RESULTS CONCERNING *TANYMECUS DILATICOLLIS* CONTROL IN A COMMERCIAL FARM FROM THE SOUTH-EAST OF ROMANIA, IN THE CONDITIONS OF THE YEAR 2020

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Abstract

The maize leaf weevil (*Tanymecus dilaticollis* Gyllenhal, 1834) represent one of the most destructive pests of maize crops in Romania, especially in the south and south-east of the country. Every year was attacked more than 1 million hectares cultivated with maize. This pest is very dangerous when maize is in early vegetation stages, from plant emergence until four leaves (BBCH 10-BBCH 14). After the ban of the seeds treatment with neonicotinoids in the Europe Union, no alternatives for seed treatment to control this pest remain available in our country. In this article, it has assessed both, seeds treatment with neonicotinoids and possible alternatives for controlling of the maize leaf weevil in conditions of the commercial farm located in the south-east of Romania. Seeds treatment with imidacloprid (600 g/l), cyantraniliprole (625 g/l) active ingredients, maize foliar treatment with acetamiprid (20 %), lambda-cyhalothrin (50 g/l) active ingredients, granules application at maize sowing, with chlorpyrifos (5 %), lambda-cyhalothrin (4 g/kg) active ingredients or two granules application, at maize sowing and after plants emergence with cypermethrin (0.8 %) active ingredients were assessed. The efficacy of the applied insecticides was determined by evaluating weevils attack intensity at the maize plants, at BBCH 14 stage, using a scale from 1 (plant not attacked) to 9 (plant destroyed). In the spring of 2020, weather conditions from the experimental site, during assessments period were unfavorable for weevils activity at the soil surface. Even if the pest density from the experimental location was high (10-15 insects/m^2) however weevils attack at maize plants was low. At variant with seeds treated with imidacloprid active ingredient, maize attack intensity at maize plant was 3.86, at untreated variant attack intensity was 4.47 while at rest of the experimental variants, attack intensity ranged between 4.29 and 4.46. It has registered significant statistical differences between weevils attack at maize plants from variant with seeds treated with imidacloprid active ingredient and the rest of the variants from this assessment ($p<0.05$). In the weather conditions of the year 2020, from the experimental location from the south-east of Romania, there weren't registered significant statistical differences between seeds treatment with cyantraniliprole active ingredient, maize foliar treatment with acetamiprid, lambda-cyhalothrin active ingredients, granules application with chlorpyrifos, cypermethrin, lambda-cyhalothrin active ingredients, and untreated variant ($p<0.05$).

Key words: maize, weevils, control, alternatives, farm

Maize leaf weevil (*Tanymecus dilaticollis* Gyllenhal, 1834) is one of the most dangerous and destructive pest of the maize crops from Romania (Paulian F., 1972; Voinescu I., 1985; Barbulescu A. *et al*, 2001; Cristea M. *et al*, 2004; Vasilescu V.S. *et al*, 2005; Popov C. and Barbulescu A., 2007; Rosca I. and Istrate R., 2009; Trotus E. *et al*, 2011; Georgescu E. *et al*, 2014). The same authors mentioned that the main favorable area for this pest occurred in the south and south-east of Romania, but in some years, weevils produce damages at the maize crops in the south-west too. According to Popov C. *et al* (2006), in these areas, climatic conditions from spring are most favorable for weevils activity and feeding process. Maize leaf weevil is a thermo-xerophilous insect; thus, the weevils are very active at high air temperatures and low air humidity. New researches make in evidence higher attack of the *Tanymecus dilaticollis* at the maize plants, in areas considered until now, unfavorable for weevils activity, such as Transylvania (Antonie I. *et al*, 2012). Possible explication for extending the weevils area to northern latitudes is increases of *the temperatures (*Camprag D., 2007; Olesen J.E. et al, 2011). Recent studies made at NARDI Fundulea, make in evidence atypical behavior of the maize leaf weevil, in spring, as a result of the daily rainfall and temperature distribution in the spring (Georgescu E. *et al*, 2014, 2015). Maize leaf weevil is a polyphagous pest, with a range of 34 host plants in Romania (Paulian F., 1972). Maize is the main host of this pest, but sunflower, soybean,

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wheat or barley can be a good food source for weevils (Rosca I. and Istrate R., 2009). Damages are caused by weevils that feeding with maize leaves. The attack is dangerous when maize is in early vegetation stages, from plant emergence until four leaves stage (Paulian F., 1972; Barbulescu A., 2001). In the case of weevils high attack, maize plants can be destroyed and farmers must sow again (Popov C. and Barbulescu A., 2007). After four leaves stage (BBCH 14) the pest attack is less economically important, the weevils consume only leaves margins and plants survive of the attack (Rosca I. and Istrate R., 2009). Recent studies make in evidence that in Romania, every year, one million hectares cultivated with maize are attacked by *T. dilaticollis* weevils, with different attack intensity degrees (Barbulescu A. *et al*, 2001; Popov C. *et al*, 2002, 2004, 2007a). According to Paulian F. (1972), in case of pest density ranged between 25 and 30 weevils/m^2, average maize yield losses can reach at 34%. Data from the literature make in evidence that in the last 30 years, in the south-east of Romania, pest density ranged between 15 and 80 weevils/m^2 (Barbulescu A. *et al*, 1993, 1997; Barbulescu A., 2001, Popov C. *et al*, 2004). In some favorable years, there were extreme cases when it had recorded a pest density of 160 weevils/m^2, in the Dobrogea area (Voinescu I., 1987 cited by Rosca I. and Istrate R., 2009). Analyzing the data between 2011 and 2018 from 15 locations placed in East, South-East, South and South-West of Romania, Badiu A.F. *et al* (2019) concluded that maize plant losses ranged from 25 to 50 %. However, in this paper, the author didn't make references to maize yield losses only to plant density losses. Maize monoculture, for several years, favored weevlis attack (Voinescu I. and Barbulescu A., 1998). Crop rotation has a low impact in decreasing of the weevils attack, because insects can migrate from plots sowed, the previous year with maize (Popov C. and Barbulescu A., 2007). High areas cultivated both with maize and sunflower is concentrated in the south-east of Romania (Lup A. *et al*, 2017). A low number of crops from rotation, increasing of the areas with maize monoculture, higher areas cultivated both, with maize and sunflower, in the most pest favorable areas from the south-east of Romania represent favorable conditions for increasing of the weevils population in our country. The suppression of these insects largely relies on chemical protection with systemic insecticides used for maize seeds treatment (Voinescu I., 1985; Barbulescu A. *et al*, 2001; Vasilescu V.S. *et al*, 2005; Popov C. *et al*, 2007b, Trotus E. *et al* l, 2011; Georgescu E. *et al*, 2014). As result of the European Commission regulations 218/783, 218/784 and 218/785, the use of the imidacloprid, clothianidin and thiamethoxam active ingredients will be total banned in UE, starting from 2019 (Official Journal of the European Union, 2018a,b,c). After these regulations, in Romania, no insecticides will remain available for maize seed treatment to control weevils attack. Lack of the seed treatment alternatives of the maize crops can have negative impact in Romanian agriculture, in next years (Ionel I.I., 2014). In this paper our goal was to evaluate the effectiveness of the possible alternatives to the maize seed treatment with neonicotionids, in conditions of the high pest pressure, in a commercial farm located in the south-east of the Romania.

MATERIAL AND METHOD

In 2020, a field trial were conducted in Romania at the commercial farm Sopema SRL, located at Mihail Kogalniceanu, Ialomita County, Romania (latitude: 44°42'N, longitude: 27°40', altitude: 18 m a.s.l). Over the course of the trial, the average temperatures and precipitation were recorded daily. The experiments were carried out according to the standard of the European and Mediterranean Plant Protection Organization (EPPO) (2012a, 2012b, 2014) methods for the data analysis, efficiency evaluation trials, and phytotoxicity. At trial location from the commercial farm Sopema, the area of each experimental plot was of 8000 m^2. Maize was sowed in 17 April and plants emergence were recorded on 2 May. For this trial, it has been used P0900 maize hybrid (FAO 480). In 2019, the previous crop was soybean. Experimental variants are presented in *table* 1. It has tested foliar spray with acetamiprid (20 %) and lambda-cyhalothrin (50 g/l) active ingredients (variants 2-3), seed treatment with imidacloprid (600 g/l) and cyantraniliprole (625 g/l) active ingredients (variants 4-5), granules application at sowing and plants emergence, with cypermethrin (0.8 %) active ingredient (variant 7) and granules application at plants emergence with chlorpyrifos (5 %) and lambda-cyhalothrin (4 g/kg) active ingredients (variants 6 and 8).

Assessments: when maize plants were in early vegetation stages (BBCH 11-12 and BBCH 14-16) it has assessed plant densities. On each variant, it has established four assessment points. At each assessment point, it has counted emerged maize plants from 20 row meters (80 row meters/variant).

Attack intensity was evaluated when maize plants were in four leafs stage, according to a scale from 1 to 9, elaborated and improved by Paulian F. (1972), as follows: note 1-plant not attacked; note 2-plant with 2-3 simple bites on the leaf edge; note 3-plants with bites or clips on all leaves edge; note 4-plants with leaves chafed in a proportion of 25 %; note 5-plants with leaves chafed in a proportion of 50 %; note 6-plants with leaves chafed in a proportion of 75 %; note 7-plants with leaves chafed almost at the level of the stem; note 8-plants with leaves completely chafed and beginning of the stem destroyed; note 9-plants destroyed, with stem chafed close to soil level. At each variant, it has established four assessment points. At each assessment point, it has evaluated 50 maize plants, from five rows (10 plants/row). Before the assessment, plants were marked with sticks, in the stair system.

Table 1

Active ingredients used for controlling of the *Tanymecus dilaticollis* Gyll in commercial farm conditions, from south-east of the Romania, in 2020

Variant	Active ingredients	Rate	Rate type	Application type
1	—	—	—	—
2	acetamiprid (20 %)	0.10	kg/ha	B
3	lambda-cyhalothrin (50 g/l)	0.15	l/ha	B
4	imidacloprid (600 g/l)	2.20	µl/grain	A
5	cyantraniliprole (625 g/l)	2.00	µl/grain	A
6	chlorpyrifos (5 %)	16.00	kg/ha	D
7	cypermethrin (0.8 %)	12.00	kg/ha	C, D
8	lambda-cyhalothrin (4 g/kg)	12.00	kg/ha	D

A-Seed treatment (BBCH 00); **B**-Foliar applications (BBCH 11-12); **C**-Granules application at sowing time (BBCH 00), **D**-Granules application after plants emergence (BBCH 09-10)

Table 2

Results of foliar and granules application for controlling of the *Tanymecus dilaticollis*, in commercial farm conditions, from south-east of the Romania, in 2020

Active ingredients	Plants (no/Rm) 13.05.2020	Phytoxicity (%) 20.05.2020	Incidence (%) 20.05.2020	Attack (I:1-9) 20.05.2020	Plants (no/Rm) 20.05.2020
control (untreated)	5.57a	**0a**	**100a**	4.47a	5.40a
acetamiprid (20 %)	5.59a	**0a**	**100a**	4.42a	5.51a
lambda-cyhalothrin (50 g/l)	5.61a	**0a**	**100a**	4.46a	5.54a
Imidacloprid (600 g/l)	5.60a	**0a**	**100a**	3.86b	5.57a
cyantraniliprole (625 g/l)	5.50a	**0a**	**100a**	4.29a	5.45a
chlorpyrifos (5 %)	5.51a	**0a**	**100a**	4.32a	5.51a
cypermethrin (0.8 %)	5.54a	**0a**	**100a**	4.39a	5.50a
lambda-cyhalothrin (4 g/kg)	5.35a	**0a**	**100a**	4.40a	5.29a
LSD (P=.05)	0.313	0	0	0.289	0.356
Standard deviation (SD)	0.213	0	0	0.196	0.242
Coefficient of variation (CV)	3.840	0	0	4.540	4.420

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls test)

Statistical analysis. The results of the field trial were presented as the absolute and mean values for maize plants density, phytotoxicity, attack incidence and weevils attack intensity, the standard deviation from the average values (SD) and the coefficient of variation (CV). Data were statistically analyzed using Student-Newman-Keuls test (Student, 1927; Neuman D., 1939; Keuls M., 1952).

RESULTS AND DISCUSSIONS

In April and May, weather conditions recorded at the experimental site, were unfavorable for weevils activity at the soil surface and feeding process. The average air temperature recorded in April was close to the multiyear average, while in May, average air temperature was below the multiyear average (*figure 1*). Even if the rainfalls amount recorded in April and May were below the multiyear average (*figure 2*), temperatures recorded when maize plants were in early vegetation stages (BBCH 10-BBCH 14) were lower than normal. Also, it has registered higher differences between minimum and maximum daily temperatures (more than 20 °C).

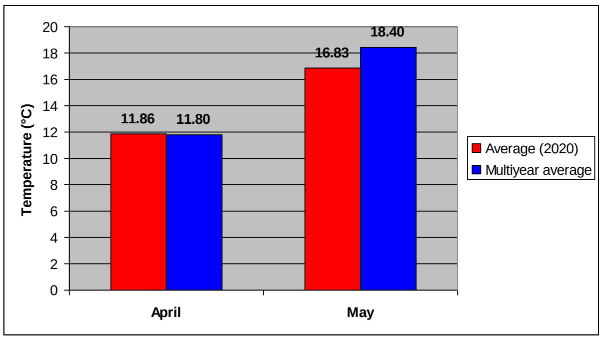

Figure 1 **Average air temperatures registered at Sopema farm, in April and May, 2020**

In first 15 days of May, minimum temperature was 3.85 °C while maximum temperature was bellow 27 °C. As result, maize plants have a slow development, in early vegetation stage. In the same time, the interval with optimum temperature, during the day, for weevils activity at soil surface, was low. As result, the attack intensity of the weevils at maize plants, at Sopema farm, was low compared with the previous years. Badiu A.F. *et al*. (2019) mentioned that higher temperatures differences from the spring period can have an impact in reducing the maize leaf weevil attack intensity, because of the shorting of the weevils active period during the day. However, further studies are necessary to elucidate this aspect.

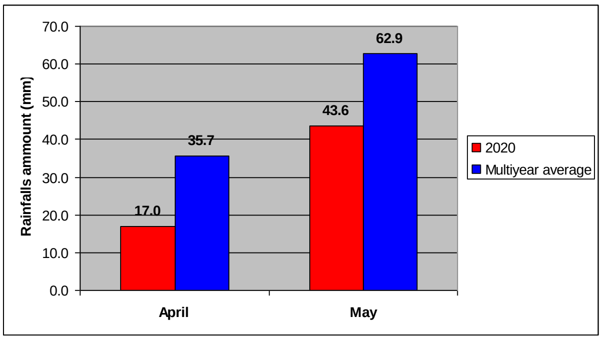

Figure 2 **Rainfalls amount registered at Sopema farm, in April and May, 2020**

In 2020, at the experimental location from Sopema farm, first assessment was made on 13 May, when maize plants were in two leaves stage and the second assessment was made at 20 May, when maize plants were in four leaves stage (BBCH 14). The two assessments make in evidence a high pest population level at the experimental site, with a density ranged from 10 to 15 weevils/m^2. Even if the pest density was smaller compared with previous years (Georgescu E *at al*, 2018), however, it was higher than economic damages limits for this specie (5 weevils/m^2 according to Rosca I. and Istrate R., 2009; 3 weevils/m^2 according to Badiu A.F. *et al.*, 2019).

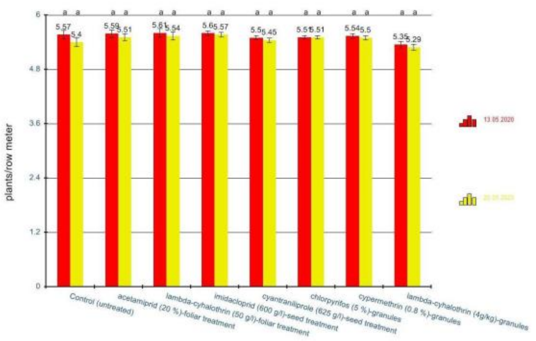

Figure 3 **Maize plants density, at experimental location from Sopema farm (2020)**

Regard as maize plants density, data from the *table* 2 make in evidence slight variability of this parameter between experimental variants, at first assessment. At the untreated variant it has recorded 5.57 plants/row meter, while in the case of the treated variants, plants density ranged from 5.35 to 5.61 plants/row meter. At the second assessment, made one week later, when maize plants were in four leaves stage (BBCH 14), it has ascertained a slight decrease of the plants density comparative with the previous assessment (*figure* 3). However, maize plants density was higher at all experimental variants than the 5.25 plants/row meter. According Student-Newman-Keuls (SNK) test, there weren't recorded significant statistical differences between plants density at control (untreated) variant and treated variants ($p<0.05$).

In 2020, at the experimental location, from Sopema farm, it hasn't recorded phytotoxicity at treated variants (*table* 2). Both seed treatment and foliar treatment hasn't a negative effect on maize plants in early vegetation stages. Also, insecticides applied like granules, both at sowing and after plants emergence does not affect maize plants.

Regarding of the attack incidence, all assessed plants from this field trial was attacked by the weevils, with different intensity of the attack.

In the weather conditions of the spring of 2020, at experimental site from Sopema farm, weevils attack intensity at maize plants, on a scale from 1 to 9, was 4.47 at untreated variant (*figure* 4). Most of the maize untreated plants from this experiment have leaf chaffed in proportion of 25-50% as result of weevils feeding process. Some plants have leaves completely chafed and beginning of the stem destroyed. However the majority of the plants from this field trial survived.

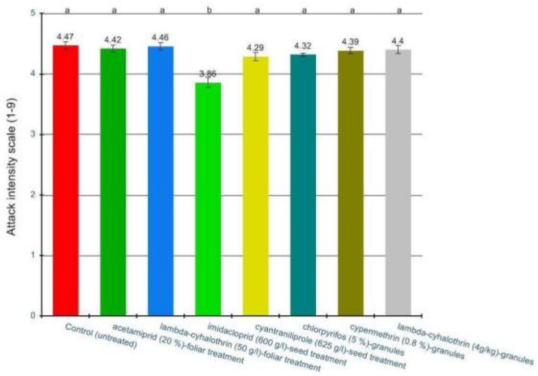

Figure 4 **Attack intensity of *Tanymecus dilaticollis* weevils at maize plants, at Sopema farm (2020)**

At variants with foliar treatment (without seed treatment), made when maize plants were in BBCH 11-12 stage, attack intensity was 4.42 (in case of variant sprayed with acetamiprid active ingredient) and 4.46 in case of variant sprayed with lambda-cyhalothrin active ingredient). The lower value of the attack intensity has been recorded incase of the variant with imidacloprid active ingredient (seed treatment). Attack intensity was 3.86, which means maize plants have leaves chaffed in the proportion of 5-15%, and some plants have leaves chaffed in the proportion of 25 %. In case of the variant with maize seeds treated with the cyantraniliprole active ingredient, weevils attack intensity was higher comparative with variant treated with imidacloprid active ingredient and lower than the control variant. Regard to variants treated with granule insecticides, it has ascertained slight differences of the weevils attack intensity at the maize plants comparative with untreated variant. Also, two applications of granules, with cypermethrin active ingredient, both at sowing and after plants emergence hasn't impact in reducing of the weevils attack intensity at maize plants. According Student-Newman-Keuls (SNK) test, in the field trial from Sopema farm, in weather conditions of the spring of year 2020, it has registered significant statistical differences between weevils attack intensity at maize plants from variant treated with imidacloprid active ingredient (seeds treatment) and attack intensity at untreated maize plants (control variant). At the same time, it hasn't registered significant statistical differences between weevils attack intensity at variants with foliar treatment, variants with granules application, variant with seed treated with the cyantraniliprole active ingredient and untreated variant ($p<0.05$). In this field trial, treatment with lambda-cyhalothrin active ingredient apply like spraying or granules after plants emergence didn't have any impact in reducing of the weevils attack intensity at maize plants. Also, foliar spraying with insecticides with different mode of actions didn't have any impact in reducing of the weevils attack intensity at maize plants. Regard as granules treatments, both single application, after plants emergence and two applications, at sowing and after plants emergence didn't have any impact in reducing of the weevils attack intensity at maize plants. In the case of seeds treated with the cyantraniliprole active ingredient, even if it has ascertained a slight decreasing of the weevils attack intensity at maize plants comparative with control variant, however, it hasn't registered significant statistical differences comparative with untreated plants. At this conclusion, we arrive in previous studies effectuated both in the field and laboratory conditions (Georgescu E. *et al*, 2015, 2016). Results from this study and from previous studies make in evidence lack of the alternatives to seed treatments with neonicotionids systemic insecticides for control of *T. dilaticollis* weevils attack at maize plants (Georgescu E. *et al*, 2014, 2018).

CONCLUSIONS

In 2020, weather conditions from the spring period (April-May) at the experimental site (Sopema farm, Ialomita County) were unfavorable for maize leaf weevil (*Tanymecus dilaticollis* Gyll) attack. In conditions of high pest pressure (10-15 weevils/m^2) from experimental site, the attack intensity of the weevils at maize plants was low, as result of the unfavorable weather conditions from period when maize plants were in early vegetation stages (BBCH 10-BBCH 14). Most of the maize plants survive of the attack. In this field trial, foliar treatment with acetamiprid, lambda-cyhalothrin active ingredients, granules application with chlorpyrifos, cypermethrin, lambda-cyhalothrin active ingredients and seed treatment with cyantraniliprole active ingredient didn't have effectiveness in controlling of the maize leaf weevil attack.

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REFERENCES

Antonie I., Stanciu M., Sand C., Blaj R., 2012 - *The researches regarding the biodiversity of the entomologic of the corn cultures in the Sibiu county*. Scientific Papers, Series Management, Economy. Engineering. in Agriculture and Rural Development, 12 (1):5-10.

Badiu A.F., Iamandei M., Trotus E., Georgescu E.I.V., 2019 - *Study concerning Tanymecus sp. populations behavior in some locations from Romania in period 2010-2018*, Acta Agricola Romanica, 1(1):108-136.

Barbulescu A., Mateias M.C., Popov C., Voinescu I., Guran M., Raranciuc S., Mincu M., Spiridon C., Stanciu, M., 1997 - *Evolution of some diseases and pests of cereal, industrial and forage crops in our country during 1997*. Problems of Plant Protection, 25(1):51-72.

Barbulescu A., Popov C., Mateias M.C., Voinescu I., Guran, M., Raranciuc S., Spiridon C., Vasilescu, S., Valasn, D., 2001 - *Evolution of some diseases and pests of cereal, industrial and forage crops in our country during 2000*. Problems of Plant Protection, 29(1):1-16.

Barbulescu A., Voinescu I., Sadagorschi D., Penescu A., Popov C., Vasilescu S., 2001 - *Cruieser 350 FS-A new product for maize and sunflower seed treatment against Tanymecus dilaticollis Gyll*. Romanian Agricultural Research, 15: 77-87.

Cristea M., Cabulea I., Sarca T., 2004 - *Maize. Monographic study*. Romanian Academy Publishing-house, 1:589-626.

Georgescu E., Cana L., Popov C., Gargarita R., Rasnoveanu L., Voinea L., 2014 - *Maize leaf weevil (Tanymecus dilaticollis Gyll) in the context of neonicotinoid seed treatment restriction*. Annals of N.A.R.D.I. Fundulea, 82:251-277.

Georgescu E., Cana L., Gargarita R., Voinea L., Rasnoveanu L. 2015 - *Atypically Behavior of the Maize Leaf Weevil (Tanymecus Dilaticollis Gyll) on Maize and Sunflower Crops, in Climatic Conditions of the Year 2014, in South-East of Romania*. Agriculture and Agricultural Science Procedia, 6:9-16.

Georgescu E., Toader M., Ionescu A.M., Cana L., Rasnoveanu L., 2016 - *Testing of the new insecticides formulation for maize seeds treatment against Tanymecus dilaticollis Gyll in laboratory conditions*, AgroLife Scientific Journal, 5(1):83-90.

Georgescu E., Cretu A., Zob C., Cana L., 2018 - *Preliminary results concerning maize leaf weevil (Tanymecus dilaticollis Gyll) control, in commercial farm conditions, from south-east of the Romania*. Scientific Papers. Series Agronomy, 61(1):221-226.

Ionel I. I., 2014 - *Regulation implications on banning the treatment of seeds with neonicotinoid insecticides on the seed market in Romania*. Scientific Papers Agricultural Management, 16(2):223-228.

Keuls M., 1952 - *The use of the "studentized range" in connection with an analysis of variance*. Euphytica, (1), 112–122.

Lup A., Miron L., Alim I.D., 2017 - *Studies and strategies regarding the evolution of crop yields per unit of land area in Romania*, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 17(2):227-233.

Newman D., 1939 - *The distribution of range in samples from a normal population, expressed in terms of an independent estimate of standard deviation*. Biometrika, 31(1):20–30.

Olesen J. E., Tmka M., Kersebaumc K.C., Skjelvågd A.O., Seguine B., Peltonen-Sainiof P., Rossig F., Kozyrah J., Micalei, F., 2011 - *Impacts and adaptation of European crop production systems to climate change*. European Journal of Agronomy, 34(2):96-112.

Paulian F., 1972 - *Contribution at knowledge of the development, ecology and control of the Tanymecus dilaticollis specie*. Doctoral thesis, I.A.N.B. Bucharest, pp. 300.

Popov C., Barbulescu A., Guran M., Raranciuc S., Spiridon C., Vasilescu S., Valsan D., Mateias M.C., Voinescu I., 2002 - *Phytosanitary state of cereals, leguminous for grain, industrial and fodder crops in Romania in 2001*. Problems of Plant Protection, 30(1):1-21.

Popov C., Guran, M., Raranciuc S., Rotarescu M., Spiridon C., Vasilescu S., Gogu F., 2004 - *Phytosanitary state of cereals, leguminous for grain, industrial and fodder crops in Romania in 2003*. Problems of Plant Protection, 32(1):1-23.

Popov, C., Trotus, E., Vasilescu, S., Barbulescu, A., Rasnoveanu, L., 2006 - *Drought effect on pest attack in field crops*. Romanian Agricultural Research, 23:43-52.

Popov, C., Trotus, E., Vasilescu, S., Barbulescu, A., Rasnoveanu, L., 2006 - *Drought effect on pest attack in field crops*. Romanian Agricultural Research, 23:43-52.

Popov C., Raranciuc S., Spiridon C., Vasilescu S., Cana L., 2007a - *Phytosanitary state of cereals, leguminous for grain, industrial and fodder crops in Romania in 2006*. Problems of Plant Protection, 35(1):1-24.

Popov, C., Barbulescu, A., Raranciuc, S., 2007b - *Seed treatment a modern, efficient and less pollutant method for field crops protection*, Annals of N.A.R.D.I. Fundulea, 75:133-139.

Popov, C., Barbulescu, A., 2007 - *50 years of scientific activity in field crop protection area, against pests and diseases*, Annals of NARDI Fundulea, 75:371-404.

Rosca, I., Rada, I., 2009 - *Entomology (Agriculture, Horticulture, Forest)*, Alpha MDN Publishing house, Chapter 2:115-143,

Student. 1927 - *Errors of Routine Analysis*. Biometrika, 19(1/2):151-164.

Vasilescu, V. S., Popov, C., Stoica, V., Negrila, M., Procopovici E., 2005 - *Results regarding control of maize leaf weevil (Tanymecus dilaticollis Gyll) by chemical seed treatment during 2000-2004*. Scientific Papers, USAMV, 48:343-350.

Trotus, E., Buburuz A.A., Zaharia, P., 2011 - *Researches on the protection of maize crops against soil pests*. Agronomical Researches in Moldavia, 4:45-51.

Voinescu, I., 1985 - *Maize seed treatments with carbamic insecticides, effective method of T. dilaticollis Gyll controll*. Problems of Plant protection, 13(2):151-156.

Voinescu I., Barbulescu A., 1998 - *Evolution of maize leaf weevil (Tanymecus dilaticollis Gyll.) in various crops depending on the preceding crop*. Proceedings of International Symposium on Integrated Protection of Filed Crops, Vrnjaka Banja: 157-164.

*****EPPO Standards, 2012a** - *Design and analysis of efficacy evaluation trials, PP 1/152(4)*. European and Mediterranean Plant Protection Organization, 44:367–381.

*****EPPO Standards, 2012b** - *Conduct and reporting of efficacy evaluation trials including good experimental practice, PP 1/181(4)*. European and Mediterranean Plant Protection Organization, 44: 382–393.

*****EPPO Standards, 2014** - *Phytotoxicity assessment, PP 1/135(4)*. European and Mediterranean Plant Protection Organization, 44:265–273.

*****Official Journal of the European Union, 2018a** - Commission implementing regulation (EU) 2018/783 of 29 May 2018 amending Implementing Regulation (EU) No 540/2011 as regards the conditions of approval of the active substance imidacloprid. 61(L132):31-34, ISSN 1977-0677.

*****Official Journal of the European Union, 2018b** - Commission implementing regulation (EU) 2018/784 of 29 May 2018 amending Implementing Regulation (EU) No 540/2011 as regards the conditions of approval of the active substance clothianidin. 61(L132):35-39, ISSN 1977-0677.

*****Official Journal of the European Union, 2018c** - Commission implementing regulation (EU) 2018/785 of 29 May 2018 amending Implementing Regulation (EU) No 540/2011 as regards the conditions of approval of the active substance thiamethoxam. 61(L132):40-44, ISSN 1977-0677.