INFLUENCE OF THE SOWING DATA CONCERNING MAIZE LEAF WEEVIL (*TANYMECUS DILATICOLLIS* GYLL) ATTACK IN ATYPICALLY CLIMATIC CONDITIONS FROM SPRING PERIOD, IN SOUTH-EAST OF ROMANIA

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Abstract

Maize leaf weevil (*Tanymecus dilaticollis* Gyll) is main pest of the maize crop in south and south-east of the Romania. Every year, more then one million of hectares sowed with maize are attacked by this pest. Climatic conditions registered in April and May, between 2016 and 2018, at NARDI Fundulea, was atypically for this pest attack. In years 2017 and 2018, rainfalls amount was over multiyear averages, both in April and May, while average air temperature was lower then multiyear average, in May (years 2016 and 2017) and April, year 2017. Registered rainfalls amount in April and May, in year 2018 were lower while average air temperatures were higher then multiyear average. At NARDI Fundulea, it has studied maize sowing data influence, in period 2016-2018, concerning maize leaf weevil attack at maize plants in first vegetation stages (BBCH 10-BBCH 14). In the climatic conditions of the year 2016, the attack of the *T. dilaticollis* weevils was higher at untreated maize plants sowed on 27 April (I=6,01) comparative with untreated maize plants sowed on 19 May (I=5,85), but statistical differences weren't significant ($p<0.05$). In the climatic conditions of the year 2017, the attack of the *T. dilaticollis* weevils was higher at untreated maize plants sowed on 19 May (I=5,68) comparative with untreated maize plants sowed on 27 April (I=5,30), but statistical differences weren't significant ($p<0.05$). In the climatic conditions of the year 2018, the attack of the *T. dilaticollis* weevils was higher at untreated maize plants sowed on 25 April (I=4,61) comparative with untreated maize plants sowed on 17 May (I=4,16), in this case statistical difference was significant ($p<0.05$). In case of variants with treated seeds with imidacloprid active ingredient, it hasn't registered significant statistical differences concerning attack intensity between plots sowed in April and plots sowed in May. In all studied years, differences between untreated variants and variants with seed treated with imidacloprid active ingredient, was significant from statistically point of view ($p<0.05$), regardless sowing data.

Key words: maize, sowing data, weevil, attack

According MADR data (2019) in the last years, maize are cultivated on approximate 2.5 million hectares in Romania, being the one of the most important crop for this country. Maize leaf weevil (*Tanymecus dilaticollis* Gyll) is main pest of the maize crops in south and south east of Romania (Paulian F. *et al*, 1969; Barbulescu A. *et al*, 1997; Barbulescu A., 2001; Cristea M. *et al*, 2004; Popov C. *et al*, 2007a). Each year, there were attacked approximate one million hectares cultivated with maize (Popov C. and Barbulescu A., 2007). According Paulian F. (1972) the attack is very dangerous when maize plants are in first vegetation stages, from plants emergence (BBCH 10) until four leaf stage (BBCH 14). Same author mentioned that after four leaf stage (BBCH 14), the weevils feeding only with leaf margins and the attack are not economically important. In case of high pest pressure and lack of the treatments, maize seedlings can be destroyed and farmers must sow again (Popov C. *et al*, 2007b).

Favorable area of *T. dilaticollis* is located in south and south-east of the Romania (Paulian F., 1972; Cristea M. *et al*, 2004; Popov C. *et al*, 2002). In these areas it has registered highest damages at maize crop, produced by this pest. Popov C. *et al*, (2006) mentioned that maize leaf weevil is a thermo and xerophilous insect, spread especially in arid and semi-arid areas, from south and south-east of the Romania. Same author mentioned that the weevils are very active at high air temperatures and low humidity while the low air temperatures and high rainfall amount interfere very much with their activity. Recent studies make in evidence important attack of the *T. 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 maize leaf weevil occurrence in northern areas from Romania is because of the climatic changes. Many pests can be favored by climatic changes such as increasing of the air temperature in northern latitudes

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(Cuculeanu V. *et al*, 1999; Čamprag D., 2011; Daniel P. B. *et al*, 2013). Long term studies on precipitation evolution show a decreasing trend, especially in spring period (Bozo L., 2011). Same author mentioned that, sometime, increasing precipitations is visible as a shorter term tendency.

In last 50 years, in Romania it has made many researches concerning control methods of the maize leaf weevil (Popov C. *and* Barbulescu A., 2007). It has researched both, cultural practices and chemical control methods. Paulian F. (1972) studied both, crop rotation and sowing data influence concerning attack of the *T. dillaticollis* at maize plants. According this author, highest attack of maize leaf weevil occurred in case of maize sowed in last 20 days of the April while lower attack occurred in case of maize sowed after the middle of the May. Recent studies make by Voinescu I. *and* Barbulescu A. (1998) arrives at same conclusions. Also, these authors concluded that traditional practice of cropping maize after maize, for several consecutive years greatly contributes to the reproduction of this insect and thus, to an increase in its population. In last 25 years, in Romania the number of the main crops decreasing. As result it has increasing the area with crops sowed in monoculture, including maize (Lup A. *et al*, 2013). Because of increasing of the maize area and climate change, in many cases, especially in the south and south east of Romania, farmers practice early sowing of the maize crops (Ion V. *et al*, 2013; Pravalie R. *et al*, 2017). Main conclusion on researches concerning both, crop rotation and maize sowing data is that cultural methods are not effective in control of maize leaf weevil populations (Popov C. *and* Barbulescu A., 2007). Until now, chemical seed treatment with systemic insecticides was the most effective method to protect maize plants, in first vegetation stages, against *T. dilaticollis* weevils attack (Kakso A., 1974; Voinescu I., 1985: Barbulescu A. *et al*, 2001; Vasilescu S. *et al*, 2005; Krusteva H. *et al*, 2006; Popov C. *et al*, 2007 a,b; Keszthelyi S. *et al*, 2008; Trotus E. *et al*, 2011; Georgescu E. *et al*, 2014). As result of European Commission Regulations 218/783, 218/784 and 218/785, the use of imidacloprid, clothianidin and thiamethoxam active ingredients for all field crops, both like seed treatment and foliar application will be total banned in UE, from 2019. After these relegations in Romania, won't remain available any active ingredients for controlling of this pest. Lack of seed treatment alternatives of the spring crops can have negative impact in Romanian agriculture in next years (Ionel I.I., 2014). In last years several studies were made for finding alternatives at seed treatment (Georgescu E. *et al*, 2014, 2016). Main conclusions of these researches is that the alternatives at maize seed treatment with systemic insecticides are not available for control of this pest when maize plants are in first vegetation stages. Georgescu E. *et al* (2015) mentioned that atypically climatic conditions from April and May, registered in last years in Romania, favored weevils activity and, in same time, can stress maize emergence or maize plants development. The aim of this present study is to determine if the sowing data can have influence of *T. dilaticollis* weevils at maize plants in first vegetation stages (BBCH 10-BBCH 14), in atypically climatic conditions from spring period.

MATERIAL AND METHOD

The experience were carried out at Plants and Environment Protection Collective from National Agricultural Research and Development Institute (NARDI) Fundulea, Calarasi County (latitude: 44,46; longitude: 26,32; alt.: 68 m), Romania, between 2016 and 2018.

In this study it has tested two sowing periods, one at the end of April and second period after middle of May. In 2016 and 2017, maize plots were sowed in 27 April and 19 May while in 2018 maize plots were sowed in 25 April and 17 May. At each data it was sowed two variants: untreated and seeds treated with imidacloprid active ingredient. In this way it was compared both, untreated and treated variants in case of different sowing data.

Each variant has four replications. Experimental plots were arranged according randomized blocks scheme. Plot length has 10 m and plot with has 4.2 m, as result plot area has 42 m². For this study it has used maize Olt hybrid (FAO 420).

Weevils (*T. dilaticollis*) **attack intensity** was evaluated when the maize plants arrive in four leaf stage (BBCH 14), according 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 four leafs edge; **note 4**-plants with leafs chafed in proportion of 25 %; **note 5**-plants with leafs chafed in proportion of 50 %; **note 6**-plants with leafs chafed in proportion of 75 %; **note 7**-plants with leafs chafed almost at the level of the stem; **note 8**-plants with leafs completely chafed and beginning of the stem destroyed; **note 9**-plants destroyed, with stem chafed close to soil level. At each plot it has evaluated 20 maize plants, from four central rows (5 plant/row). Before assessment, plants were marked with sticks, in „stair" system (*fig*ure 1).

After 30 days from the plant emergence it has evaluated **saved plant percent** by counting all the plants from a plot and comparing them with the sowing seeds number/plot.

Plants height was assessed at same plants that, previously it has made observations concerning attack intensity, at 50 days from maize emergence.

Meteorological data was provided by automate Pessl meteorological stations at NARDI Fundulea placed at 100 m from experimental field. Between 2016 and 2018 it has monitoring air temperature and rainfalls occurred in spring period.

Data from the field assessments was **statistically analyzed** using **Student-Newman-Keuls test** (Student, 1927; Neuman D., 1939; Keuls M., 1952).

Table 1

Temperatures registered at NARDI Fundulea, during April-May 2016-2018

Year	**Temperature (°C)**				**Deviation from average temperature registered in April (°C)**	**Deviation from average temperature registered in May (°C)**
	April		**May**			
	Curent year	Multiyear average	Curent year	Multiyear average		
2016	14.0	**11.1**	16.1	**16.9**	**+2.9**	**-0.8**
2017	10.6		16.8		**-0.5**	**-0.1**
2018	15.8		19.4		**+4.7**	**+2.5**

Table 2

Rainfalls registered at NARDI Fundulea, during April-May 2016-2018

Year	**Rainfalls (mm)**				**Deviation from average temperature registered in April (mm)**	**Deviation from average temperature registered in May (mm)**
	April		**May**			
	Curent year	Multiyear average	Curent year	Multiyear average		
2016	73.7	**59.0**	81.2	**72.3**	+14,7	+8.9
2017	73.4		81.8		+14,4	+9.5
2018	3.8		50.6		**-55.2**	**-21.7**

Table 3

Attack intensity of *T. dilaticollis* at maize plants, in field conditions, at NARDI Fundulea

Nr. crt.	**Variant**	**Sowing month**	**Attack intensity (1-9)**					
			2016		**2017**		**2018**	
1	control (untreated)	April	6.01	a	5.30	a	4.61	a
2	imidacloprid (seed treatment)	May	3.73	b	3.61	b	3.45	c
3	control (untreated)	April	5.85	a	5.68	a	4.16	b
4	imidacloprid (seed treatment)	May	3.70	b	3.63	b	3.61	c
LSD P=0.05			0.404		0.554		0.376	
Standard deviation (SD)			0.253		0.346		0.235	
Variation coefficient (C.V.)			5.240		7.600		5.940	

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

Table 4

Influence of the sowing data concerning attack of *T. dilaticollis*, in field contitions, at NARDI Fundulea

Nr. crt.	**Variant**	**Sowing month**	**Saved plant percent (%)**					
			2016		**2017**		**2018**	
1	control (untreated)	April	66.34	b	82.23	b	89.94	a
2	imidacloprid (seed treatment)	May	80.99	a	87.28	a	90.66	a
3	control (untreated)	April	68.06	b	80.28	b	92.39	a
4	imidacloprid (seed treatment)	May	80.28	a	86.25	a	92.86	a
LSD P=0.05			12.496		3.492		2.900	
Standard deviation (SD)			7.813		2.183		1.813	
Variation coefficient (C.V.)			10.570		2.600		1.980	

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

RESULTS AND DISCUSSIONS

Data from *tables 1* and *2* show that climatic conditions registered in last two months from spring, at NARDI Fundulea, were atypically. In 2016, average air temperature from April was higher then multiyear average and lower then multiyear average from May. In 2017, average air temperature was bellow multiyear average, both in April and May, while in 2018, average air temperature registered in April and May was higher then multiyear averages, with high positive deviation (+4.7 °C in April and +2.7 °C in May). In same time, rainfalls amount registered at NARDI Fundulea was higher then multiyear average, both in April and May, in 2016 and 2017. However, in 2018, climatic conditions from this period were different. In April it has registered only 3.8 mm of rains comparative with multiyear average (59.0 mm) while in May, total rainfalls amount was below multiyear average. From climatic point of view, in this study, in 2018 it has registered the most favorable conditions for maize leaf weevil attack (high temperatures and drought).

Figure 1 **Plants marked in „stair" system**

Data from *table* 3 demonstrate that, in 2016 and 2017, there weren't statistical differences between attack intensity of maize leaf weevil (*T. dilaticollis*) at maize untreated plants, sowed in 27 April and 19 May ($p<0.05$). Similar situation it has registered in case of variants with seeds treated with imidacloprid active ingredient. These results registered in first two years from this study were different with those reported by Paulian F. (1972). According this author, weevils attack was lower at plants sowed after middle of the May. The data from 2018 were in contradictions with data from literature (Popov C. *et al*, 2006). Possible explications for lower weevils attack, at untreated plants, even if the climatic conditions for these insects were very favorable, are because of daily distributions of the rainfalls amount from this period. The most of the rainfalls occurred in April and May, was registered from 13 to 19 May, when maize plants, sowed in April were in first vegetation stages (BBCH 10-14). As result, in this short period, weather conditions weren't favorable for maize leaf weevils and the attack of this insects at maize plants, in experimental field of the NARDI Fundulea were lower comparative with 2016 and 2017, even if the overall climatic conditions from April and May (2018) were very favorable for *T. dilaticollis* weevils. In 2018, there were significant statistical differences between weevils attack registered at maize untreated plants sowed in 25 April and attack registered at maize untreated plants sowed in 17 May ($p<0.05$).

In all studied years, on a scale from 1 to 9, the attack of weevils at maize plants from variants treated with imidacloprid active ingredient, ranged from 3.45 to 3.73 (*table* 3). Attack was low and plants recover after the attack. In all years taken in this study, at experimental field from NARDI Fundulea, there weren't statistical differences between attack at treated variants sowed in last days of April or after middle of the May ($p<0.05$). In same time, there were significant statistical differences between attack registered at treated plots and attack registered at untreated plots. The results concerning seed treatment with imidacloprid active ingredient from this study were in accordance with those obtained by Vasilescu S. *et al* (2005), Keszthelyi S. *et al* (2008), Trotus E. *et al* (2011), Georgescu E. *et al* (2014, 2016).

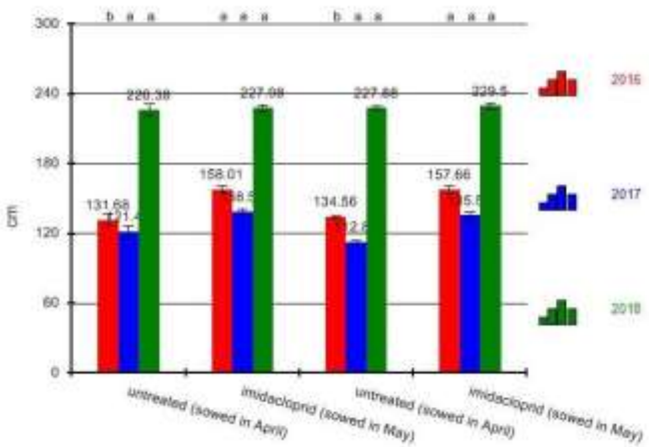

Figure 2 **Plants height at 50 days from emergence**

In the climatic conditions of the year 2016, saved plants percent was below 70 % at untreated plots, both sowed on 27 April and 19 May (*table 4*). At treated variants, saved plants percent was slightly higher then 80 %. In the climatic conditions of the year 2017, saved plants percent presented higher values comparative with 2016, both at treated and untreated plots, wile in 2018 the differences between treated and untreated variants, sowed both, in April and May were lower. According Student-Newman-Keuls test, there weren’t statistical differences between saved plants percent registered at plots sowed at the end of the April and after middle of the May, both in 2016 and 2017 ($p<.05$). Similar situation was registered in case of treated plots. Sowing data didn’t influence this parameter. However, in first two years from this study, it has registered higher statistical differences between untreated plots and treated plots, concerning saved plants percent ($p<0.05$). In the climatic conditions of the year 2018, at experimental field from NARDI Fundulea, there weren’t registered significant statistical differences concerning saved plants percent, both at treated and untreated variants, sowed at the end of April or after the middle of May (*table* 4).

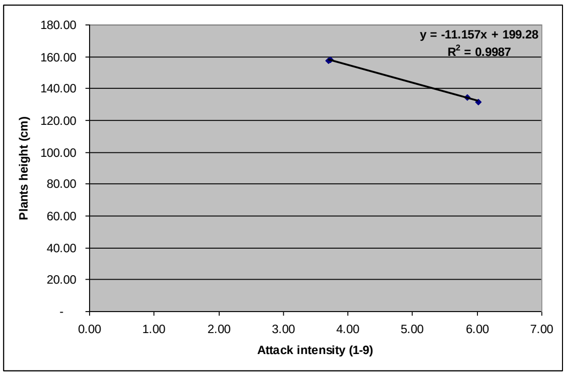

Figure 3. **Relation between attack intensity of *T. dilaticollis* and maize plants height at 50 days from emergence, in 2016, at NARDI Fundulea**

Concerning plant height, assessed at 50 days from the plants emergence, it has ascertained that in climatic conditions of the year 2018 it has registered highest value of this parameter (*fig*. 2). Possible explication for this situation is because of lower weevils attack registered in spring period of this year and high rainfalls amounts registered in June and first 15 days of the July. In the climatic conditions of the year 2017, at experimental field from NARDI Fundulea there weren’t statistical differences between this parameter at both maize untreated and treated plots, sowed at the end of April and after the middle of the May. Only in 2016 it has registered higher statistical differences between treated and untreated plots concerning plant height, at 50 days from plants emergence. In same time there weren’t registered statistical differences between plants height at untreated plots, sowed on 27 April and 19 May. Similar situation was ascertained in case of variants treated with imidacloprid active ingredient. In the climatic conditions of the year 2016 it was a negative relation between attack intensity attack of *T. dilaticollis* weevils at maize plants, in first vegetation stages and plants height at 50 days from emergence (*fig*ure *3*). Results from this study demonstrate that in case of atypically climatic conditions from spring period, sowing data has less relevance concerning maize leaf weevil attack at maize plants, in first vegetation stages, comparative with data from the Romanian literature (Paulian F., 1972). As result, changing of the sowing data of the maize plants, in south east of the Romania, couldn’t be an alternative for chemical control of *T. dilaticollis* and couldn’t replace seeds treatment. In case of variable climatic conditions from period when maize plants are in first vegetation stages (BBCH 10-BBCH 14) seed treatment with imidacloprid active ingredient provide satisfactory and constant protection against maize leaf weevil attack. At this conclusion arrive Popov C. *et al* (2006) and Georgescu E. *et al* (2015). However, further studies are necessary, in many locations from different regions of this country, to solve these aspects.

CONCLUSIONS

Between 2016 and 2018, climatic conditions from spring period registered in south-east of the Romania were atypically.

In 2016 and 2017 there weren’t registered significant statistical differences between weevils attack at untreated plots sowed at the end of the April or after middle of the May. Similar situation was registered in case of variants treated with imidacloprid active ingredient.

Even if the climatic conditions from spring of 2018 were favorable for *T. dilaticollis*, however attack of weevils at maize untreated plants were lower comparative with previous two years.

Changing of the sowing data of the maize plants, in favorable area of this pest, in Romania, couldn’t be an alternative for chemical control of *T. dilaticollis* and couldn’t replace seeds treatment.

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