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RESEARCH ON THE ATTACK PRODUCED BY *Tanymecus dilaticollis* Gyll. (Coleoptera: Curculionidae) IN THE CONDITIONS OF CENTRAL MOLDOVA, ROMANIA

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Abstract

One of the most polyphagous pests encountered in maize crops is Tanymecus dilaticollis Gyll. which, are consuming the plants foliage in the first phenophases of vegetation and reduce the crop density. Between 2018 and 2021, the series of research carried out in the Center of Moldova concerning the T. dillaticollis Gyll. pest continued and consisted in monitoring the insect attack produced at: (I) maize sown in different sowing timing and (II) different Romanian and foreign maize genotypes. The maize seeds were treated with systemic insecticide from the neonicotinoid class (imidacloprid 600 g/l) according to the disclaimers received year after year from the Ministry of Agriculture in Romania. In the experimented period, the lowest degree of attack was recorded in the late sowing time, at the beginning of May and in mid-May compared to the optimal sowing time, and the most affected by the attack of hibernating adults was the maize sown early. Regarding the attack produced in Romanian and foreign maize genotypes, it was found five of the hybrids experimented registered attack below the average experience. The results show that sowing time and maize genotype have a smaller role as opposed to spring weather conditions which are influencing the attack size and adult density in the maize crop.

Key words*: maize genotype, sowing time, maize weevil.*

INTRODUCTION

T. dilaticolis Gyll. is one of the most well-known pests of corn and sunflower crops in Romania (Georgescu, 2014). Under the conditions in Romania, the insect has one generation per year, the hibernation takes place in the adult stage in the soil at a depth of 40 cm even up to 100 cm (Paulian, 1972). Being a thermophilic insect, the weevils come out to the surface of the soil when the temperature exceeds 9°C and start feeding on weeds and continue on agricultural crops that are emerging (Georgescu, 2019). The most affected areas in Romania by the insect attack are in south, south-east and east of Romania and insect does not create economic losses in the rest of the areas (Georgescu et al., 2012; Bărbulescu, 2001; Trotus et al., 2019). The insect attack on agricultural crops is easy to recognize, the weevils consume the young leaves of the plants from their emergence until the development of 6 leaves (Rosca et al., 2011) and leads to the decrease in plant density per ha, to the delayed development of the attacked plants and increasing the production cost if it is necessary to apply additional crop protection measures when the density of weevils exceeds the EDT (5 specimens/m^2) (Dudoiu et al., 2018). What influences the growth of the weevil population and the attacks intensification is a combination of factors made up of climatic conditions and agrotechnical factors. The influence of climate change on the insect was studied by Badiu et al. (2019) who found that the increase in temperature in the second part of April influences the weevils attack and their density in agricultural crops. Winters deficient in precipitation and with higher average temperature values together with hot and dry springs lead to the shortening of the weevils hibernation, which appears earlier and develops large populations, that consume maize plants, sunflowers, other agricultural crops or weeds (Georgescu et al, 2015). Regarding agronomic factors, crop rotation by avoiding monoculture and the use of systemic insecticides in the seed chemical treatment reduce the weevils attack and spread (Georgescu et al., 2019; 2020). Being a polyphagous insect, the weevils find good feeding conditions in several agricultural crops, but the one that provides them with the best conditions for development is maize crop (Voinescu and Bărbulescu, 1998; Popov et al., 2006). The effectiveness of seed chemical treatment was studied by a number of Romanian researchers (Georgescu et al., 2012; 2014; 2015; 2016; 2019; 2020; Trotuș et al., 2011; 2017; 2019), but according to the 2013 EU directive (NO 485/2013) their use was prohibited. Year after year, Romania obtains derogation for the use of systemic insecticides in the chemical treatment of maize, sunflower and beet seeds.

In the Center of Modova, the harmful entomofauna to maize crops is abundant, but of all the species inventoried, of economic importance due to the damage it cause are the soil pests: *Agriotes* spp. and *T. dilaticollis* Gyll., that affect the crops in the period between seed germination - the plant emergence - the formation of the first 3-5 leaves (Trotuș et al., 2021). The present work presents data regarding the influence of some agronomic factors on the attack produced by *T. dilaticollis* Gyll. to maize crops.

MATERIALS AND METHODS

Research location

The research was carried out within the Agricultural Research and Development Station Secuieni - Neamț located at the geographical coordinates of 26°5' east longitude and 46°5' north latitude. A.R.D.S. Secuieni is located in the Central Plateau of Moldova, located in the eastern part of the country where the altitude drops below 250 m and is replaced by the forest-steppe area. From a practical point of view for agriculture, the relief includes extensive interfluvial plains, meadows and terraces (Trotuș et al., 2020).

The climate temperate continental (D.f.b.) with short springs, cool summers and harsh winters in Koppen (1936) climate classification.

In order to reduce the *T. dillaticollis* Gyll. attack the following experimental factors were studied:

1. Sowing time: Five sowing times were experienced from the beginning of April until mid May. The hybrid used was Turda star.

- Sowing time I - extra-early sowing (beginning of April)
- Sowing time II - early sowing (mid - April)
- Sowing time III - optimal sowing (end of April) for the conditions in the Center of Moldova
- Sowing time IV - semi-late sowing (beginning of May)
- Sowing time V - late sowing (mid - May)

2. Cultivated maize genotype: In this experience, several maize hybrids were sown in the optimal sowing time for the conditions in Central Moldova, at the end of April, and were studied: Vibrion (FAO 290), Inventive (FAO 300), Turda star (FAO 370), Turda 248 (FAO 380), Turda 344 (FAO 380), Turda 332 (FAO 380), Method (FAO 380), Kerala (FAO 400), Olt (FAO 430) and Messir (FAO 500).

The two experiments were laid out in the field according to the randomized block design with three replications. Each variant in each replicate had four rows of plants and all determinations were performed on plants from the two middle rows. The length of one variant was 10 m, and the width 2.8 m. The area of one variant was 28 square meters. Sowing was done manually, at a distance of 22 cm between the grains, ensuring a density of 65,000 b.g./ha. The seeds were treated before sowing with Nuprid 8 l/to (imidacloprid 600 g/l) according to the derogation received from year to year. An early pre-emergence herbicide Adengo 0.3 l/ha and a mechanical harrow were applied to control weeds. No vegetation treatment was applied.

The experiments were located on a typical cambic chernozem soil, with water pH 6.29, humus content 2.3, nitrogen index 2.1, mobile P_2O_5 content 39 ppm, mobile K_2O content 161 ppm.

Attack determination

The attacks determination for sowing time and genotypes was performed on the middle rows from each variant in each replicate.

The attacks determination produced by the pest was done according to the 0-6 scale, where: 0 = no attack; 1 = attack between 1 and 3%; 2 = attack between 4 and 12%; 3 = attack between 13 and 25%; 4 = attack between 26 and 75%; 5 = attack between 76% and 100%. After the marks were awarded, the frequency, intensity and degree of the attack was calculated.

The frequency of attack (F%) is the ratio between the number of attacked plants or organs of the attacked plant (n), related to the number of plants or vegetative organs observed (N).

Attack intensity (I%) represents, in fact, the percentage of attacked plants or organs of the plant destroyed by the pest.

The degree of attack (GA%) is equal to the product of these two indicators.

Statistical analyses

This paper presents the results obtained between 2018 and 2022 and includes the average values of the degree of attack of the recorded attack level. Experimental data from each experiment were calculated in Microsoft Excel. The obtained results were processed with ANOVA (analysis of variance - Fisher test) and limit differences - LSD (where p<5% = */O; p < 1% **/OO; p < 0.1% = ***/ OOO).

Weather conditions

Meteorological data were recorded at the facility's own weather station, which is a VANTAGE PRO 2 type. It is located in the experimental field, and data recording and computer storage is automated. To characterize the years from a climatic point of view, we used the data on the average air temperature (°C) at 2 m height and the amount of precipitation (mm).

RESULTS AND DISCUSSIONS

The climatic conditions during the determination period show that the spring months were atypical. In 2018, the recorded temperatures exceeded the multi-year monthly averages, and the months of April and May recorded summer temperatures and the lack of precipitation raised problems for crop emergence and contributed to the early weevils appearance (Tables 1 and 2).

In 2020, the two months were atypical in terms of average temperatures and precipitation, April being hot (10°C) and very dry (1.2 mm) followed by average temperatures dropping in May (13.9°C), and the precipitation were recorded in normal amounts (69.6 mm). One of the most atypical springs was recorded in April 2021 when the average temperature decreased by -2.1°C, and May recorded average temperatures (14.7°C) close to the multiannual average (15.4°C). On the other hand, from a pluviometric point of view, the months were very dry, the precipitation deficit being between -21.6 mm and -34.2 mm (Tables 1, and 2). In 2022, the thermal regime was normal (9.5°C) in April and normal to warm in May (16.3°C). The precipitation was reduced, the months being dry, these conditions being favorable for the emergence and attack of hibernating adults. From the data published in the specialized literature, we find that the insect is heat-loving, and the lack of precipitation contributes to the attacks increses (Popov et al., 2006), Analyzing the climatic conditions recorded in the Center of Moldova, it is found that it were favorable for the weevils appearance, spread and attack.

Table 1. The average temperatures recorded in April and May between 2018 and 2022, Secuieni - Neamț

Year	April				May			
	T air, °C	T soil, °C	Multiannual average (1962-2021)	Deviation (Characterization)	T air, °C	T soil, °C	Multiannual average (1962-2021)	Deviation (Characterization)
2018	14.3	17.1	9.6	+4.6 (very warm)	17.8	21.6	15.4	+2.4(very warm)
2020	10	12.3		1.4 (warm)	15.3	17.9		-1.5 (cool)
2021	7.5	9.3		-2.1 (very cool)	13.9	16.8		-0.7(normal)
2022	9.5	11.2		0.1 (normal)	14.7	17.2		0.9(normal to warm)

Table 2. Precipitation recorded in April and May between 2018-2022, Secuieni - Neamț

Year	April monthly rainfall ∑ (mm)	Multiannual average (1962-2021)	Deviation (Characterization)	May monthly rainfall ∑ (mm)	Multiannual average (1962-2021)	Deviation (Characterization)
2018	14.8	45.4	-30.6 (very dry)	23.4	65.6	-42.2 (very dry)
2020	1.2		-44.2 (very dry)	69.6		+4 (normal)
2021	23.8		-21.6 (very dry)	31.4		-34.2 (very dry)
2022	38.4		-8.5 (less dry)	20.8		-44.8 (very dry)

The attack produced by weevils on maize sown in different sowing times was monitored in 2018, 2020, 2021 and 2022 under the conditions of Central Moldova, Romania.

Analyzing the determinations from 2018 regarding the insect attack, it is found that high temperatures in spring positively influenced the insect appearance, the attack frequency register

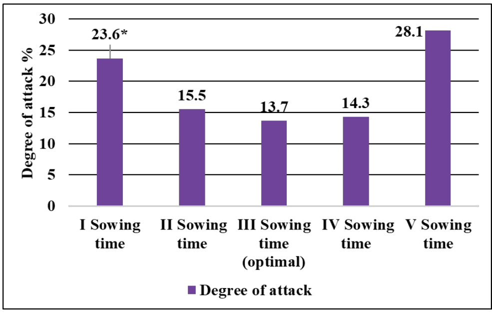
100% in all five sowing times experienced. The lowest degree of attack was recorded at the optimal sowing time (III[rd]), of 13.7%, compared to the rest of the sowing times, where the increase in attack at earlier and later sown maize by 23.6% (I[st] sowing time) and 28.1% (V[th] sowing time) (Figure 1).

In 2020, the insect's activity was positively influenced by the temperatures in April, but the temperatures dropping in May reduced the attacks. The attack frequency recorded in the five tested sowing times was between 0.1% (V[th] sowing time), and 1.3% (III[rd] sowing time) (Figure 1). Although April 2021 was cool, the spring drought and normal temperature conditions in May favored the insect's activity. The highest attacks were recorded in the first two sowing times, where weevils consumed the leaf foliage. The degree of attack was maximum in I[st] and II[nd] sowing times, of 45.3% and 32%, and greatly diminished in sowing times III[rd] and IV[th], of 25% and 11.1% (Figure 1).

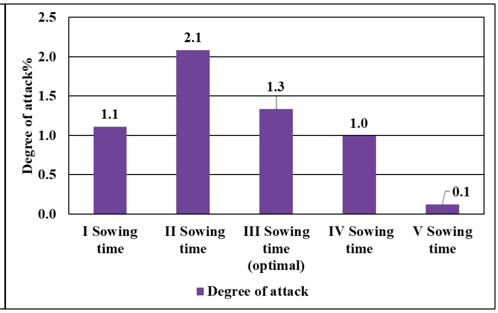
These atypical conditions in the two months of 2021 determined the mass weevils appearance to primarily attack early maize that emerges (Figure 1).

In 2022, rising temperatures and lack of precipitation influenced adult emergence and attack, which were concentrated, as in previous years, on maize sown early in the I and II sowing times compared to maize sown in the optimal time. The late sowing times, IV and V, recorded reduced attacks of hibernating adults, below 2% (Figure 1). Considering that insect is active when ground temperatures exceed 18^{o}C, and average daily temperatures exceed 20^{o}C (Georgescu, 2019), in May 2018 and 2021, the insect had favorable conditions, with temperatures close to 18^{o}C recorded at ground level (Table 1). Observations show that weevils populations focus their attacks on young plants that sprout first in the spring. As other maize crops are emerging, the weevils feed on the new plants. Once maize fields have passed the BBCH 12-14 stage, the crop's vulnerable stage to weevils, attacks focus on late-sowed maize.

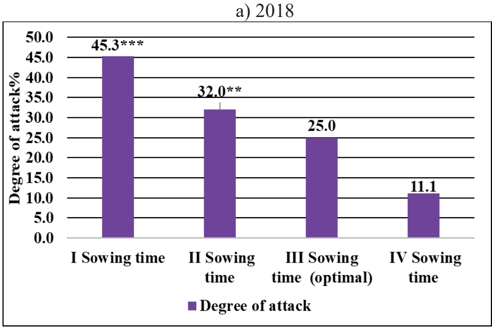
Our results are similar to those published by Georgescu et al. (2019) which show that changing the sowing time does not reduce the insect attack in maize and cannot replace the chemical treatment of the seed with systemic insecticides.



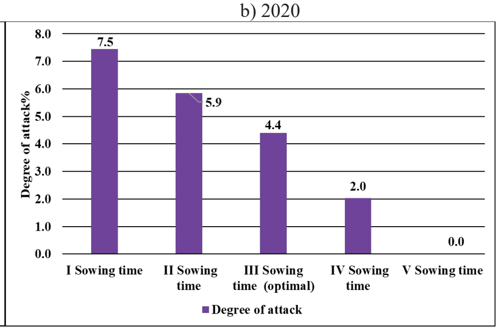
a) 2018



b) 2020



c) 2021



d) 2022

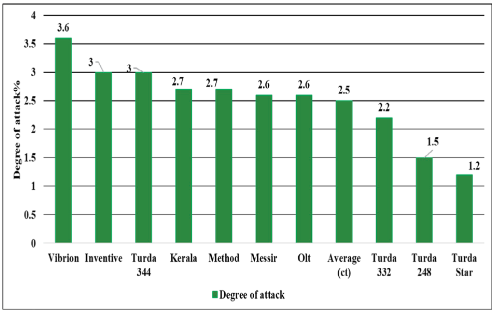
Figure 1. The attack produced by *T. dilaticollis* Gyll. to maize sown in different times (2018-2022)

(Note: LSD where p< 5% = */O; p < 1% **/OO; p < 0.1 % = ***/OOO; 2018: LSD 5%=9.9; LSD 1%=14.0; LSD 0.1%=20.3%; 2020: LSD 5%=1.4; LSD 1%=2.0; LSD 0.1%=2.8; 2021: LSD 5%=13.0; LSD 1%=18.5; LSD 0.1%=26.5; 2022: LSD 5%=2.4; LSD 1%=3.4; LSD 0.1%=5; *T. dilaticollis* Gyll. density: 2018 = 7 specimens/m^2; 2020 = 3 specimens/m^2; 2021 = 5 specimens/m^2; 2022 = 5 specimens/m^2)

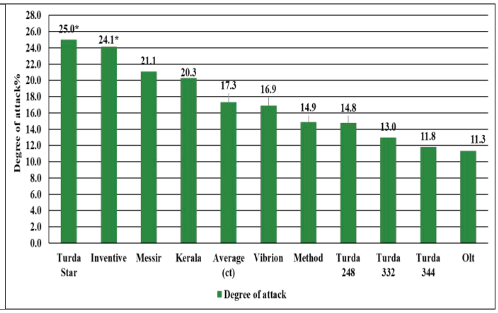
Regarding the weevils attack at some Romanian and foreign maize genotypes, the situation was also influenced by spring weather conditions. In 2020, the attack degree was greatly reduced and ranged from 1.2% (Turda star) to 3.6% (Vibrion). The attack reduction was achieved because the average temperature in May were with -1.5°C lower than the multi-year average (15.4°C) and this conditions were unfavorable for weevils to fed with leaves (Figure 2). The situation was different in 2021, the drought in spring and the high temperatures in the second half of May favored the insects attack. The maize genotypes recorded attacks between 11.3% (Olt) and 25% (Turda star), and the experience average, was of 16.9% (Figure 2).

In 2022, it can be seen that the maximum degree of attack was recorded for the Inventive genotype, of 13.8%, and the lowest, below the experience average (6.0), for Turda 248, of 1.9% (Figure 2).

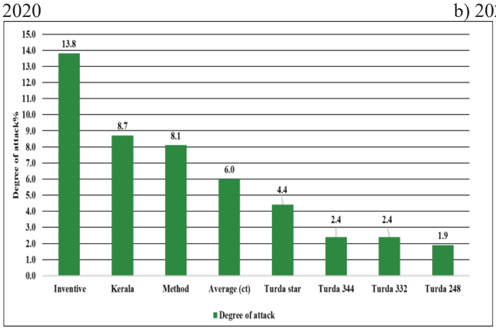
The tested genotypes had the same chemical seed treatment and emerged concomitantly with other maize crops, the adults having other host plants available for feeding, but it is noted that the hybrids Turda 248, Turda 344, Turda Star, Turda 332 and Olt, have registered attack degree values below the experience average.



a) 2020



b) 2021



c) 2022

Figure 2. The attack produced by *T. dilaticollis* Gyll. in some Romanian and foreign maize genotypes (2020-2021)
(Note: LSD where p< 5% = */O; p < 1% **/OO; p < 0.1 % = ***/OOO; 2020: LSD 5%=2.2; LSD 1%=3.2; LSD 0.1%=4.6; 2021: LSD 5%=6.5; LSD 1%=9.2; LSD 0.1%=13.4; 2022: LSD 5%=5.6; LSD 1%=8.0; LSD 0.1%=11.6)

CONCLUSIONS

Climatic conditions in April and May influence the *T. dilaticollis* Gyll. appearance, spread and attack on agricultural crops in Central Moldova. The most favorable conditions for the insect attack were recorded in April and May 2018, 2021 and 2022 respectively.

The highest degree of attack was recorded on early-emerging maize plants because the hibernating adults concentrated the attack here, compare to the optimal sowing time and the lowest degree of attack values were recorded on late-sown maize.

The genotypes Turda 248, Turda 332, Turda 344, Turda star and olt recorded attack values below the experience average.

It is necessary to continue research regarding *T dilaticollis* Gyll. to identify alternative solutions in order to prevent attacks and control the populations whose densities raise problems year after year in the maize crops in the east of the country.

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