ASSESSMENT OF POPULATION DENSITY OF INSECT SPECIES CALLED "SPECIES PROBLEM", IN LOTS WITH DIFFERENT MAIZE HYBRIDS

[1]Ioana GROZEA, H. HORGOS[1], Ramona STEF[1], A. CARABET[1], Ana Maria VIRTEIU[1], Monica BUTNARIU[1], L. MOLNAR[1]

[1]Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" Timisoara, Romania
Corresponding author: ioana_entomol@yahoo.com

Abstract. *Maize has been and continues to occupy a major place, being one of the most cultivated plants in Europe. Romania and, in particular, the western part of the country provides a great deal of corn production. As such, special care should be taken to protect these plants against harmful organisms and especially insects. There are currently some species that affect corn crops, and these include Diabrotica virgifera virgifera Le Conte (western corn rootworm), Ostrinia nubilalis (European corn borer) and Helicoverpa armigera (corn earworm). All three species have one particularity. So, Diabrotica is an invasive species that has a great ability to move and few natural enemies. Ostrinia is hard to fight, and there is no clear strategy at the moment. Helicoverpa is known to be highly resistant to insecticides, as well as the previous species. Taking into account all this, in the present paper we have proposed to evaluate the current state of population density of the above-mentioned insects from 10 different maize hybrids. The corn hybrids tested were selected according to the maturity group and their availability on the market. These were included in different maturity groups, such as semi-early, early and semi-early. The FAO classification included groups 300 and 400. The test site was Nerau in Timis County (western Romania) and the period covered 2 years, 2015 and 2016, respectively. Assessment of the population level of each species has been done specifically, depending on the size of the insect and the possibility of better catching them. Thus, colorful panel traps for the species Coleoptera and box-type traps for butterfly species were used. Traps were placed 3 in each batch following the manufacturer's instructions. In all the experimental lots the three harmful species were present in great dimension but the population level did not differ much from hybrid to hybrid.*

Keywords*: Diabrotica virgifera, Ostrinia nubilalis, Helicoverpa armigera, corn.*

INTRODUCTION

Invasive species are the most dangerous organisms, once they enter a new site, they can have undesirable effects on crops and the negative effects can be felt for a long time. Of the invasive species recently introduced in Romania and affecting the corn culture, we can mention *Diabrotica virgifera virgifera* Le Conte (Coleoptera: Chrysomelidae) known as western corn rootworm (WCR) (GROZEA, 2003; VIDAL ET AL, 2005; VONICA, 1998). This causes double damage, attacking both larval and adult stages. The species did not cover the whole country, but the western area is a big problem. To date, most studies have been conducted in this area (west and some in the Center of the country) (FLORIAN, 2010) explicable, considering the fact that the insect expands to the east of the country. The extension of Diabrotica continues and it is expected to cover maize crops from all the world (KRITICOS, 2012).About resistance of maize to this pest there are some results, but unfortunately in US (TOLLEFSON, 2007).

Very recent studies were conducted to identify suitable areas for the occurrence of other Diabrotica species and that is possible to be occurrence in nearly future (MARCHIORO AND KRECHEMER, 2018).

Another species affecting corn is *Ostrinia nubilalis* (Hübner) or European corn borer (ECB). For a long time, the insect larva has been considered as the most dangerous harmful due to the lack of resistance or resistance to products, making it only beneficial to the use of Bt hybrids. New solutions have been adopted by American researchers who have demonstrated that there are other non-aggressive solutions to the larval population reduction by using traps (BOHN ET AL, 1999; BOHNENBLUST ET AL, 2014).

Corn earborn or CEB (*Helicoverpa armigera*) are beginning to become a growing problem for European maize producers and implicitly for Romania. The damage caused by it has reached the threshold of

economic losses, especially for sweet corn (KESZTHELYI ET AL, 2011; ROBINSON, 2010). It is considered to be one of the most dangerous harmful corn species, as well as an increased polyphagism.

MATERIAL AND METHODS

Research has been carried out in field conditions in a corn culture in the western part of Romania, which is one of the largest corn growing areas. These took place during the years 2015 and 2016 (Figure 1).

The hybrids that were the basis of these assessments are part of FAO 300 and 400. The hybrids that were the basis of these assessments are part of FAO 300 and 400 (Table 1). They were selected in view of their maturity characteristics, but also their availability on the market or even the positive advertisement from the producers.

Fig. 1. The experimental field at Nerau (Timis County) and traps used to collect adults of *Ostrinia nubilalis* and *Helicoverpa armigera* (left) and color traps for catching adults of *Diabrotica virgifera virgifera* (right)

Of course, the basic element in selectivity was their diversity. So, the hybrids used were framed in follow categories: semi-early (PR37NO1, SY BATANGA, SY ALADIUM, NK COBALT), early: (NK LUCIUS, P9241) and semi-late (KREON, SY SENKO, SY DARTONA, SY ULISES).

In order to evaluate the level of the three pest's populations, 1 or 3 traps were installed in each different hybrid parcel (the ones mentioned above) (Figure 1). These were chosen according to the recommendations of the trapping companies (Csalomon, Budapest), but also depending on the size of the insect and the possibility of capturing them better (TOSHOVA ET AL, 2017). Thus, for Diabrotica, colored traps were used, and for Ostrinia and Helicoverpa, special "box-type" traps for butterfly capture. The colored traps were placed in number of 3, on diagonally and those one type boxes in each plot/hybrid.

Readings were made every 14 days (twice a month), between May and September, of corn vegetation. Only adult stages that were evaluated by direct observations in culture were addressed.

Table 1

Details of maize hybrids subject to observations on pest population assessment (Timiş County)

No	Name of hybrid	Type of hybrid	FAO group	The producing company
1	PR37NO1	semi-early	370	DuPont Pioneer
2	NK LUCIUS	early	330	Syngenta
3	SY ULISES	semi-late	360	Syngenta
4	KREON	semi-late	460	Syngenta
5	SY BATANGA	semi-early	320	Syngenta
6	SY ALADIUM	semi-early	320	Syngenta
7	P9241	early	330	DuPont Pioneer
8	NK COBALT	semi-early	340	Syngenta
9	SY SENKO	semi-late	490	Syngenta
10	SY DARTONA	semi-late	400	Syngenta

Details were analyzed at the Laboratory for Diagnosis and Phytosanitary Expertise (within BUASVM "King Michael I of Romania" Timisoara).

RESULTS AND DISCUSSION

Following observations, it was found that all three target species (*Diabrotica virgifera virgifera*, *Ostrinia nubilalis* and *Helicoverpa armigera*) were present throughout the analyzed period.

By far, WCR adults were predominant. So, for 2015 (Table 2) in the corn hybrid males, averaging of WCR was about 100.70 catches per colored traps. At a distance, there are ECB adults who had average values of 23.10 individuals trapped in trap boxes and, of course, CEB adults who showed an average of 14.20 individuals.

In terms of hybrids and their attractiveness for pests, one can notice that the ULISES hybrid from the semi-latex category attracted most adult WCR insects (177 ind.). The fewest WCR adults were observed in the hybrid SY ALADIUM (with an average of values over the observation period / 2015 of 14.0 ind.) (Table 2).

Table 2

The adult population level of main pests (total number) collected in traps in different maize hybrids (April to September 2015), Nerau, Timis County

No	Name of hybrid	Type of hybrid	2015		
			Diabrotica v.v.	*Ostrinia nubilalis*	*Helicoverpa armifgera*
1	PR37NO1	semi-early	77	36	33
2	NK LUCIUS	early	72	21	19
3	SY ULISES	semi-late	177	12	8
4	KREON	semi-late	143	18	12
5	SY BATANGA	semi-early	56	19	12
6	SY ALADIUM	semi-early	49	19	14
7	P9241	early	68	31	12
8	NK COBALT	semi-early	61	49	15
9	SY SENKO	semi-late	135	11	7
10	SY DARTONA	semi-late	169	15	10
		X	*100.70*	*23.10*	*14.20*
		s	*49.61*	*12.01*	*7.45*
		Sx	*15.69*	*3.80*	*2.36*
		CV	*49.27*	*52.01*	*52.47*
		Sx%	*15.58*	*16.45*	*16.59*

*only adult stage

Similarly, it was recorded in 2016, when western corn rootworms also predominated in the experimental lot (76.50 adults) (Table 3). Lepidopteran insects (trapped in special traps) were present in values less than WCR, such as 32.40 and 15.50 ind.

Table 3

The adult population level of main pests (total number) collected in traps in different maize hybrids (April to September 2016), Nerau, Timis County

No	Name of hybrid	Type of hybrid	2016		
			*Diabrotica v.v.**	*Ostrinia nubilalis**	*Helicoverpa armifgera**
1	PR37NO1	semi-early	55	48	28
2	NK LUCIUS	early	54	35	20
3	SY ULISES	semi-late	124	18	10
4	KREON	semi-late	119	19	10
5	SY BATANGA	semi-early	39	16	13
6	SY ALADIUM	semi-early	31	29	5
7	P9241	early	48	47	7
8	NK COBALT	semi-early	70	48	23
9	SY SENKO	semi-late	100	23	16
10	SY DARTONA	semi-late	125	41	23
	X		*76.50*	*32.40*	*15.50*
	s		*36.92*	*13.07*	*7.74*
	Sx		*11.67*	*4.13*	*2.45*
	CV		*48.26*	*40.33*	*49.90*
	Sx%		*15.26*	*12.75*	*15.78*

*only adult stage

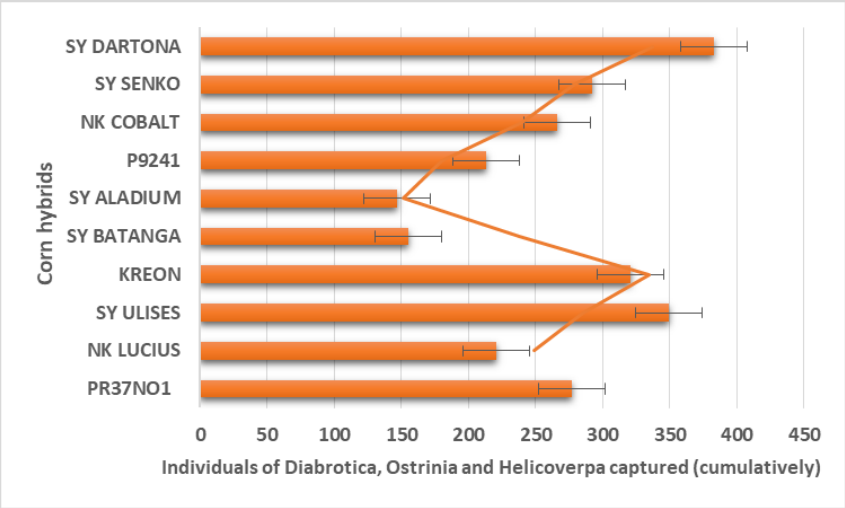

Fig. 2. Graphic highlighting the most affected maize hybrids by cumulated the 3 harmful species (*Diabrotica virgifera virgifera*, *Ostrinia nubilalis* and *Helicoverpa armigera)* collected during 2015-2016

By analyzing comparatively the attraction capacity or, more precisely, the attractiveness of harmful insects to a certain type or categories of corn (and here maturity is the main characteristic) it can be seen from the Graph/Figure 2 that the cumulated values in the two years of study have differentiated hybrids between them. Thus, a hierarchy of them would look like this: SY DARTONA (383 ind.), followed at a short distance by

SY ULISES (349 ind.), KREON (321 ind.), SY SENKO (292 ind.), then NK COBALT (266 ind.), NK LUCIUS (221 ind.), P9241 (213 ind.), SY BATANGA (155 ind.) and SY ALADIUM (with value of 147 ind.).

Probably, other hybrid characteristics, related to silk color, preferred substrate texture, plant height, and emanated essence have helped attract insects to a greater or lesser extent.

An overview of the 10 hybrids shows that those with early maturity (early, semi-early) have attracted less insects of the genus Diabrotica than those late (semi-late) have attracted fewer. We are talking about insects of the order Coleoptera, which have the ability to moving both on the substrate (soil, plants) and in the flight, but which are attracted by the source of food primarily (silk, pollen, leaves) and lastly by the color of the trap. Perhaps that is why there is this difference in values between the three insect species analyzed.

With regard to the other species, the flyers (of the genus Ostrinia and Helicoverpa) involved cannot establish attractiveness in terms of plant characteristics as the food source as mentioned earlier in Diabrotica, but in fact the need to lay eggs.

CONCLUSIONS

As a result of the observed data and analyzes of the data obtained, it can be concluded that all maize hybrids tested were visited by the target insects. The most numerous were Coleopteran insects and Lepidopteran ones. It is certain that their population level is above or close to the damage threshold and deserves all the attention in the future given the destructive capacity, both separately and through association. And, as a rule, these three species are present and associated in a maize culture.

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