Romanian Journal for Plant Protection, Vol. XVII, 2024
ISSN 2248 – 129X; ISSN-L 2248 – 129X

RESEARCH ON THE INFLUENCE OF CHEMICAL TREATMENT ON THE ATTACK PRODUCED BY *OSTRINIA NUBILALIS* HBN. AT MAIZE, IN THE AREA OF THE SUBCARPATHIAN HILLS

Maria Magdalena Podea, Ilie Cătălin Dinuță, Cristina Ghiorghe, Mariana Cristina Nicolae, Georgeta Trașcă*

Agricultural Research and Development Station Pitești-Albota

* correspondence address:
Agricultural Research and Development Station Pitești-Albota,
Comuna Albota, Argeș 117030, Romania,
Phone: + 40 24820 63 34
E-mail *maria.podea@yahoo.com

Abstract:*Ostrinia nubilalis* (Hübner) is one of the most dangerous pests of corn in Romania. Along with very hight yield losses, physical damage to maize plants is the pathway for infection by fungi of the genus *Fusarium* spp**.** The paper is a synthesis of the research results obtained in 2022 at the Pitesti Agricultural Research and Development Station on the effectiveness of chemical treatments (chlorantraniliprol and deltamethrin) in a number of 5 maize hybrids (Felix, Magnus, Amurg, F423 and Miraj).The experiments were of bifactorial type, placed according to the method of randomized blocks in 4 repetitions.The treatments were applied in the first decade of July with the help of portable sprinklers. At the end of the growing season, 25 plants/ variant/ repetition were harvested and sectioned to establish the parameters of the attack: the frequency of attacked plants, the number of larvae/plant, the average number of holes/plant and the length of the galleries. Given the fact that this pest in the researched area is less known, the purpose of this work is to highlight the response of corn hybrids to the attack of the corn borer under conditions of application with various insecticides. The best results were obtained by applying in combination the 2 insecticides based on chlorantraniliprol + deltamethrin.

Keywords*:* corn, insecticides, *Ostrinia nubilalis,* pests

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important crops both in terms of surface area (185 million hectares sown annually worldwide, according to Food and Agriculture Organization data), with a special natural variability, being adapted to a large variety of climatic conditions, from 58° north latitude to 40° south latitude and up to 3800 m altitude (Hallauer and Miranda, 1981) but also of production, with a wide use in animal feed, in human nutrition, in industry but and for the production of fuels. The maize crop represents for Romania, the spring crop with the largest spread and share.

The species is affected by a number of pests that attack plants throughout the growing season. Thus, along with the damage caused by the complex of soil pests: *Agriotes spp*., *Tanymecus dilaticollis* and *Opatrum sabulosum*, attack occurring during: sowing –the first vegetation phases (Bărbulescu et al., 2002; Popov et al., 2004), particular damage, is recorded as a result of the attack produced on different parts of the plant (stem, cob, inflorescence) by the species *Ostrinia nubilalis* Hbn. and *Helicoverpa armigera* Hbn (Trotus et al., 2017; 2018) until plant maturity. Originally from Europe, the corn borer is one of the most important pests of corn (Arion, 1958, Paulian et al., 1962; Bărbulescu et al., 2002; Cristea et al., 2004).

In the southern and southeastern areas of Romania, the corn borer is the second most economically important pest after *Tanymecus dilaticollis* Gyll (Cristea et al., 2004; Popov, 2002; Popov et al., 2005, 2007). Popov and Rosca (2007) reported that crop losses in Romania due to the corn borer attack range from 1.3% in Dobrogea, 8.5% in Transylvania, 10.5% in southern Moldova, 11.7% in Baragan and 17.7% in the Western Plain. The authors note that the average amount of damage caused by this pest is 7.5% and varies from region to region and

year to year. It is a host plant for over 50 pathogens, with invasive action on all plant organs from germination to harvest. Control of *Ostrinia nubilalis* larvae by direct means (chemical or biological) in the maize agroecosystem is difficult to achieve due to the short period of exposure to treatments (from hatching until the larvae enter the stalks) (Manson et al., 1996; Degenhardt et al. et al., 2003).

Insecticides are most effective when applied immediately after larvae hatch from eggs (Bartels and Hutchison 1997; Rinkleff et al., 1995) because mature larvae become inaccessible to chemical treatments due to their penetration into the host plant stem (Pélozuelo L. et al., 2006). At first the larvae feed on the leaf epidermis and pollen from the inflorescences, and as they advance through the larval stages, they pierce the stem, petiole of the leaves and finally consume the grains on the cobs. Attack at the stem level causes the plants to break, which makes mechanized harvesting difficult, leading to quantitative losses. The global distribution of the European corn borer demonstrates its high adaptability to different climatic zones in Europe and America (Showers et al., 1990). In Europe, the number of generations differs by region; in Mediterranean countries, the pest presents 2-3 generations.

In the central area of the continent, 1-2 generations are registred, and in the northern regions there is only one generation per year (Svobodova, E et al., 2013;).The research carried out in Romania (Paulian F., et al., 1961) showed that, depending on the average annual temperature, the European corn borer develops one generation per year in the northern part of the country, and two generations in the south of the country (Geogescu, E., et al., 2019; Trotuș, E et al., 2018). Recent studies conducted by Pintilie et al. (2023) in the eastern part of Romania, regarding the bioecology of the corn borer is closely related to climatic conditions, especially temperature and precipitation.

The study indicates that *Ostrinia nubilalis* Hbn.has two generations per year; a full one between June and September, and a partial one in August. The increase in average annual temperature affects the bioecology of insects by expanding the spatial distribution to the north, thereby increasing the number of generations, reducing the diapause time and extending the development period of the insect (Porter et al., 1991). In this paper, the team of authors followed the behavior, studying the resistance / sensitivity of some corn hybrids, created at I.N.C.D.A. Fundulea, to the attack of the corn borer, *Ostrinia nubilalis* Hbn. by applying treatments with different insecticides to the vegetation.

MATERIALS AND METHODS

In order to achieve the proposed objectives, in the year 2022, in the experimental field of the Pitesti Agricultural Research and Development Station, a bifactorial experiment of type A*B was placed, where factor A was represented by the corn hybrids created at INCDA Fundulea, and factor B from the treatment of vegetation with insecticides, with the following graduations:

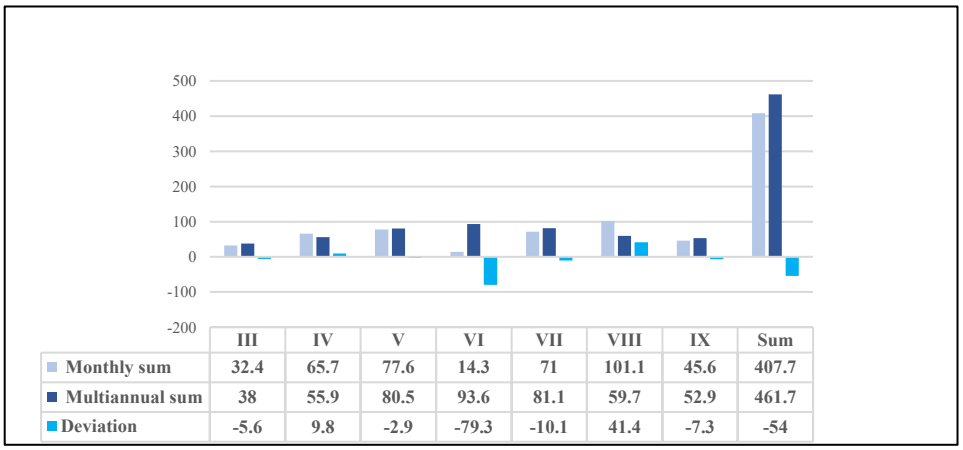
Factor A: Maize hybrids analyzed with 6 graduations: a_1-Control variant (Olt), a_2-F423 a_3 - Felix, a_4 - Magnus, a_5 - Amurg, a_6 - Miraj

Factor B: Chemical treatments on vegetation with 3 graduations: b_1 without insecticides, b_2 Coragen (clorantraniliprol 200 g/l) 125 ml/ha + Faster Delta (deltametrin 25 g/l) 80 ml/ha, b_3 Coragen 125 ml/ha (clorantraniliprol 200 g/l)

The experience was established in the spring of 2022, within the experimental field of the resort, being laid according to the method of subdivided plots, in four repetitions. The corn crop was established respecting the culture technology of this species for the conditions in the area of influence of ARDS Pitesti-Albota.

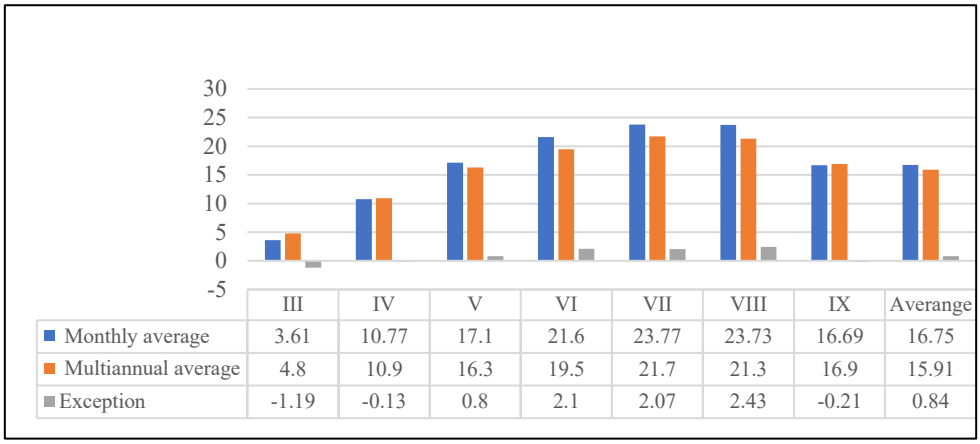
The treatments were applied in the first decade of July, with the help of portable sprinklers. At the end of the vegetation period, 25 plants/variant were harvested from all 4 repetitions, which were then sectioned to establish the parameters of the attack: frequency, average number of holes/plant, gallery length and number of larvae/plant. Meteorological data were recorded at the weather station of the resort, located about 750 m from the experimental field. From a climatic point of view, ARDS Pitesti is located in an area with a temperate continental climate, with a multiannual average temperature of the last 50 years of 10.7 C °. To characterize the researched period from a climatic point of view, we used the data on the average air temperature (°C) and the amount of precipitation (mm) during the agricultural year (march-september), in order to trace the influence of environmental factors on the attack produced by *Ostrinia nubilalis*.

Climatic conditions influenced the evolution of the maize crop, but also the appearance, spread and attack of the species *Ostrinia nubilalis* Hbn. The flight of the insect was continuous, without interruption, the first adults were registred in the first decade of june, and the flight ended at the end of september. From the point of view of temperatures, the year 2022 was characterized as an atypical hot and dry year, with low temperatures in march and april. Positive deviations were recorded in the months: may 0.8 °C, june 2.1 °C, july 2.07 °C and 2.43 °C in august. In the agricultural year 2022, the average annual temperature of the period recorded 16.75 °C, exceeding by 0.84 °C the multiannual average temperature of the period of 15.91 °C. From a pluviometric point of view, although the multi-annual average of the period is 461.7 mm, in the march-september period, 407.7 mm of precipitation was registred with a deficit of 54 mm.



	III	IV	V	VI	VII	VIII	IX	Sum
Monthly sum	32.4	65.7	77.6	14.3	71	101.1	45.6	407.7
Multiannual sum	38	55.9	80.5	93.6	81.1	59.7	52.9	461.7
Deviation	-5.6	9.8	-2.9	-79.3	-10.1	41.4	-7.3	-54

Figure 1. The monthly sum rainfall registered in period March-September 2022



	III	IV	V	VI	VII	VIII	IX	Averange
Monthly average	3.61	10.77	17.1	21.6	23.77	23.73	16.69	16.75
Multiannual average	4.8	10.9	16.3	19.5	21.7	21.3	16.9	15.91
Exception	-1.19	-0.13	0.8	2.1	2.07	2.43	-0.21	0.84

Figure 2. The monthly average temperature registered in the period March-September 2022

RESULTS AND DISCUSSIONS

Following the results obtained regarding the frequency of attacked plants, analyzed at harvest, it was highlighted that the attack frequency had values between 13.3% and 30.5%. The variant in which the Coragen+ Faster Delta insecticide was administered recorded the lowest frequency values as follows: Felix hybrid 13.3%, Amurg hybrid with 14.9%, Magnus hybrid 15.2%, Miraj hybrid 16.2%, F423 hybrid 16.8% and control variant 23.2%.

The influence of Coragen insecticide treatment recorded less higher values compared to the Coragen+ Faster Delta variant, it fell into the following values: the lowest value was the Felix hybrid of 14.8%, followed by the Amurg hybrid 17.1%, Miraj 17.6%, Magnus 17.9%, F423 18.3% and the control variant with 25.1%. In the case of the variant without treatment of the hybrids, the values were between 19,4 % in the variant in which we have the Felix hybrid and 30.5% in the control variant without insecticides (figure 3).

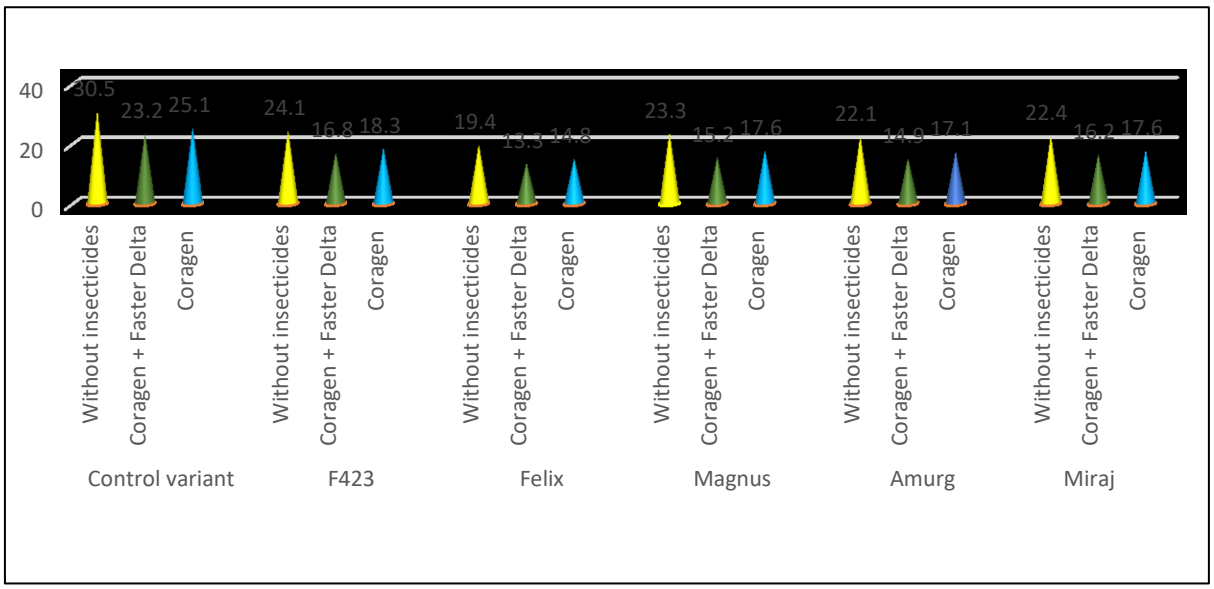


Figure 3- The influence of the interaction between maize hybrids x insecticide treatment on the frequency of attack produced by *Ostrinia nubilalis*, ARDS Pitești 2022

Figure 4 – Determinations regarding the attack produced by *Ostrinia nubilalis,* ARDS Pitești 2022

The average number of holes (Figure. 5) varied depending on the hybrid and the treatment performed. In the control variant with the 3 treatments, the average number of holes was higher compared to the other hybrids as follows: the control variant without insecticides registered 4.63 holes/plant, the Coragen+Faster Delta variant 3.02 holes/plant and the variant with only Coragen 3.63 holes/plant. The lowest number of holes/plant was registered for the variant with Coragen+ Faster Delta treatment as follows: 2.01 holes/plant registered at the Felix hybrid, followed by the Amurg hybrid (2.07 holes/plant), the Magnus hybrid (2.13). holes/plant), Miraj (2.14 holes/plant) the differences being statistically assured as very significantly negative, and no differences were registered at the hybrid F423 (2.98 holes/plant). In the case of the variant with the application of the Coragen insecticide (simple), the lowest values were recorded by the hybrid Felix 2.40 holes/plant followed by Magnus 2.62 holes/plant, Amurg 2.64 holes/plant, the differences being statistically assured as very significantly negative.

The Miraj hybrid had average values of 2.91 holes/plant, the differences being statistically assured as distinctly significant and the F432 hybrid with an average of 3.11 holes/plant, with significantly negative differences. For the variant without treatment, all the studied hybrids registered very significantly negative differences compared to the control variant.

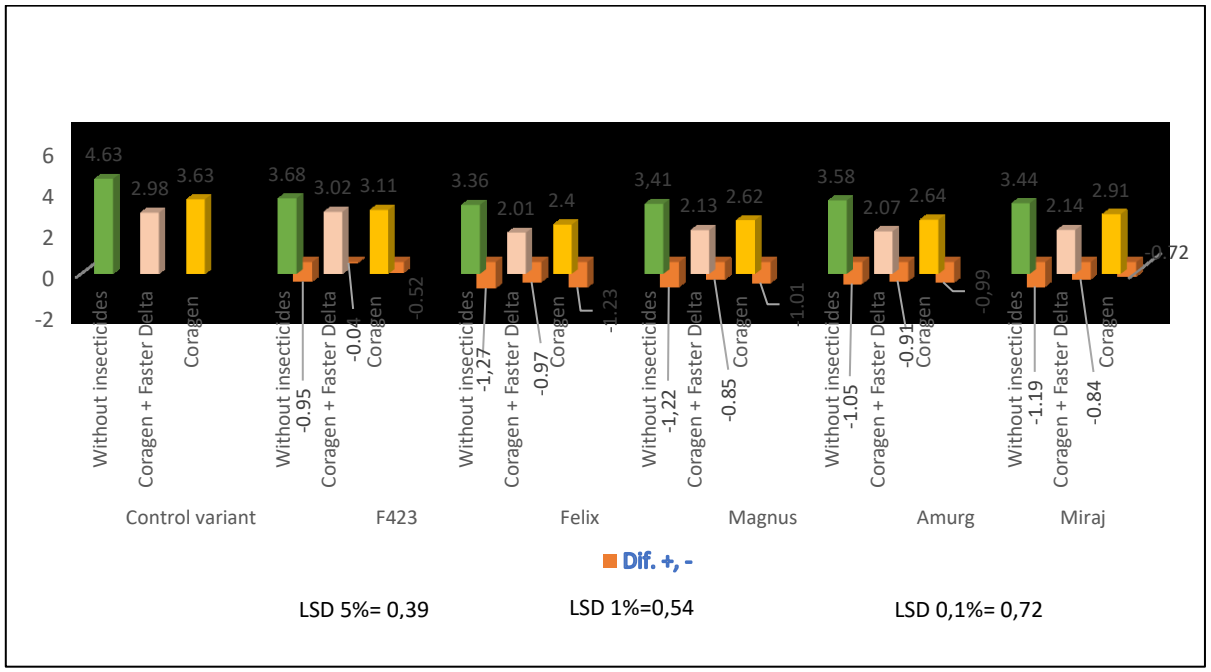


Figure 5. The influence of the interaction between maize hybrids x insecticide treatament on the number of holes/plant produced by *Ostrinia nubilalis*, ARDS Pitești 2022

The number of larvae (Figure.6) identified in maize after stem sectioning varied between 0.64 and 3.43 larvae/plant. In the variant to which the insecticide Coragen+Faster Delta was applied, the number of larvae was strongly influenced, the hybrids registred average values of the number of larvae/plant as follows: Felix 0.64 larvae/plant, Amurg 0.84 larvae/plant, Magnus 0.92 larvae/plant and Miraj 0.93 larvae/plant, the differences being statistically assured as very significantly negative, while in the hybrid F423 the average was 1.33 larvae/plant, not being statistically assured.

The application of Coragen insecticide treatment influenced the presence of larvae in the hybrids studied, so that the average values were between 1.13 larvae/plant and 2.38 larvae/plant. The hybrids Felix, Magnus, Amurg, Miraj registered very significantly low differences from a statistical point of view, and no differences were registered in the F432 hybrid. The variant where no treatments were applied, the average number of larvae/plant had values between 2.87 in the Felix hybrid and 3.43 larvae/plant in the control. The other hybrids registred the following average values: Miraj 2.92 larvae/plant, Amurg 2.98 larvae/plant, Magnus 3.01 larvae/plant and F423 3.11 larvae/plant. The differences being statistically ensured as follows: the hybrids Felix, Amurg, Miraj registered very significantly negative differences, Magnus registered distinctly negative differences and the F423 hybrid significantly negative differences.

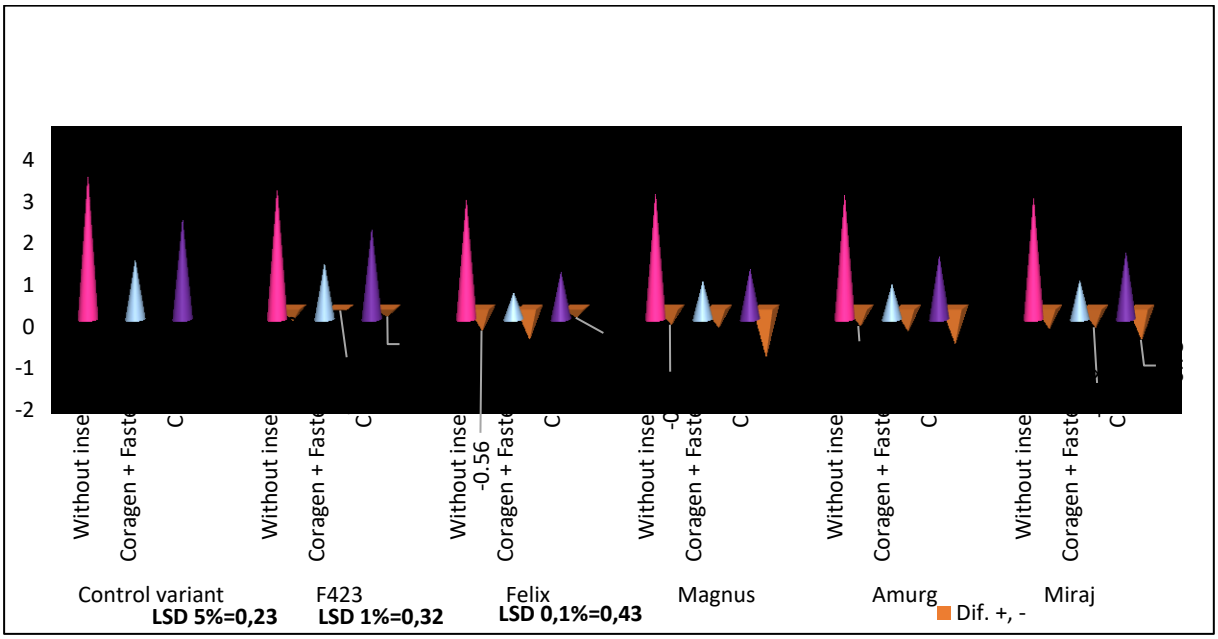


Figure 6. The influence of the interaction between maize hybrids x insecticide treatment on the number of larvae/plant produced by *Ostrinia nubilalis*, ARDS Pitești 2022

The length of the galleries. At harvest, the average length of galleries created by larvae reached, on average,values between 6.10 cm for the Felix hybrid (Coragen+ Faster Delta variant) and 10.65 cm in the control variant without insecticides (figure 7). It is noted that the shortest galleries are registered for variants treated with Coragen + Faster Delta followed by variants in which treatment with Coragen insecticide (simple) was applied. The average values being close, there were no significant differences in the length of the galleries.

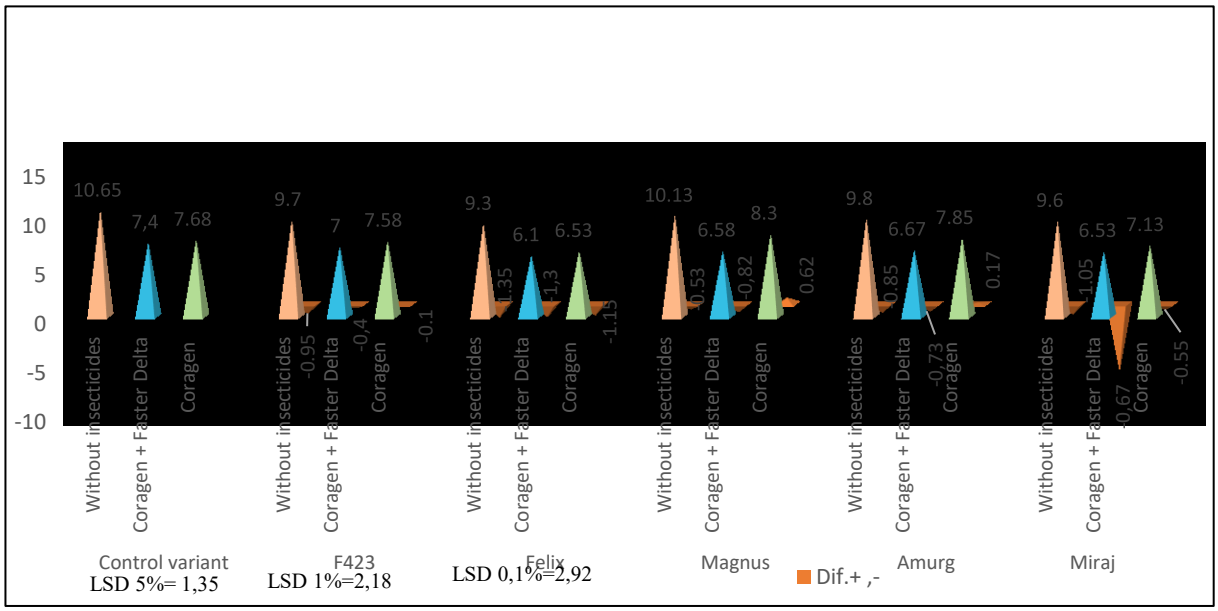


Figure 7. The influence of the interaction between maize hybrids x insecticide treatment on the length of the galleries (cm) produced by *Ostrinia nubilalis*, ARDS Pitesti 2022

CONCLUSIONS

In the conditions from ARDS Pitești-Albota, the 6 hybrids studieds registered in the variant without insecticides the highest values of frequency, number of holes/plant, number of larvae/ plant, average length of galleries (cm). The variant to which the chimical treatment with Coragen insecticide (125ml/ha) + Faster Delta (80 ml/ha) was applied on vegetation registered the best results compared to the other variants studied.

Regarding the resistance of hybrids to attack the pest *Ostrinia nubilalis*, the Felix hybrid had the best results in the researched area.

REFERENCES

ARION, G., 1958 – Entomologia agricolă. Editura Agrosilvică de stat, 777 pp. (Cap. V: 464-466).

BARTELS, D. W.,HUTCHISON, W.D., & UDAYAGIRI, S. (1997). Pheromone trap monitoring of Z-strain European corn borer (Lepidoptera: Pyralidae): optimum pheromone blend, comparison with blacklight traps, and trap number requirements. *Journal of economic entomology*, *90*(2), 449-457.

BĂRBULESCU, A., POPOV, C., MATEIAŞ, M.C., 2002 – Bolile şi dãunãtorii culturilor de câmp. Editura Ceres, 376 pag., Bucureşti

BLANDINO, M., V., SCARPINO, F., VANARA, M., SULYOK, R., KRSKA, A., REYNERI (2015): Role of the European corn borer (*Ostrinia nubilalis*) on contamination of maize with 13 Fusarium mycotoxins. Food Additives & Contaminants: Part A, *32*(4): 533-543

CRISTEA, M, CĂBULEA, I., SARCA, T., 2004 – Porumbul. Studiu monografic, Volumul 1, Editura Academei Române, Cap. 14: 589-626.

CZEMBOR, E., Ł., STĘPIEŃ, A., WAŚKIEWICZ (2015): Effect of Environmental Factors on Fusarium Species and Associated Mycotoxins in Maize Grain Grown in Poland. PLoS ONE 10(7): e0133644

DEGENHARDT, H., HORSTMANN, F., & MULLEDER, N. (2003). Bt-Mais in Deutschland. Erfahrungen mit dem Praxisanbau von 1998 bis 2002. *Mais*, *2*(2003), 75-77.

GEORGESCU, E.;TOADER, M.; CANĂ, L.; RÎȘNOVEANU, L. Researches concerning European corn borer (*Ostrinia nubilalis Hbn*.) control, in South-East of the Romania; Scientific Papers; Series A; Agronomy: Bucharest, Romania, 2019; Volume LXII, pp. 301–308.

HALLAUER A.R MIRANDA J.B, 1981,- Quantitative genetics in maize breeding.Ames:Iowa State University Press.

MANSON, C. E., STROMDAHL, E. Y., & PESEK JR, J. D. (1997). Placement of pheromone traps within the vegetation canopy to enhance capture of male European corn borer (Lepidoptera: Pyralidae). *Journal of economic entomology*, *90*(3), 795-800.

NEDĚLNÍK, J., H., LINDUŠKOVÁ, M., KMOCH (2012): Influence of Growing Bt maize on Fusarium Infection and Mycotoxins Content – a Review, *48*, Special Issue: S18–S24, Plant Protect. Sci.

PAULIAN, F., BĂRBULESCU, A., MUSTEA D., BELU V., PEIU M., 1962 – Contributii la studiul biologiei și combaterii sfredelitorului porumbului (*Pyrausta nubilalis Hb*.) în conditiile din R.P.R. An. I.C.C.A., Seria B: 376-420.

PAULIAN, F.; BĂRBULESCU, A.; MUSTEA, D.; BELU, V.; PEICU, M. Contributions to the status of the biology and control of the corn borer (Pyrausta nubilalis Hb.) under Romanian conditions. An. I.C.C.A. B Series **1961**, XXIX, 397–420.

PELOZUELO, L.,AVAND-FAGHIH, A., ESPAHBODI, A., ÉGENESTIR, G., GUÉNÉGO, H., MALOSSE, C., & FRÉRÉROT, B. (2006). Efficiency of pheromone baited traps for monitoring of the European corn borer *Ostrinia nubilalis* (Lep.: Crambidae) in Mazandaran province. *Applied Entomology and Phytopathology*, *73*, 19-31.
PINTILIE, P. L., TROTUȘ, E., TĂLMACIU, N., IRIMIA, L. M., HEREA, M., MOCANU, I., & TĂLMACIU, M. (2023). European Corn Borer (Ostrinia nubilalis Hbn.) Bioecology in Eastern Romania. *Insects*, *14*(9), 738.
POPOV, C., ROȘCA, I., 2007 – Technology of European Corn Borer (*Ostrinia nubilalis Hbn*.) mass rearing, in continuous system and successive generations. Entomological Research, 37, (1) 126
POPOV, C., GURAN, MARIA, RARANCIUC, STELUŢA, ROTĂRESCU, MIHAELA, SPIRIDON, CRISTINA, VASILESCU, S., GOGU, FLORICA, 2005 – Starea fitosanitarã a culturilor de cereale, leguminoase pentru boabe, plante tehnice şi furajere din România, în anul 2004. Probl. Prot. Pl., XXXIII (1-2): 7-30
PORTER, J.H.; PARRY, M.L.; CARTER, T.R. (1991).The potential effects of climatic change on agricultural insect pests. Agric. For. Meteorol.
RINKLEFF, J. H., HUTCHISON, W. D., CAMPBELL, C. D., BOLIN, P. C., & BARTELS, D. W. (1995). Insecticide toxicity in European corn borer (Lepidoptera: Pyralidae): ovicidal activity and residual mortality to neonates. *Journal of economic entomology*, *88*(2), 246-253.
SHOWERS,W.B.; KEASTER, A.J.; WITKOWSKI, J.F.; CLEMENT, S.L.; CHIANG, H.C.; SPARKS, A.N. (1990) Manipulation of larval diapause of the European Corn Borer (Lepidoptera: Pyralidae) as a potential mechanism of Integrated Pest Management. Environ. Emtomol. 19, 1311–1319. [CrossRef]
SOVOBODOVA, E.;TRNKA, M.; DUBROVSKY, M.; SEMERADOVA, D. (2013). Pests occurrence model in current climate—Validation study for European Domain. Acta Univ. Agric. Silvic. Mendel. Brun. LXI, 205–214. [CrossRef]
SZŐKE, C., Z., ZSUBORI, I., PÓK. F., RÁCZ, O., ILLÉS, I., SZEGEDI (2002): Significance of the European corn borer (*Ostrinia nubilalis* Hübn.) in maize production. Acta Agronomica Hungarica, *50*(4):447-461.
TROTUȘ, E., BUBURUZ, A.A., URSACHE , P.L., 2017- Date noi privind protecția culturilor de porumb împotriva dăunătorilor specifici. Volum omagial-55 ani de cercetare-dezvoltare , Ed. Ion Ionescu de la Brad, Iași: 115-130.
TROTUȘ, E., BUBURUZ, A.A., URSACHE, P.L., 2018- New data regarding the appearance, evolution and the attack produced by Ostrinia nubilalis Hbn. species, at maize crop, uder center of Moldova conditions. Romania Agriculture Reserch, 35: 229-236.
online: https://www.incda-fundulea.ro/rar/nr35/rar35.27.pdf
FAO Stat. 2022. Available online: https://www.fao.org/faostat/en/#data/QCL (accessed on 21 July 2023).