, 31, p 139-146.

7. Dascălu Constantin D.C., Munteanu N., Scurtu I., Buzatu M.A., 2022 – Research on eggplant seedlings fertilized with macro and microelements. Lucrări Ştiinţifice Seria Horticultură, 65 (1), p 113-118.

8. Du Jardin P., 2015 – *Plant biostimulants: Definition, concept, main categories and regulation.* Scientia horticulturae, 196, p 3-14.

9. Fageria N.K., Filho M.B., Moreira A., Guimarães C.M., 2009 – Foliar fertilization of crop plants. Journal of plant nutrition, 32(6), 1044-1064.

10. Florescu Elena, 1992 – *Producerea răsadurilor de legume în gospodăriile populației (Production of vegetable seedlings in households)*. Editura Ceres, București.

11. Grabowska A., Kunicki E., Jezdinsky A., Kalisz A., Sekara A., 2015 – *The effect of biostimulants on the quality parameters of tomato grown for the processing industry.* Agrochimica: International Journal of Plant Chemistry, Soil Science and Plant Nutrition of the University of Pisa: 59(3), p 203-217.

12. Kantharajah A.S., Golegaonkar P.G., 2004 – *Somatic embryogenesis in eggplant*. Scientia Horticulturae, 99(2), p 107-117.

13. Kopta T., Pavlikova M., Sękara A., Pokluda R., Maršálek B., 2018 – *Effect of bacterial-algal biostimulant on the yield and internal quality of lettuce (Lactuca sativa L.) produced for spring and summer crop.* Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 46(2), p 615-621.

14. **Liu H., Chen D., Zhang R., Hang X., Li R., Shen Q., 2016** – *Amino acids hydrolyzed* from animal carcasses are a good additive for the production of bio-organic fertilizer. Frontiers in microbiology, 7: 1290.

15. **de Moraes Echer M., Guimarães V.F., Aranda A.N., Bortolazzo E.D., Braga J.S., 2007** – *Avaliação de mudas de beterraba em função do substrato e do tipo de bandeja*. Semina: Ciências Agrárias, 28(1), 45-50.

16. Krełowska-Kułas M., 1993 – *Badanie jakości produktów spożywczych (The study of food quality)*. PWE, Warszawa.

17. Michalojc Z., Buczkowska H., 2008 – ***Content of macroelements in eggplant fruits depending on nitrogen fertilization and plant training method*. Journal of Elementology, 13(2), pp 269-274.**

18. Munteanu N., 2003 – *Tomatele, ardeii şi pătlăgelele vinete (Tomatoes, peppers and eggplant).* Editura Ion Ionescu de la Brad, Iaşi, pp 181-183.

19. **Shchetyna S.V., Kichigina O.O., Ulianych O.I., 2024** – *Effects of biologicals and plant growth regulators on the sowing quality of eggplant seeds.* Vegetable and Melon Growing, (75), 59-71.

20. Sovarel G., 2023 – *The influence of some foliar fertilizers on the growth and quality of vegetable seedlings from the Cucurbitaceae family.* Acta Horticulturae, 1391, 497-502.

21. Stan N.T., Stan T.N., 2010 – *Legumicultură generală* (Vegetable growing). Editura "Ion Ionescu de la Brad", Iaşi.

22. **Temelie M., 2020** – *Enciclopedia plantelor medicinale cultivate din România (Encyclopedia of cultivated medicinal plants from Romania)*. Editura Rovimed Publishers, Bacău.

23. Umemiya Y., Furuya S., 2002 – *The influence of chemical. Forms on foliar-applied nitrogen absorption for peach trees.* Acta Horticulturae, 594, pp 97-103.

24. Voican V., Lăcătuș V., 1998 – *Cultura protejată a legumelor în sere și solarii (Protected vegetable crop in greenhouses)*. Editura Ceres, București.

25. Wahba H.E., Motawe H.M., Ibrahim A.Y., 2015 – *Growth and chemical composition of Urtica pilulifera L. plant as influenced by foliar application of some amino acids*. Journal of Materials and Environmental Science, *6*(2), pp 499-506.

26. Wang X., Fan J., Xing Y., Xu G., Wang H., Deng J., Wang Y., Zhang F., Li P., Li Z., 2019 – *The effects of mulch and nitrogen fertilizer on the soil environment of crop plants.* Advances in agronomy, 153: 121-173.

OPTIMIZING EGGPLANT SEED PRODUCTION TECHNOLOGY THROUGH USING BIOSTIMULANTS

OPTIMIZAREA TEHNOLOGIEI DE PRODUCERE A SEMINȚELOR DE PĂTLĂGELE VINETE CU AJUTORUL BIOSTIMULATORILOR

DASCĂLU (CONSTANTIN) Delia – Cristina[1,2]*, MUNTEANU Neculai[1], SCURTU Ion[2]

*Corresponding author e-mail: deliacristinadascalu@yahoo.com

Abstract.
This paper presents a state of arts on the influence of treatments with biostimulants on eggplant, based on the results of scientific research and technological practice in Romania and in the world. This study aims to introduce these biostimulants in the seed production technology of eggplant, in order to obtain a higher quantity of quality seed.
Key words: amino acids, biostimulant, seaweed, *Trichoderma*

Rezumat.
Prezenta lucrare prezintă stadiul actual al cunoașterii privind influența tratamentelor cu biostimulatori asupra plantelor de pătlăgele vinete, pe baza rezultatelor de cercetare științifică și practică tehnologică din țară și de pe plan internațional, având ca scop introducerea acestor biostimulatori în tehnologia de producere a semințelor, în vederea obținerii unei cantități mai mari de sămânță de calitate.
Cuvinte cheie: alge marine, aminoacizi, biostimulatori, *Trichoderma*

INTRODUCTION

The seed production of cultivated plants is a strategic activity for agriculture and horticulture, because it ensures the "raw material" for the establishment of any crop [Echim and Scurtu, 2020; Munteanu, 2003]. The eggplant (*Solanum melongena* L.) crop has became more and more popular in Romania, over the last 50-60 years, due to increasing preferences of consumers, as well as the fact that this species finds favorable crop conditions in our country, both in the field and in protected areas [Maier, 1969; Munteanu, 2003]. The average per capita consumption of eggplant in 2020 was 6.4 kg/capita, and is expected to increase over the next 15 years [Scurtu *et al*., 2020].

Currently, in Romania, as well as in the European Union, the marketing of seeds and propagating material, used for the establishment of crops, is carried out only under the auspices of the laws, respecting the norms of certified seed production, in order of mentaining constant the characteristics of cultivars [Echim

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania
[2] Research and Development Institute for Vegetable and Flower Growing Vidra

and Scurtu, 2020; Stan and Stan, 2010]. Certain rules that ensure the conservation of the biological value of the cultivars are strictly followed, such as: crop location, crop rotation, isolation distances, biological purification works, fruit harvesting and seed extraction, conditioning and packaging. All these norms are respected within specific cultivation technologies for seed production [Stan and Stan, 2010].

The crop technology for seed production, including eggplant, consists of a flow of works and operations carried out in a certain order that takes into account the stage of plant development and the natural conditions of cultivation, as well as the precise technical indicators that optimally satisfies the requirements of the plants throughout the vegetation period, so that an economically efficient activity is done. The entire technological flow must end with a quantity of seed that strictly meets the qualitative characters for each biological category of seed, and some care works can be improved [Echim and Scurtu, 2020].

The use of biostimulants in seed production is little studied, but their potential in this branch of agriculture and horticulture should not be neglected. The present review aims to carry out a study of the specialized literature regarding the use of biostimulants in eggplant seed production, in order to introduce them into the seed production technology of this crop.

MATERIAL AND METHOD

This review intends to evaluate the possibilities to use different types of biostimulants in eggplant seed production, based on the current level of knowledge and the technical conditions from our country and from abroad, illustrated by international literature. To get this literature review, the internet and appropriate books were used.

RESULTS AND DISCUSSIONS

Biostimulants are considered to be any substance of natural, and sometime, synthetic, origin that has the ability to bring improvements to plants, in terms of growth, development, yield, resistance to biotic and abiotic stress factors by stimulating natural processes, but without being in fact fertilizers or pesticides (Du Jardin, 2015). Their composition and origin show great variability, being classified into several classes, such as plant extracts, different microorganisms beneficial to plants, hydrolyzed proteins, amino acids, enzymes, chitosan or some inorganic compounds [Bulgari *et al*., 2019; Du Jardin, 2015]. They can be used as a foliar or soil treatment [Drobek *et al*., 2019; Parađiković *et al*., 2019].

Results regarding the use of biostimulants based on seaweed to eggplant

Seaweed-based products consist of green, brown or red seaweed, most of which are available in the form of extracts [Battacharyya *et al*., 2015; Khan *et al*., 2009], but most commercial products are synthesized from brown seaweed, like *Ascophyllum nodosum*, *Ecklonia maxima*, *Fucus* spp. or *Laminaria* spp., [Khan *et al*., 2009]. Their valuable content is rich in macro and microelements and organic substances, such as vitamins or amino acids. These also present phytohormone-like activity [Battacharyya *et al*., 2015; Crouch and Van Staden, 1993; Khan *et al*.,

2009]. In the seed production process, the phytohormonal activity produced by cytokinins seems to play an important role [Van Staden, 1983]. At the same time, it must be taken into account that some auxins and gibberellins induce parthenocarpy in eggplant [Nothmann and Koller, 1975].

Studies conducted so far on the effects of seaweed treatments on eggplants have indicated positive results regarding the increase in plant height, leaf area, number of fruits and fruit size, both in field crops [Abd El-Gawad and Osman, 2014] and in protected areas [Khazaal and Rashed, 2018].

Seaweed treatments can be used to obtain quality eggplant seedlings by increasing root and stem mass, height and diameter of stem [Villa e Vila *et al*., 2024].

The increase of the number of fruits can also lead to the increase of the number of physiologically mature fruits, from which the seed can be extracted. Positive results were obtained regarding the increase of the number of fruits per plant by the use of green seaweeds treatments, such as *Ceratophyllum demersum* [Al-Saadi and Abohanah, 2020], brown seaweeds such as *Ascophyllum nodosum* [Pohl *et al*., 2018; Rasheed and Shareef, 2019], *Sargassum polycystum* [Jamili *et al*., 2022], *Laminaria digitata* [Constantin *et al*., 2023], *Gracilaria textorii, Hypnea musciformis* [Rao and Chatterjee, 2014].

Certain studies indicate that the size of the eggplant fruit can have a good influence on the amount of seeds and 1000 seeds weight [Badea *et al*., 1996]. Some treatments with seaweed led to an increase in fruit weight. Positive effects were shown by the treatments with brown seaweeds *Ascophyllum nodosum* [Rasheed and Shareef, 2019] *Gracilaria textorii, Hypnea musciformis* [Rao and Chatterjee, 2014], *Sargassum polycystum* [Jamili *et al*., 2022]. Treatments with seaweed influenced the size of eggplant fruits both in the open field [Jamili *et al*., 2022] and in plastic houses [Khazaal and Rashed, 2018].

At the same way, the germination of eggplant seeds can be improved with the help of presoaking treatments in seaweed solutions. Positive results were obtained by using of red seaweeds, such as *Laurencia obtusa* [Pandya and Mehta, 2022], brown seaweeds, such as *Sargassum wightii* [Sreelatha *et al*, 2018], *Gracilaria textorii, Hypnea musciformis* [Rao and Chatterjee, 2014], *Laminaria digitata* and *Ascophyllum nodosum* [Constantin *et al*., 2024].

It was found that treatments based on *Ascophyllum nodosum* led to an increase in fruit quality, by improving the content of sugars and anthocyanins [Pohl *et al*., 2019a]. Also, treatments with *Sargassum wightii* led to an increase in the content of total sugars, proteins and lipids [Sreelatha *et al*., 2019]. Other research found that treatments based on *Ascophyllum nodosum* have an important positive influence in increasing the number of medium- and long-styled flowers [Pohl *et al*., 2019b].

Results regarding the use of biostimulants based on beneficial microorganisms to eggplant

Biostimulants based on microbial inoculum can contain single culture or mixtures of cultures of microorganisms [Du Jardin, 2015]. Both beneficial bacteria and fungi can be part of the composition of these biostimulants. Among the bacteria we mention *Bacillus* spp, *Pseudomonas* spp, *Enterobacter* spp, *Streptomyces* spp or *Acinetobacter* spp., and among fungi – *Trichoderma* spp., *Glomus* spp, *Heteroconium chaetospira* [Drobek *et al*., 2019]. Their most important effect is the antimicrobial biocontrol of ceratin plant diseases [Drobek *et al*., 2019, Ongena and Jacques, 2008]. This aspect is important, because, in the practice of seed production, the plants with different diseases are removed [Ciofu *et al*., 2004; Echim and Scurtu, 2020].

Soil pathogens, such as *Verticillium dahliae* and *Fusarium oxysporum* f. sp. *melongenae,* can cause significant losses in eggplant crops. Certain Romanian cultivars have good tolerance to these diseases, but are not immune [Sovarel and Costache, 2018], which leads to the need for additional protection. Some species of *Bacillus* can be used for biocontrol of some important diseases like *Verticillium dahliae* [Li *et al*., 2008], *Fusarium oxysporum* [Altinok *et al*., 2013] or *Ralstonia solanacearum* [Sakthivel *et al*., 2019]. Also, *Trichoderma* spp. can be used to control *Fusarium oxysporum* [Abdel-Monaim *et al*., 2014] or *Rhizoctonia solani* [Faruk and Rahman, 2015]. Also, *Trichoderma* can be used in combination with *Bacillus* spp or *Pseudomonas* spp to control *Verticillium dahliae* [Bilginturan and Karaca, 2021].

Beneficial microorganisms also play an important role in plants growth and development. The number of fruits on plant increased following treatments with *Trichoderma viride* and *Trichoderma hamatum* [Abdel-Monaim *et al*., 2014]. Also, the weight of eggplant fruits increased following treatments with *Trichoderma viride* and *Trichoderma hamatum* [Abdel-Monaim *et al*., 2014].

The treatments applied to eggplant seeds indicate the potential of *Trichoderma harzianum* to increase eggplant seed germination percentage and germination speed index [Wu *et al*., 2017].

Studies show that seaweed-based biostimulants and beneficial microorganisms can be used together with beneficial effects on eggplant crops [Aydi- Ben-Abdallah *et al*., 2021].

Results regarding the use of biostimulants based on amino acids to eggplant

Amino acids are essential in the physiological processes of the plants, being basic components of cells. Amino acids play an important role in the processes of photosynthesis, can increase the vegetative mass of plants, can influnce the development of fruits and seeds or can increase plant resistance to drought and diseases [Baquir *et al.*, 2019; Rai, 2002]. Drought and high temperatures can lead to significant yield losses, even though eggplant is a species quite resistant to this type of abiotic stress [Chira *et al*., 2015].

Treatments with amino acids led to an increase in the weight of eggplant fruits [El-Nemr *et al*., 2015]. Also, the eggplant yield increased even in the case of water deficit [Bader *et al*., 2020].

Results regarding the use of biostimulants based on humic and fulvic acids to eggplant

Humic acids are formed following chemical and biological transformations of plant and animal organic matter, representing the main source of organic carbon. They comprise more than 60% of the organic matter of the soil. Fulvic acids are, like humic acids, a fraction of humic substances from soil. Fulvic acids remain soluble in aqueous solution at any pH value, but humic acids precipitate when the pH of the solution is lowered from alkaline pH to pH values of 1-2. Humic and fulvic acids can be used separately or together as fertilizers [Canellas *et al*., 2015].

Fertilizers based on humic acids gave positive results in foliar [Azarpour *et al*., 2012] and soil application [Shehab and Ibrahim, 2022], or the treatments methods can be combined [Paramasivan *et al*., 2015].

Fulvic acids can be used separately from humic acids, with good results at eggplant, but some studies suggest that the use combined of humic and fulvic acids leads to better results in this species than when they were used separately [Mammadova, 2023].

The use of treatments with the humic acids [Azarpour *et al*., 2012; Shehab and Ibrahim, 2022] or combination of humic and fulvic acids [Jaafar and Abbass, 2020] have a beneficial effect on the number of fruits in eggplant.

Also, humic acids have beneficial effects on the increase of fruit size, either alone [Azarpour *et al*., 2012; Shehab and Ibrahim, 2022] or combined with fulvic acids [Jaafar and Abbass, 2020].

Biostimulants from humic acids can also be combined with nitrogen-based fertilizers, with good results in eggplant [Azarpour *et al*., 2012].

Other positive results were also observed to usage of biostimulants with humic acids to eggplant seedlings, by increasing the weight of the seedlings, and also the level of macro and micronutrients [Dursun *et al*., 2002].

CONCLUSIONS

There is a wide variety of biostimulants available on the market, which can be easily applied, foliar or on the soil, depending on the applied technology.

The use of biostimulants in eggplant crops can lead to an increase in yield, fruit size and quality, and also can increase the resistance to biotic and abiotic stress factors.

The potential of their use in seed production has not been explored, but the results obtained in increasing the yield and quality of the eggplant fruits lead to the conclusion that they have high potential to be successfully used in seed production in this crop.

ACKNOWLEGMENTS

The present work is part from is part of the PhD thesis of the main author of the article.

REFERENCES

1. **Abd El-Gawad H.G. Osman H.S., 2014** – *Effect of exogenous application of boric acid and seaweed extract on growth. biochemical content and yield of eggplant*. Journal of Horticultural Science & Ornamental Plants, 6(3), pp. 133-143.
2. **Abdel-Monaim M.F., Abdel-Gaid M.A., Zayan S.A., Nassef D.M., 2014** –*Enhancement of growth parameters and yield components in eggplant using antagonism of Trichoderma spp. against Fusarium wilt disease*. International Journal of Phytopathology, 3(1), pp 33-40.
3. **Al-Saadi B.S., Abohanah M.A., 2020** – *Response of three cultivars of eggplant to spraying with organic extracts in growth and yield indicators*. Plant Archives, 20 (2), pp 4845-4850.
4. **Altinok H.H., Dikilitas M., Yildiz H.N., 2013** – Potential of Pseudomonas and Bacillus isolates as biocontrol agents against fusarium wilt of eggplant. Biotechnology & Biotechnological Equipment, 27(4), pp 3952-3958.
5. **Aydi- Ben-Abdallah R., Ammar N., Ayed F., Jabnoun-Khiareddine H., Daami-Remadi M., 2021** – *Single and combined effects of Bacillus spp. and brown seaweed (Sargassum vulgare) extracts as biostimulants of eggplant (Solanum melongena L.) growth*. Advances in Horticultural Sciences, 35(2), pp. 151-164.
5. **Azarpour E., Motamed M.K., Moraditochaee M., Bozorgi H.R., 2012** – *Effects of bio, mineral nitrogen fertilizer management, under humic acid foliar spraying on fruit yield and several traits of eggplant (Solanum melongena L.)*. African Journal of Agricultural Research, 7(7), pp 1104-1109.
6. Battacharyya D., Babgohari M.Z., Rathor P., Prithiviraj B., 2015 – *Seaweed extracts as biostimulants in horticulture*. Scientia Horticulturae, 196, pp 39-48.
7. **Badea R., Voican V., Tudor M., 1996** – *Cercetări privind unii parametri ai producţiei de seminţe la pătlăgelele vinete (Soanum melongena L.) (Research on some parameters of aubergine seed production – Solanum melongena L.)*. Anale - Institutul de Cercetări pentru Legumicultură şi Floricultură Vidra, Vol XIV, pp. 241-252.
8. **Bader B.R., Abood M.A., Aldulaimy S.E.H., Al-Mehmdy S.M.H., Hamdi G.J., 2020** – *Effect of water deficit and foliar application of amino acids on growth and yield of eggplant irrigated by two drip systems under greenhouse conditions*. Agraarteadus, 31(2), pp 131–138.
9. **Bilginturan M., Karaca G.H., 2021** – *Effects of Trichoderma and PGPR applications on growth and Verticillium wilt of eggplant*. Mediterranean Agricultural Sciences, 34(3), 267-272.
10. **Bulgari R., Franzoni G., Ferrante A., 2019** – *Biostimulants application in horticultural crops under abiotic stress conditions*. Agronomy, 9(6), article 306.
11. **Canellas L.P., Olivares F.L., Aguiar N.O., Jones D.L., Nebbioso A., Mazzei P., Piccolo A., 2015** – *Humic and fulvic acids as biostimulants in horticulture*. Scientia horticulturae, 196, pp 15-27.
12. **Chira E., Tudor M., Sbîrciog G., Dumitru M., 2015** – *The study of some eggplant (Solanum melongena L.) genotypes under the thermal and hydric stress*. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Horticulture, 72 (1), pp 211-212.
13. **Ciofu R., Stan N., Popescu V., Chilom P., Apahidean S., Horgoş A., Berar V., Lauer K.F., Atanasiu N., 2004** – *Tratat de legumicultură*. Editura Ceres, Bucureşti, p 586.

14. **Constantin D.C., Gheorghe M.C., Buzatu M.A., Scurtu I., 2023** – *The role of biostimulants in the fertilization program in eggplant*. Romanian Journal of Horticulture, IV, pp. 59-64.

15. Constantin D.C., Scurtu I., Sbîrciog G., Dorobanţu A., 2024 – *Effects of seaweed extract for seed priming of tomatoes and eggplant on seed germination and seedling vigor*. Acta Horticulturae, 1391, pp 511-518.

16. **Crouch I.J., Van Staden J., 1993** – *Evidence for the presence of plant growth regulators in commercial seaweed products*. Plant growth regulation, 13, pp 21-29.

17. Drobek M., Frąc M., Cybulska J., 2019 – *Plant biostimulants: Importance of the quality and yield of horticultural crops and the improvement of plant tolerance to abiotic stress—A review*. Agronomy, 9(6), article 335.

18. **Du Jardin P., 2015** – *Plant biostimulants: definition, concept, main categories and regulation. Scientia Horticulturae*, vol 196, pp 3-14

19. Dursun A., Güvenç I., Turan M., 2002 – *Effects of different levels of humic acid on seedling growth and macro and micronutrient contents of tomato and eggplant*. **Acta Agrobotanica, 55(2), pp 81-88.**

20. Echim T., Scurtu I., 2020 – *Indici tehnici privind înmulţirea plantelor legumicole şi aromatice*. Editura Pim, Iaşi, pp. 26-35.

21. El-Nemr M.A., El-Bassion A.M., Tantawy A.S., Fawzy Z.F., 2015 – *Responses of eggplant (Solanum melongena var. esculenta L) plants to different foliar concentrations of some Bio-Stimulators*. Middle East Journal of Agriculture Research, 4(4), pp 860-866.

22. **Faruk M., Rahman M., 2015** – *Efficacy of carrier materials to formulate Trichoderma harzianum bio-fungicide in controlling seedling disease (Rhizoctonia solani) of eggplant*. Journal of Global Agriculture and Ecology, 2(1), pp 17-25.

23. Jaafar H.S., Abbass J.A., 2020 – *Effect of Spraying Humi Max on the Vegetative Growth and Yield Parameters of Eggplant (Solanum melongena L.)*. Indian Journal of Ecology, 47(12), pp 159-162.

24. **Jamili K.M., Catubis K.M.L., Pascual P.R.L., Cabillo R.A., 2022** – *Enhanced growth and yield of eggplant (Solanum melongena L.) applied with seaweed extract*. Thai Journal of Agricultural Science, Vol 55, pp 175-184.

25. **Khazaal Z.H., Rashed Z.S., 2018** – *Effects of Cultivars and the Spraying with seaweed extract (Tecamin Algae) in the growth and yield of eggplant (Solanum melongena L.)*. Euphrates Journal of Agriculture Science, 10 (2), pp 1-6.

26. **Khan W., Rayirath U.P., Subramanian S., Jithesh M.N., Rayorath P., Hodges D.M., Critchley A.T., Craigie J.S., Norrie J., Prithiviraj B., 2009** – *Seaweed extracts as biostimulants of plant growth and development.* Journal of plant growth regulation, 28, pp. 386-399.

27. **Li J. G., Jiang Z. Q., Xu L. P., Sun F. F., Guo J. H., 2008** – *Characterization of chitinase secreted by Bacillus cereus strain CH2 and evaluation of its efficacy against Verticillium wilt of eggplant*. BioControl, 53, pp 931-944.

28. **Maier I., 1969** – *Cultura legumelor (Vegetable crop)*. Ed. Agrosilvică, Bucureşti, pp 328-329.

29. **Mammadova U., 2023** – *Effect of humic substances on yield and nutrient contents of Eggplant Santana (Solanum melongena) plants in gray-brown soil*. Eurasian Journal of Soil Science, 12(1), 98-103.

30. **Munteanu N., 2003** – *Tomatele, ardeii şi pătlăgelele vinete (Tomatoes, peppers and eggplant)*. Editura Ion Ionescu de la Brad, Iaşi, pp 181-183.

31. **Nothmann J., Koller D., 1975** – *Effects of growth regulators on fruit and seed development in eggplant (Solanum melongena L.)*. Journal of Horticultural Science, 50(1), pp 23-27.

32. **Ongena M., Jacques P., 2008** – *Bacillus lipopeptides: versatile weapons for plant disease biocontrol*. Trends in Microbiology, 16, 115-125.
33. **Pandya M.P., Mehta S.K., 2022** – *Effect of Presoaking of Solanum melongena L (Brinjal) Seed in Laurencia obtusa Seaweed extract on Germination and Growth Parameter*. International Journal of Emerging Technologies and Innovative Research, ISSN:2349-5162, 9(2), pp b849-b855.
34. **Parađiković N., Teklić T., Zeljković S., Lisjak M., Špoljarević M., 2019** – *Biostimulants research in some horticultural plant species—A review*. Food and Energy Security, 8(2), article e00162.
35. **Paramasivan M., Arunkumar V., Prabhu T., 2015** – *Effect of humic acid and inorganic fertilizers on productivity, profitability, nutrient uptake and soil fertility in brinjal (Solanum melongena L.) var. KKM1 in Alfisol of Tamil Nadu*. An Asian Journal of Soil Science, 2015, Vol. 10, No. 2, pp 185-190.
36. **Pohl A., Grabowska A., Kalisz A., Sekara A., 2018** – *Preliminary screening of biostimulative effects of Goemar BM-86 on eggplant cultivars grown under field conditions in Poland*. Acta Agrobotanica, 71(4), article 1752.
37. **Pohl A., Grabowska A., Kalisz A., Sękara A., 2019 a** – *The eggplant yield and fruit composition as affected by genetic factor and biostimulant application*. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 47 (3), pp 929-938.
38. **Pohl A., Grabowska A., Kalisz A., Sękara A., 2019 b** – *Biostimulant application enhances fruit setting in eggplant - an insight into the biology of flowering*. Agronomy, 9(9), 482, https://doi.org/10.3390/agronomy9090482.
39. **Rao G.M.N., Chatterjee R., 2014** – *Effect of seaweed liquid fertilizer from Gracilaria textorii and Hypnea musciformis on seed germination and productivity of some vegetable crops*. Universal journal of plant science, 2(7), pp 115-120.
40. **Rai V.K., 2002** – *Role of amino acids in plant responses to stresses*. Biologia plantarum, 45(4), pp 481-487.
41. **Rasheed S.M., Shareef R.S., 2019** – *Effect of seaweed extract and plant spacing on growth and yield of two eggplant hybrids (Solanum Melongena L.)*. Journal of Duhok University, 22(2), pp 101-112.
42. **Sakthivel K., Manigundan K., Gautam R. K., Singh P.K., Nakkeeran S., Sharma S.K., 2019** – *Bacillus spp. for suppression of eggplant bacterial wilt pathogen in Andaman Islands: Isolation and characterization*. Indian Journal of Experimental Biology, 57, 131-137.
43. **Scurtu I., Sbîrciog G., Constantin D.C., 2020** – *Possible Model of Development of Vegetable Yield in Romania by 2040*. Contemporary Economy Journal, 5(2), pp 50-61.
44. **Shehab O.H., Ibrahim N.S., 2022** – *The Effect of Fertilization by Humic Acid and Foliar Spraying with Nano-Micro-Nutrients on the Productive Traits of Solanum melongena L.* Journal for Research in Applied Sciences and Biotechnology, 1(4), pp 139-150.
45. **Sovarel G., Costache M, 2018** – Behavior of Some Eggplant Cultivars to Fusarium and Verticillium Wilts in the Greenhouses. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Horticulture, 75 (2), pp 183-184.
46. **Sreelatha K., Mathew L., Kaladharan P., 2018** – *Drenching aqueous extracts of seaweeds for enhancing growth, biochemical constituents and yield of Solanum melongena*. Journal of the Marine Biological Association of India, 60(2), pp 18-23.
47. **Stan N.T., Stan T.N., 2010** – *Legumicultură generală*. Editura Ion Ionescu de la Brad, Iaşi.
48. **Van Staden J., 1983** – *Seeds and cytokinins*. Physiologia plantarum, 58 (3), pp 340-346.
49. **Villa e Vila V., Piedade S.M.D.S., Bouix C.P., Rezende R., Wenneck G.S., Terassi D.D.S., Matumoto-Pintro P.T., Marques, P.A.A., 2024** – *Use of a Biostimulant*

Based on Seaweed Extract as a Sustainable Input to Enhance the Quality of Solanaceous Seedlings. Horticulturae, 10(6), 642.

50. **Wu L., Yao D., Li M., 2017** – *Effects of solid matrix priming with Trichoderma harzianum on seed germination, seedling emergence and photosynthetic capacity of eggplant*. African Journal of Biotechnology, 16(14), pp 699-703.

THE INFLUENCE OF THE CONSUMPTION OF SWEET AND PASTRY PRODUCTS, PLANT-BASED PRODUCTS AND LIFESTYLE ON ORAL HEALTH

INFLUENȚA CONSUMULUI DE PRODUSE DULCI ȘI DE PATISERIE, A PRODUSELORDE ORIGINE VEGETALĂ ȘI A STILULUI DE VIAȚĂ ASUPRA SĂNĂTĂȚII ORALE

VASILIU Mihaela Păpușa[1], TOMIȚA Daniela Ivona[1]*, STADOLENU Carmen[1], FUIOAGĂ Codrin Paul[1], GHEBAN Mihaela Diana[1]

*Corresponding author e-mail: daniela.tomita@yahoo.com

Abstract

The present study analyzes the relationship between dietary habits and oral health, with a focus on the consumption of sweet and pastry products compared to plant-based foods, as well as the influence of lifestyle factors. The research was conducted on a group of 32 patients aged between 55 and 75 years, using the G.O.H.A.I. questionnaire, applied pre- and post-prosthetic treatment. The results highlight an increased frequency of sweet food consumption, associated with risk factors such as smoking, alcohol consumption and poor oral hygiene. In contrast, the consumption of plant-based products was more frequent in people with a higher educational level.The study relevate the importance of adopting a balanced diet and a healthy lifestyle in preventing dental diseases and maintaining oral health.

Key words: oral health; sweets; vegetables; oral hygiene

Rezumat

Prezentul studiu analizează relația dintre obiceiurile alimentare și sănătatea orală, concentrându-se pe consumul de produse dulci și de patiserie în comparație cu alimentele de origine vegetală, precum și pe influența factorilorstilului de viață. Cercetarea a fost realizată pe un grup de 32 de pacienți cu vârste cuprinse între 55 și 75 de ani, utilizând chestionarul G.O.H.A.I., aplicat pre- și post-tratament protetic. Rezultatele evidențiază o frecvență crescută a consumului de alimente dulci, asociată cu factori de risc precum fumatul, consumul de alcool și igiena orală precară. În schimb, consumul de produse de origine vegetala a fost mai frecvent la persoanele cu un nivel de educație mai ridicat. Studiul subliniază importanța adoptării unei diete echilibrate și a unui stil de viață sănătos în prevenirea afecțiunilor dentare și menținerea sănătății orale.

Cuvinte cheie: sănatate orală,dulciuri.legume,igiena orală.

[1] Apollonia University from Iași, Romania

INTRODUCTION

Oral health is an essential component of overall health, influenced by biological, behavioral, and nutritional factors. In recent years, the role of diet in the onset and progression of dental disease has become increasingly evident, especially in the context of the increased consumption of products rich in fermentable sugars [Moynihan and Kelly, 2021; Sheiham and James, 2020].

Frequent consumption of sweet and pastry products favors the development of dental caries, being considered one of the main etiological factors [Moynihan and Kelly, 2021]. In contrast, plant-based products, fruits and vegetables, contribute to maintaining oral health by providing vitamins, minerals and bioactive compounds with a protective role. Thus, flavanols, anthocyanins and proanthocyanidins inhibit biofilm formation on dental surfaces, while presenting strong antioxidant and anti-inflammatory activity [Skoczek-Rubińska et al.,2018].

In addition to diet, lifestyle factors, such as poor oral hygiene, smoking, and alcohol consumption, significantly influence an individual's oral status [Peres et al., 2020]. Educational level and preventive behaviors are also important determinants of oral health.

People with little saliva and a habit of frequently consuming acidic beverages are at increased risk for enamel erosion. The basic recommendations are to drink water as the first choice and eat fresh fruits as an integral part of a healthy and balanced diet [Inghingolo et al., 2023]. Inadequate nutrition can affect the oral health including dental caries, periodontal diseases, diseases of oral mucosa and infectious diseases [Shailesh et al., 2019].

In this context, the analysis of the relationship between nutrition and oral health becomes relevant from both a medical and nutritional perspective.

The aim of the study is to evaluate the influence of the consumption of sweet and pastry products, compared to plant-based products, as well as lifestyle factors on oral health.

MATERIAL AND METHOD

The study included a group of 32 patients aged between 55 and 75 years, from urban areas.

To assess oral health, the G.O.H.A.I. questionnaire was used, applied in two stages: initially and one month after prosthetic treatment.

Dietary habits (consumption of sweet and pastry products, consumption of fruits and vegetables) were analyzed, as well as lifestyle (smoking, alcohol consumption, oral hygiene, frequency of visits to the dentist).

The data were analyzed according to age, gender and educational level.

RESULTS AND DISCUSSIONS

The analysis of eating habits highlights an increased frequency of consumption of sweet and pastry products in all age groups, with maximum values

in the 55–60 years range (82%), followed by the 61–70 years group (58%) and 71–75 years group (33%) (Table 1, Figure 1). These results highlight the fact that with age, patients have become aware that a rational consumption of sweets represents a definite benefit for general and oral health.

Table 1

Distribution of oral health risk factors by age group

Factor analyzed	55–60 years old (%)	61–70 years old (%)	71–75 years old (%)
Sweets consumption	82	58	33
Alcohol consumption	27	67	78
Consumption of plant products (fruits and vegetables)	36	50	89
Smoking	82	75	56
Brushing teeth 2 times/day	36	42	22
Adjunctive methods to tooth brushing	27	25	11
Doctor visits (emergency)	64	67	78

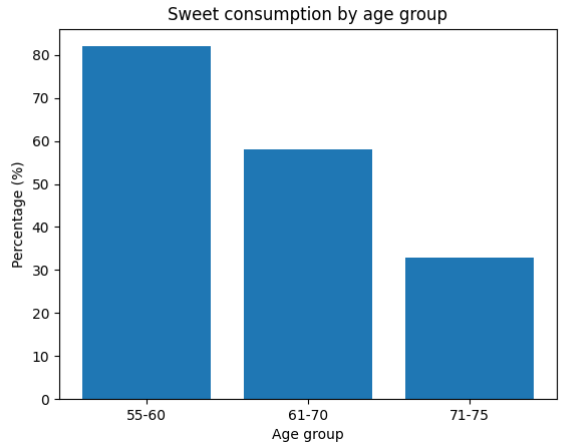

Fig. 1. Sweet consumption by age group

Alcohol consumption shows an increasing trend with age, reaching 78% in the 71–75 year old group (Table 1, Figure 2). This behavior is associated with poor oral hygiene and an increased risk of oral diseases, being described as an aggravating factor in oro-dental pathology [Peres et al., 2020].

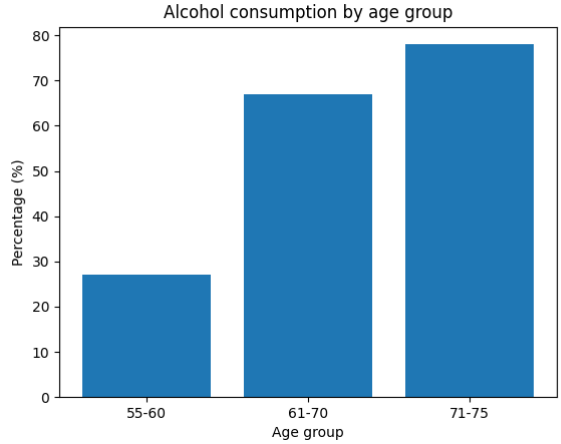

Fig. 2. Alcohol consumption by age group

Regarding the consumption of plant products, it is more common in elderly patients (89% in the 71–75 year old group), compared to younger groups (Table 1, Figure 3). This aspect suggests a healthier dietary orientation with advancing age, consistent with studies highlighting the protective role of a diet rich in plant products [Petersen and Ogawa, 2021]. Fruit and vegetable intake (at least 5 servings per day) is a significant factor that can prevent the progression of periodontal disease and even tooth loss in people of all ages [Skoczek-Rubińska et al., 2018].

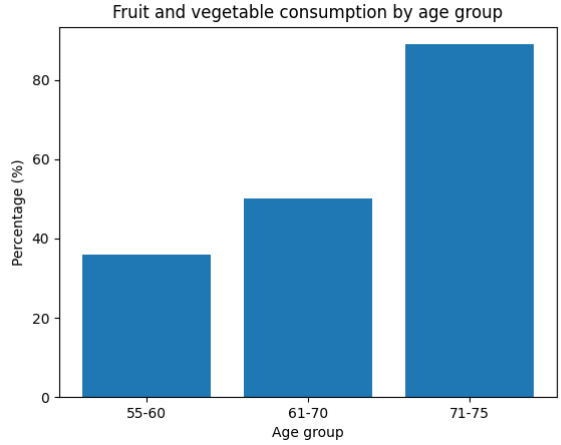

Fig. 3. Fruit & vegetable consumption

Smoking has a high prevalence in all groups analyzed, exceeding 75% in the 55–70 year old groups (Table 1, Figure 4). This risk factor is correlated with the occurrence of periodontal diseases and the worsening of oral status [Peres et al., 2020].

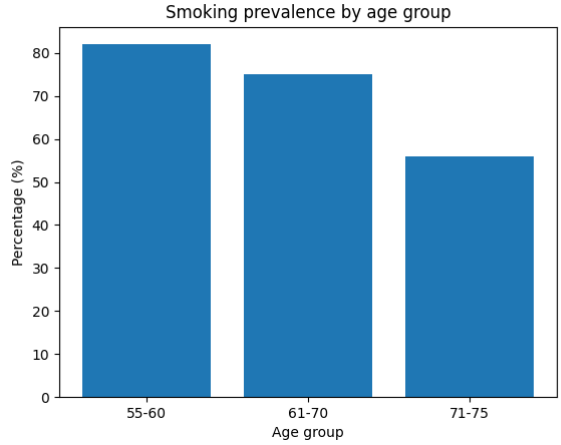

Fig. 4. Smoking prevalence

Regarding oral hygiene, the percentage of patients who brush their teeth twice a day is low, ranging between 22% and 42% depending on age (Table 1, Figure 5). The use of adjuvant oral hygiene methods is even lower, reaching minimum values of 11% in the 71–75 year old age group (Table 1, Figure 6). These results reflect a low level of oral health education.

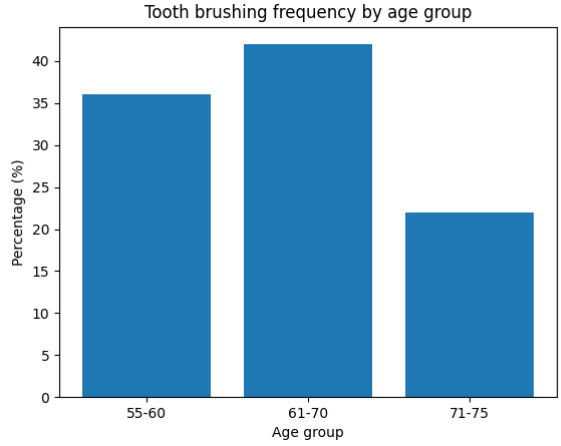

Fig. 5. Tooth brushing frequency

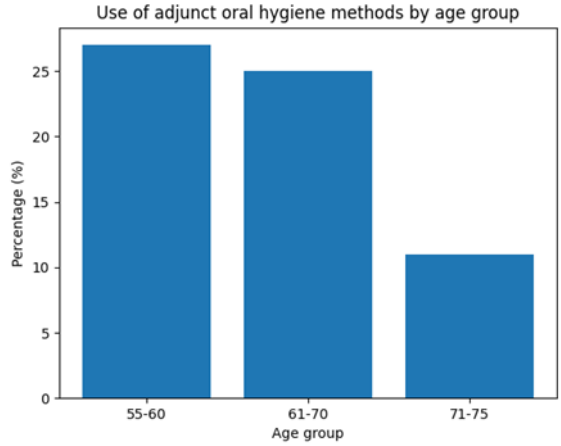

Fig. 6. Use of adjunct oral hygiene methods by age group

Dental visits are predominantly emergency-oriented, with percentages ranging from 64% to 78% across all age groups (Table 1, Fig. 7). This behavior indicates a lack of concern for prevention, contributing to the worsening of dental conditions.

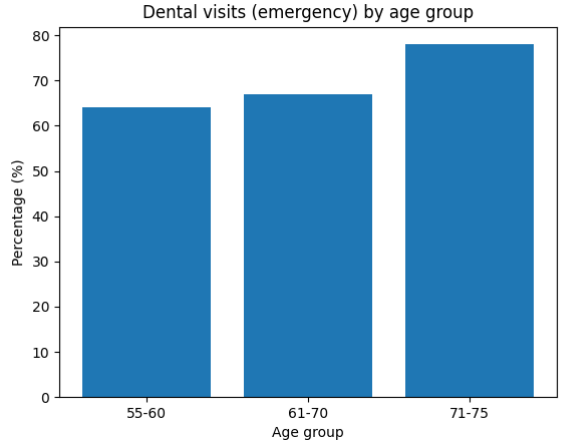

Fig. 7. Dental visits (emergency) by age group

Analysis by educational level highlights significant differences between groups. Patients with higher education have a higher consumption of plant-based foods (78%) and a higher frequency of adequate oral hygiene, compared to those with lower educational levels (Table 2). In contrast, the consumption of sweet products, alcohol and smoking are more common in people with secondary and high school education, confirming the role of education in adopting healthy behaviors.

The consumption of sweets and pastries is high in all age groups, with a maximum of 82% in the 55–60 age group (Table 3, Figure 8). A progressive decrease in this type of consumption is observed with advancing age, reaching 33% in the 71–75 age group. These results confirm the understanding of the need to reduce the intake of processed foods in the diet.

Table 2

Distribution of eating behaviors and risk factors according to educational level

Factor	Secondary (%)	High school (%)	Middle school (%)	University (%)
Sweets consumption	67	73	70	33
Alcohol consumption	100	64	45	33
Consumption of plant foods/fruits and vegetables	33	45	55	78
Smoking	100	82	78	55
Tooth brushing 2x/day	33	27	45	55

Table 3

Consumption of sweets and pastries by age

Age group	Frequent consumption (%)	Low consumption (%)
55–60 years old	82	18
61–70 years old	58	42
71–75 years old	33	67

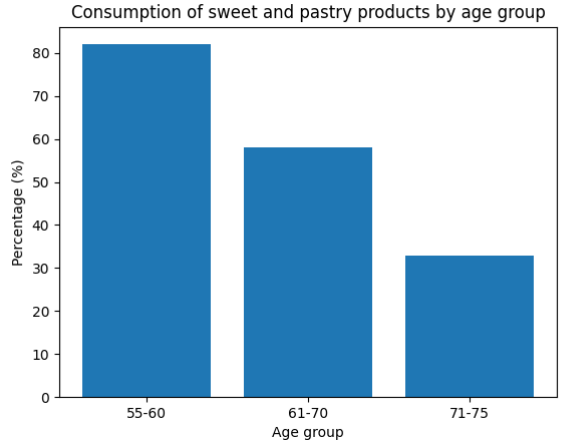

Fig. 8. Consumption of sweet and pastry products by age group

The comparative analysis highlights significant differences between the consumption of sweets and pastries and that of plant-based foods, depending on

age groups. Thus, in younger groups, the consumption of sweets predominates, while in the elderly an increase in plant-based consumption is observed (Figure 9).

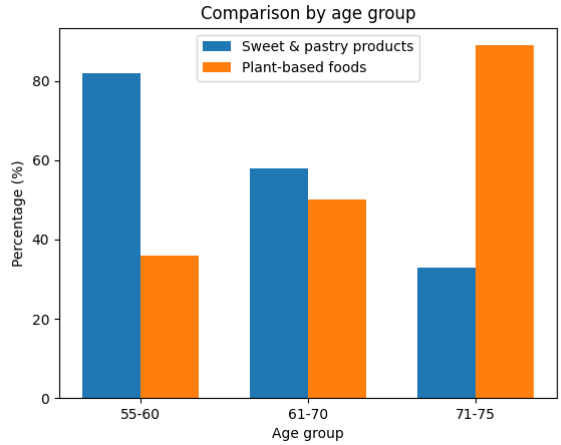

Fig. 9. Comparison by age group between consumption of sweets, pastries and plant products

Depending on the educational level, a clear trend is observed of reducing the consumption of sweets and increasing the consumption of plant-based products (fresh fruits, vegetables) with increasing educational level (Figure 10).

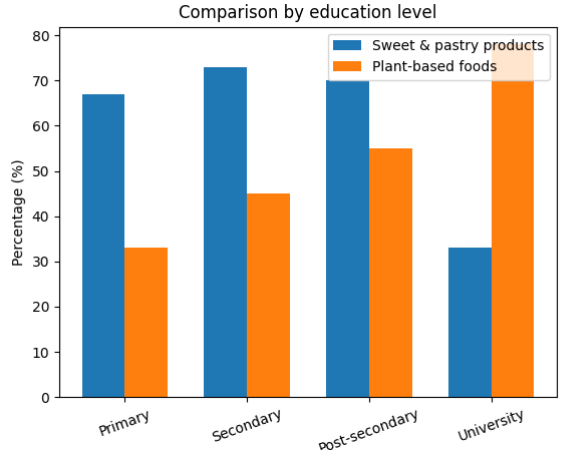

Fig. 10. Comparison by education level between consumption of sweets, pastries and plant products

Overall, the results reveal the interdependence between diet, lifestyle and oral health, underlining the need to implement oral prevention campaigns based on nutritional education and promotion of fruit and vegetable consumption.

The results of the study highlight an increased consumption of sweet products in all age groups, with maximum values in patients between 55–60 years. These data are consistent with the literature, which indicates that the intake of fermentable sugars is a major factor in the etiology of dental caries [Moynihan and Kelly, 2021].

Recent studies confirm the protective role of diets rich in fruits and vegetables on oral health [Petersen and Ogawa, 2021].

Fruit and vegetable consumption was more frequent in patients with higher educational level, suggesting an association between education and healthy eating behaviors.

Education level is a predictor of achieving recommended consumption levels for fruits and vegetables, people with secondary or higher education being more likely to achieve this than those without formal education [Aafke and Inge, 2020].

Smoking and alcohol consumption were common among patients with low educational level, being correlated with poor oral hygiene and late presentation to the dentist. These behaviors are recognized as major risk factors for oral diseases [Peres et al., 2020].

Also, most patients stated that they only present to the dentist in emergency situations, which reflects a low level of information on the importance of prevention, consistent with data from the specialized literature.

These results highlight the interdependence between diet, lifestyle and oral health, emphasizing the need to implement prevention programs based on nutritional and behavioral education for oral health.

CONCLUSIONS

Frequent consumption of sweets and pastries is a major risk factor for oral health.

Fruits and vegetables are associated with healthy eating behaviors and better oral status.

Lifestyle factors, such as smoking, alcohol consumption, and poor oral hygiene, contribute significantly to the deterioration of oral health.

Adopting a balanced diet and a healthy lifestyle is an essential component in preventing oral diseases

REFERENCES

1. Aafke N., Inge D.B., 2020 - *Fruits and vegetables consumption in low- and middle-income countries. A comprehensive review of fruits and vegetables intake and determinants using a food systems approach.* Division of Human Nutrition and Health, Wageningen University & Research Wageningen, The Netherlands. RESEARCH PROGRAM ON Agriculture for Nutrition and Health. Led by IFPRI

2. Moynihan P., Kelly S., 2021 - *Dietary sugars and dental caries: update evidence*. Journal of Dental Research, vol. 100(10), pp. 1099–1107.

3. Peres M.A., Macpherson L.M.D., Weyant R.J., Daly B., Venturelli R., Mathur M.R.,…, Watt R.G., 2020 - *Oral diseases: a global public health challenge*. The Lancet, vol. 394, pp. 249–260.

4. Petersen P.E., Ogawa H., 2021 - *Prevention of dental caries through dietary control*. Community Dentistry and Oral Epidemiology, vol. 49(3), pp. 193–200.

5. Shailesh M.G., Amol R.G., Rima S.G., Sachin C.S., Gargi S.S., Shankargouda P., Kamr an H.A., 2019 - *Nutrition and oral health*. Dis Mon, vol. 65(6), pp. 147-154.

6. Sheiham A., James W.P.T., 2020 – *Diet and dental caries: revisiting the evidence*. Journal of Dental Research, vol. 99(10), pp. 1100–1107.

7. Skoczek-Rubińska A., Bajerska J., Menclewicz K., 2018 - *Effects of fruit and vegetables intake in periodontal diseases: A systematic review*. Dent Med Probl. vol. 55(4), pp. 431–439.