

THE HYBRID INFLUENCE ON THE *OSTRINIA NUBILALIS* HBN. LARVAE ATTACK LEVEL UNDER THE CONDITION OF CENTRAL OF MOLDOVA

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Abstract

From the first report of the species *Ostrinia nubilalis* Hbn. in Romania in 1898, the insect spread and is currently present in all corn crops in our country. The production losses that the insect produces vary from one year to another, from one field to another, one of the factors influencing the reduction of the attack is the cultivated maize hybrid. This paper presents the preliminary results obtained in 2019, where was studied the influence of the precocity group and the hybrid variety on the attack level produced by the european corn borers larvae in the conditions of the Center of Moldova. The studied maize hybrids show different values of the attack produced by the *Ostrinia nubilalis* Hbn. larvae. Depending on the maturity group, the genotypes that recorded high attack values are those from FAO groups 400 - 430 (Kerala and Olt), followed by semi-early hybrids in FAO groups 370-380, and the lowest attack was recorded by the hybrid Vibrion maize classified as FAO maturity group 290. Of the three maize varieties tested, the sweet hybrid was the most affected by the european corn borer larvae attack followed by the dentate ones from the semi-early maturity groups and the flint variety (Vibrion) was not affected due to the short period of vegetation.

Key words: hybrid, maturity group, attack, larvae, european corn borer

The important role that corn plays in the economy of a country, has determined the improvement of the production potential of genotypes and cultivation technologies. The biology of the plant, together with the diversity of possibilities to capitalize on its products, determined the researchers to initiate improvement works on corn, which led to the appearance in production of the first autothoni corn hybrids, from their own inbred lines (Murariu *et al.*, 2012).

Maize grains are an important source of raw materials in many sectors of industry. The uses of corn depend on its destination: in animal feed such as concentrated feed, silage or green meal, in the food industry, by processing by dry grinding (flour, semolina) or wet (starch, protein, fiber and germ). Snacks, breakfast cereals, syrups and alcohol are obtained from starch and ground products. From an energy point of view, corn tends to become one of the most important energy plants for the temperate zone, as a recent use of starch is related to the extraction of bioethanol (Roman *et al.*, 2011).

From the first report of the species *Ostrinia nubilalis* Hbn. in Romania in 1898, the insect spread and is currently present in all corn crops in our country. The production losses that the insect

produces vary from one year to another, from one soil to another, one of the factors influencing the reduction of the attack is the cultivated corn hybrid. Following the research conducted by Săpunaru and Hatman (1975) in Moldova, the production losses caused by the attack of *Ostrinia nubilalis* Hbn larvae they varied between 1400 - 2360 kg/ha. The most recent data published by Popov and Roșca (2007) suggest that the production losses that occurred due to the pest were 7.5%.

The research conducted by Trotuș *et al* (2018) highlights the fact that for the conditions in Central Moldova, the species *Ostrinia nubilalis* Hbn. it is abundant, registering a coefficient of variability of 20.01%.

The vegetation period of maize, which is expressed by the classification of the hybrid in the FAO maturity group, is an important factor in determining the range of hybrids suitable for cultivation in each favorable area of the country.

The link between grain production and the vegetation period of each genotype is very close, a wide range of maize hybrids from different maturity groups, ensure staggered production, especially in recent years, when in the summer

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months and especially in autumn, a prolonged drought sets in in Romanian conditions (Cristea et al., 2004). Thus, early hybrids will contain higher amounts of protein than late ones, but the starch will be lower than those with a longer vegetation period.

Resistance or tolerance to larval attack by the borer occurs in genotypes containing DIMBOA amino acids, found in late hybrids.

The chemical composition of the corn kernel depends on the variety of the hybrid or genotype: the indurate will contain a higher percentage of protein, and the indentate will be richer in starch. The choice of corn hybrids must be made taking into account the destination of the crop: food industry, animal feed, green energy (Mogârzan, 2012).

Under Ukrainian conditions, Pereverzev (2005) studied 28 maize genotypes in Spain and 23 in Portugal to determine their tolerance to borer attack. The tolerance of the studied genotypes varied because the genetic material of corn was diverse both in terms of precocity, hybrids from very early to late, but also in terms of variety, with flint and dent grain. He identified semi-late and late hybrids with a better tolerance to borer attack, but also semi-early maize populations with dent grain that showed higher grain yields and reduced attack.

This paper presents the preliminary results obtained in the agricultural year 2018/2019, from an experiment where the influence of the precocity group and the variety of the hybrid on the level of attack produced by the larvae of *Ostrinia nubilalis* Hbn was monitored in the conditions of the Center of Moldova.

MATERIAL AND METHOD

In the agricultural year 2018/2019, two monofactorial experiments were placed in randomized blocks in three repetitions, in the experimental field of the Agricultural Research and Development Station Secuieni - Neamț, on a typical chernozem cambic soil, with pH in water 6,29, humus content 2,3, nitrogen index 2,1, mobile P₂O₅ 39 ppm, mobile K₂O 161 ppm. Their purpose was to monitor the contribution of the precocity group and the variety of the hybrid on the level of attack produced by the larvae of *Ostrinia nubilalis* Hbn. in the conditions of the Center of Moldova.

The biological material consisted in the first experiment of five hybrids belonging to different

maturity groups, and in the second experiment of five hybrids belonging to the varieties of maize, dent, flint and sweet (Table 1). Each hybrid was sown on an area of 28 s.m.. The maize crop was established respecting the cultivation technology of this species in the conditions of Central Moldova (Troțuș et al., 2015).

From the climatic point of view, the agricultural year 2018/2019 was characterized as being warmly thermal, with a deviation of 1.1 °C compared to the multiannual average temperature of 8.9 °C.

The recorded temperatures showed the highest deviations in March (4 °C), February (3.1 °C), April (2.5 °C) and October (2.2 °C). The spring months showed a warming trend, this phenomenon being noticed in the autumn and winter months (Figure 1).

The precipitation fell to 430.2 mm, the deficit of 114.1 mm characterizing the year as dry (Figure 2). Analyzing the amounts of rainfall in each month of the agricultural year, it is noted that the months of October (-37.6 mm), March (-22.7 mm), June (-29.2 mm), July (-35.7 mm) and August (-39.8 mm) showed a deficit in precipitation, and May was the only one that recorded an excess in precipitation of 29.3 mm (Figure 2).

At the end of the vegetation period, 25 plants / variant were harvested, from the rows in the middle of the plot and which were sectioned to determine the frequency of attacked plants, the average number of holes / plant, the number of larvae and the length of the galleries. The cobs were also noted to determine if there were any holes, larvae or the presence of the pathogen *Fusarium*.

The results obtained were calculated and interpreted statistically using the analysis of variance.

Table 1

The biological material used		
Hybrids		
No	Experience I - the variety of the hybrid	
1	Vibrion	Flint
2	Inventive	Tropical dentate
3	Method	Tropical dentate
4	Kerala	Dent
5	Deliciul verii	Sweet
No	Experience II - precocity group	
1	Turda star	370 - semi-early
2	Turda 248	380 - semi-early
3	Turda 332	390 - semi-early
4	Olt	430 - semi-late hybrid
5	Zlatan	500 - late hybrid

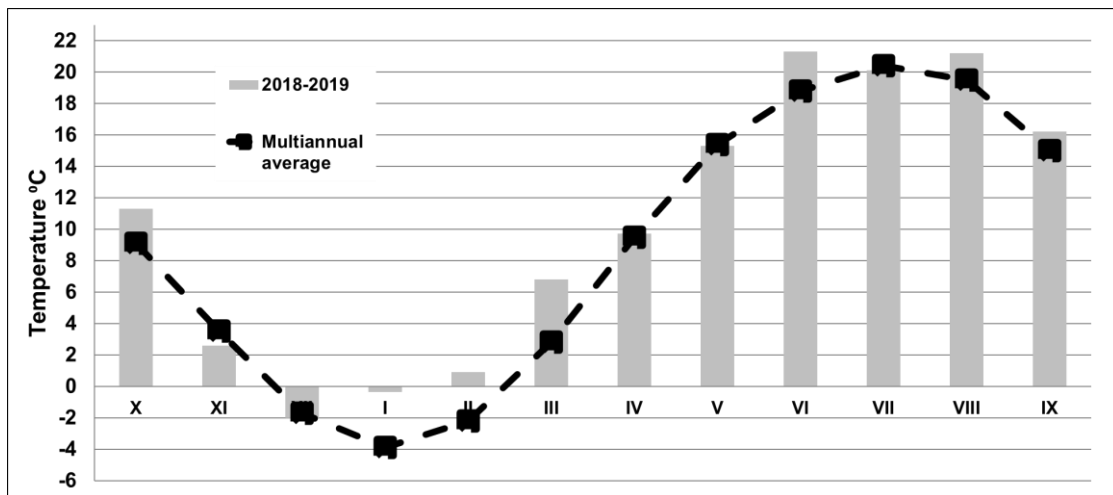


Figure 1 The evolution of monthly temperatures recorded at A.R.D.S SECUIENI in 2018/2019

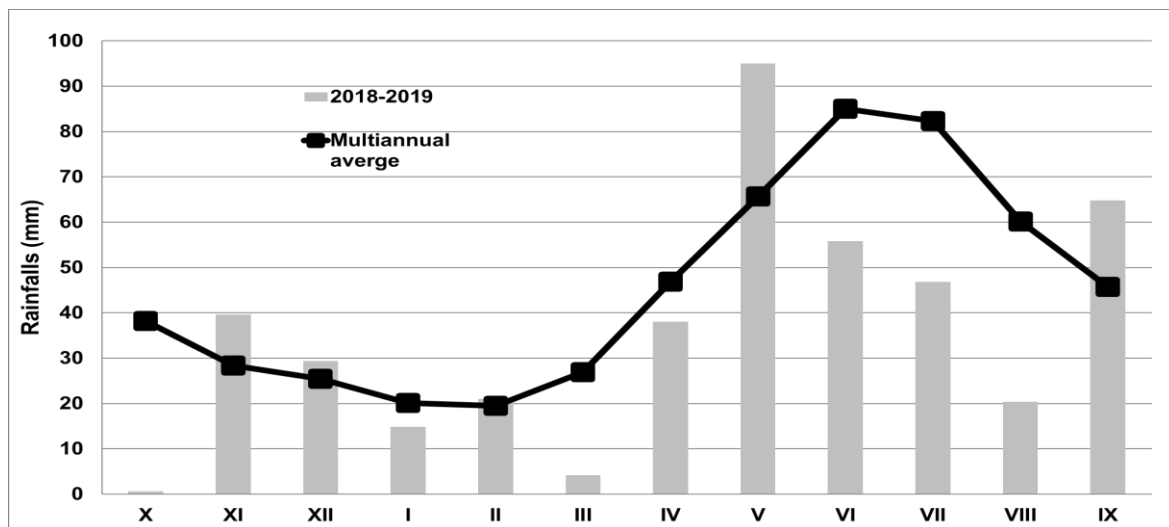


Figure 2 The evolution of the monthly precipitations recorded at A.R.D.S SECUIENI in 2018/2019

RESULTS AND DISCUSSIONS

Influence of maize variety on the attack level produced by larvae of *Ostrinia nubilalis* Hbn. was highlighted by the variability of the parameters followed (frequency of attacked plants, average number of holes / plant, number of larvae and length of galleries) from one variant to another.

Analyzing the reaction of the hybrid according to the variety of the genotype to the attack of the larvae by the corn borer, it was highlighted by minimal attack the maize hybrid with flint grain (FAO 290).

Inventive, Method and Kerala dent hybrids recorded attack frequency values between 11.67% and 25.00%. The highest values were identified for the Kerala hybrid, where the average number of holes / plant was 1.83, were found 1.25 larvae / plant and the length of the gallery reached 7.18 cm (table 2).

The sweet corn hybrid Deliciul verii was the most affected by the corn borer larvae, the

plants were affected in a percentage of 25.00%, recording, on average, 3 holes / plant, with an average gallery length of 14.92 cm.

Jarvis (1988) compared the level of attack by corn borer larvae on sweet corn, dent and popcorn, concluding that of the three varieties, sweet corn suffered the most damage and dent and popcorn varieties (everta) recorded close attack values.

The comparative study conducted by Schulz *et al.* (1997) which included 18 genotypes of flint maize and 23 genotypes of dent maize showed that under the conditions of the existence of a single generation, the number of broken plants is higher, the length of the gallery and small yields were recorded for flint grain maize varieties.

The influence of maize hybrid convariance on the attack parameters produced by the larvae of *Ostrinia nubilalis* Hbn., Secuieni - Neamț, 2019

Maize hybrid	Maize variety	Frequency of attacked plants (%)	The average number of holes/plant	The number of larvae/plant	The length of the galleries (cm)	Frequency of attacked of <i>Fusarium spp</i> (%)
Vibrion	Flint	0.00	0.00	0.00	0.00	0.00
Inventive	Tropical dent	12.50	0.50	0.50	5.42	2.50
Method	Tropical dent	14.50	0.42	0.42	3.80	2.50
Kerala	Dent	11.67	1.83	1.25**	7.18	4.76*
Deliciul verii	Sweet	25.00	3.00**	0.83	14.92**	2.83
Average (mt)	-	12.80	1,13	0,62	6,26	3.13
DL 5%		3.94	0.80	0.33	4.70	2.13
DL 1%		5.60	1.13	0.47	6.69	3.03
DL 0.1%		8.10	1.64	0.68	9.68	4.38

Roderick (1992) argues that research to identify genotypes of dentate corn resistant to borer larvae has shown that genes that provide resistance to leaf-feeding generation have been easier to identify than resistance to attack on the stem. Resistance is influenced by the amino acid continuum DIMBOA and lignin in the leaves. Efforts to transfer resistance from maize to sweet corn have generally failed because many quality factors in maize are adversely affected. In areas where two generations are reported, future *Ostrinia* attack management strategies should consider the use of genotypes with resistance to leaf attack by the first generation, and for the second, *Trichogramma* launches, the use of non-polluting insecticides and capturing adults through sex pheromones to reduce the population.

The results obtained during three years of studying by Beres (2012) show that the sugar corn was the most attacked by the borers larvae, the frequency of the attacked plants being between 89.5% and 93.0%.

Gardner and Hoffmann (2000) studied the resistance of several sweet corn genotypes to the attack produced by the larvae of *Ostrinia nubilalis* Hbn. and concluded that the susceptibility of a maize genotype to attack by borer larvae can be expressed in the number of galleries on the plant, whether small or large, which increase the length of the galleries. From the results obtained by researchers, large galleries create serious problems for corn plants, and genotypes where a large number of larvae are found suggest that they are more prone to attack.

A directly proportional relationship was established between the level of the attack and the number of galleries, genotypes with a high number of galleries recorded a higher level of

attack, while a small number of galleries showed a low level of attack.

The attack on maize from different maturity groups was dependent on the biological cycle of the insect. Females choose taller, more vigorous plants with softer tissues so that the larvae, once hatched, feed and then, past the first larval ages, can easily create holes in the surface of the plant and galleries inside the stem (Brindley and Dicke, 1963).

Under the conditions of A.R.D.S. Secuieni, following the experimentation of five hybrids from different maturity groups, was noted with the highest values of attack the semi-late hybrid Olt (FAO 430) which recorded a percentage of attacked plants of 23.00%, one hole / plant, 0.58 larvae / plant and the average length of the gallery reached 5.79 cm (table 3). Data from the literature through those published by Georgescu *et al.* (2013,2016) claim that the Olt hybrid has a lower level of attack, due to the fact that it is a late hybrid and tolerates the attack more easily compared to other hybrids.

The results obtained are similar to those published by Malvar *et al* (1993) who concluded that late and normal genotypes are much more affected by the attack produced by *Ostrinia* larvae than early and early ones. These differences are due to the number of days needed for each genotype to bloom, as when the larvae appear, the extra-early ones are more mature, and the adults prefer to lay their eggs on juicy, more succulent plants, so the extra-early genotypes have a lower attack.

Of the three semi-early hybrids with close vegetation periods, Turda star (FAO 370), Turda 248 (FAO 380) and Turda 332 (FAO 390), the frequency of attacked plants varied from 12.33% as recorded by the hybrid Turda star and 14.33% for the Turda 332 hybrid. The number of holes /

plant varied from 0.33 to the Turda 248 hybrid, while the Turda Star and Turda 332 hybrids each showed 0.50 holes / plant compared to the Olt hybrid. which recorded 1 hole / plant and the semi-late hybrid Zlatan (FAO 500) showed no signs of attack (table 3).

Analyzing the number of larvae / plant, in the semi-early hybrids Turda star, Turda 248 and Turda 332 were recorded between 0.33 and 0.50

larvae / plant, the length of the galleries was between 1.92 cm at the hybrid Turda 332 and up at 4.84 cm for the Turda Star hybrid.

The frequency of attack caused by the pathogen *Fusarium* spp in cobs was between 2.50% in the Zlatan maize hybrid and reached up to 6.67% in the Turda Star hybrid, the rest of the hybrids showed no signs of pathogen installation (Table 3).

Table3

The influence of the FAO maturity group of the maize hybrid on the parameters of the attack produced by the larvae of the species *Ostrinia nubilalis* Hbn., Secuieni - Neamț - 2019

Maize hybrid	FAO maturity group	Frequency of attacked plants (%)	The average number of holes/plant	The number of larvae/plant	The length of the galleries (cm)	Frequency attack of <i>Fusarium</i> spp (%)
Turda star	370 - semi-early	12.33	0.50	0.33	4.84**	6.67***
Turda 248	380 - semi-early	13.67	0.33	0.42	2.25 ⁰	0.00 ⁰⁰
Turda 332	390 - semi-early	14.33	0.50	0.50	1.92 ⁰⁰	0.00 ⁰⁰
Olt	430 - semi-late hybrid	23.33**	1.00**	0.58	5.79***	0.00 ⁰⁰
Zlatan	500 - late hybrid	0.00 ⁰⁰	0.00 ⁰⁰	0.00	0.00 ⁰⁰⁰	2.50
Average (mt)	-	12.73	0.47	0.36	2.96	1.83
DL 5%		5.20	0.28	0.21	0.58	1.11
DL 1%		7.39	0.40	0.29	0.83	1.58
DL 0.1%		10.70	0.57	0.43	1.99	2.28

The results obtained are similar to those published by Troțuș *et al* (2018) which recorded a density of larvae / plant between 0.40 and 1.70 specimens/plant, and the frequency of attacked plants ranged from 15.00% to 52.60 %.

In the study by Schulz *et al.* (1997) note that genotypes from earlier maturity groups showed satisfactory yields and a low attack level with a reduce number of holes and the length of the galleries. If between the productions and the maturity group, respectively the number of holes and the frequency of the attacked plants, negative correlations were established, between the attack produced by *Ostrinia* and the maturity group, the connection was highlighted by a significant positive correlation.

In Poland, Beres and Gorski (2012) monitored a number of hybrids from different precocity groups, and concluded that most attacked plants were recorded in hybrids from FAO 190-250 maturity precocity groups, compared to hybrids from FAO 270-280. The authors motivate the intense attack of *Ostrinia* larvae on maize hybrids by the rapid growth and development of plants, which is why the females were attracted to them and laid their egg.

CONCLUSIONS

Under the conditions in the Center of Moldova, the studied maize hybrids present different values of the attack produced by the larvae of the species *Ostrinia nubilalis* Hbn. depending on variety and maturity group.

Of the three maize varieties tested, the sugar hybrid was most affected by ostrinia larvae followed by Inventive, Method and Kerala toothed genotypes, while the flint grain variety had a reduced larval attack.

Depending on the maturity group, hybrids that recorded high values of attack was fao group 430 (Olt), followed by semi-early hybrids from groups 370-380 (Turda 248 and Turda 332), the Zlatan hybrid from group Fao 500 presented the lowest attack percentage.

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