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Incidence of *Fusarium* sp. and *Ostrinia nubilalis* on Late Corn Genotypes in Transylvanian Plain Due to Climate Change

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ABSTRACT

Corn is one of the most important agricultural crops worldwide, ranking third in cultivated area after wheat and rice and first in terms of total production. However, corn production is significantly threatened by several biotic stress factors, among which *Fusarium* species and the European corn borer (*Ostrinia nubilalis* Hübn.) are considered the most damaging. The larvae of the European corn borer facilitate the spread of *Fusarium* pathogens and are regarded as the main vectors of infection. The resulting yield losses may be substantial and are influenced by the cultivated genotype, crop management practices, and climatic conditions, which are continuously changing.

The objective of this study was to identify corn hybrids that combine high productivity with reduced susceptibility to *Fusarium* sp. and *Ostrinia nubilalis* under current climate change conditions. The results revealed an increase in average annual temperatures in the Transylvanian Plain over recent years, creating favorable conditions for the cultivation of later-maturing hybrids. Based on the production data obtained, the expansion of Intermediate-late hybrids belonging to the FAO 361-400 maturity group is recommended for the studied region.

Keywords: maturity groups, maize, hybrid, *Fusarium* sp., *Ostrinia nubilalis*, yield.

INTRODUCTION

Climate is one of the most important factors influencing agricultural productivity (Fischer et al., 2005; Challinor, 2014). Climate change is expected to significantly affect agriculture and food security worldwide, although its impacts vary among regions and crops (Anderson et al., 2020). Changes in soil moisture, temperature, precipitation, cloudiness, and atmospheric CO_2 concentrations can alter cultivation boundaries and crop yields (Zayan, 2019). Over the last three decades, global temperatures have increased by approximately 0.2°C per decade (Chabala et al., 2015), leading to substantial changes in agroecosystems.

Agricultural production is influenced by climatic conditions, crop and land management practices, the occurrence of pathogens and pests, and extreme weather events. Climate change can modify plant susceptibility to diseases and pest attacks, resulting in shifts in agricultural practices aimed at reducing production losses (Zayan, 2019). Furthermore, changes in temperature and precipitation may alter the distribution and abundance of insect species and create new interactions between pests and diseases (Aydinalp and Cresser, 2008). It has been estimated that a global temperature increase of 1°C could reduce wheat yields by 4-6%, with similar effects expected for maize productivity (Anderson et al., 2020).

Maize (*Zea mays* L.) is one of the world's most important cereal crops, ranking third in cultivated area after wheat and rice and first in total production. Due to its extensive cultivation and major contribution to food and feed supplies, global food security is highly dependent on maize production. The remarkable biological efficiency of maize

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enables a plant originating from a seed weighing less than one gram to grow up to 2-3 m in height and produce 600-1000 kernels within a single growing season (Cristea, 2004). However, maize productivity and grain quality depend on the genetic potential of the hybrid and its interaction with environmental conditions, including both abiotic and biotic stress factors.

Among the biotic constraints affecting maize, pathogens and insect pests are of particular importance. *Fusarium* ear rot, caused by *Fusarium* species, is one of the most widespread and economically damaging diseases of maize worldwide. The disease occurs in all major maize-growing regions and can cause substantial yield and quality losses (Nagy, 2004). More broadly, *Fusarium* species infect several cereal crops, including wheat, barley, rice, and maize, and have become increasingly important due to climate change and modern agricultural practices (Osborne and Stein, 2007). In addition to yield reduction, *Fusarium* infections may lead to contamination of grain with mycotoxins, secondary metabolites harmful to both humans and animals (Ji et al., 2019).

The European corn borer (*Ostrinia nubilalis* Hübn.) is another major biotic stress factor in maize production. Widely distributed throughout Europe and North America, it is considered one of the most economically significant maize pests (Szőke et al., 2002; Georgescu et al., 2019; Tărău et al., 2019; Zhukovskaya et al., 2020). Under favorable conditions, yield losses caused by this pest can reach up to 15% (Shpanev et al., 2019). Moreover, feeding injuries produced by O. *nubilalis* facilitate infection by *Fusarium* species, making the insect an important factor in the epidemiology of *Fusarium* ear rot (Czembor, 2010; Scarpino et al., 2015; Vălean et al., 2017; Tărău et al., 2024). Consequently, the combined action of *Fusarium* spp. and *O. nubilalis* continues to represent a serious threat to global maize production (Živanov et al., 2019).

In the Transylvanian Plain, where the present study was conducted, significant climatic changes have been recorded in recent years (Marin et al., 2014; Șimon et al., 2018; Șimon, 2019). Average annual temperatures increased by 2.1°C in 2018 and by 2.2°C in 2019 compared with long-term averages (Șimon et al., 2018; Șimon, 2019). Heat stress is considered one of the primary threats to maize production (Lizaso et al., 2018), while the thermal regime strongly influences crop performance (Chuang et al., 2017). Optimal maize yields are generally achieved under average monthly temperatures of 16-20°C in May, 19-21.6°C in June, 20-23°C in July, 19-22.7°C in August, and 14-17.7°C in September (Borcean, 2003). Recent studies have demonstrated that year-to-year climatic variability in the Transylvanian Plain significantly affects maize productivity and its quantitative traits (Ghețe et al., 2020).

Given the ongoing climatic changes and the need to ensure future food security, agriculture must adopt effective adaptation strategies, including improved crop management practices and the development of more resilient genotypes (Anderson et al., 2020; Nikolaou et al., 2020). The increase in average annual temperatures recorded in the Transylvanian Plain over the last 14 years has created favorable conditions for the cultivation of late-maturing maize hybrids. Therefore, the objective of the present study was to identify maize hybrids combining high productivity with low susceptibility to *Fusarium* sp. and *Ostrinia nubilalis*, thereby contributing to the development of sustainable maize production systems under changing environmental conditions.

MATERIAL AND METHODS

During the 2018-2020 period, in the Transylvanian Plain's, experimental conditions we studied: Fusarium ear rot attack degree; European corn borer attack frequency and the production of corn hybrids obtained in different ecological conditions to the three experimental years.

The experimental area is located in Jucu Commune, Cluj County, Romania, positioned in the eastern part of the county at approximately 46.85° N latitude and 23.78° E longitude. The region lies at the contact zone between the Someș Plateau and the

Transylvanian Plain, resulting in a varied relief with favorable agricultural conditions. The territory is crossed from south to north by the Someșul Mic River, which contributes to the local hydrographic network and soil moisture regime.

From an administrative perspective, the experimental site is bordered by Bonțida Commune to the north, Apahida Commune to the south, Apahida and Căianu administrative units to the east, and Borșa and Chinteni communes to the west. The area is characterized by temperate continental climatic conditions, with moderate thermal resources and a well-defined precipitation regime, making it suitable for maize cultivation and field experimentation (https://primariajucu.ro/comuna-jucu/prezentare-generala/).

The argic-stagnic Phaeozem from Jucu has a clay loam to clay texture (43-45.6% clay), low bulk density at the surface (<1.22 g/cm^3), slightly acidic pH, and a moderate to good humus content (3.5-4.5% in the top 50 cm), with good cation exchange and buffering capacity due to the clay-humus complex. Mobile potassium is well represented, while mobile phosphorus is low to moderate and needs supplementation; the soil is mesobasic to eubasic (base saturation 74-85%) with high levels of exchangeable bases (25.8-31.2 me/100 g soil). Management priorities include liming with carbonate materials to correct pH, sustainable practices to preserve or improve humus reserves, and adequate phosphorus fertilization.

The study comprised two experiments. The first experiment, conducted between 2018 and 2020, included the evaluation of four maize hybrids: SY Scorpius, SY Chorintos, Karpatis, and SY Orpheus. The second experiment, conducted during 2019 and 2020, was expanded to include 17 maize hybrids.

Biological Material

The biological material was represented by maize hybrids developed within different breeding programs, covering a wide range of maturity groups and exhibiting diverse genetic backgrounds (Table 1).

Table 1. Classification of maize hybrids according to FAO maturity subgroup and breeding origin

FAO Subgroup	Hybrid	Breeding Company / Origin
Intermediate Early (IE) 270-330	SY Scorpius	Syngenta
	SY Chorintos	Syngenta
	SY Torino (SD 2186)	Syngenta
	CERA 320	Expert Agribusiness
	Karpatis	KWS
Intermediate Medium (IM) 340-370	SY Orpheus	Syngenta
	RGT Zanetixx	RAGT Semences
	KWS Smaragd	KWS
	Ajowan	RWA
	SY Infinite (SC 3477)	Syngenta
	EXP 3702	Expert Agribusiness
Intermediate Late (IL) 380-390	Premeo	Syngenta
	Basmati CS	Caussade
	CERA 380	Expert Agribusiness
	SY Zephir	Syngenta
	Topkapi	KWS*
	MAS 43P	MAS Seeds
	RGT Noemixx	RAGT Semences

APPR annual report (2019, 2020).

Hybrids were grouped into three maturity classes according to the FAO classification: Intermediate Early, Intermediate Medium, and Intermediate Late. This grouping was used to facilitate the interpretation of productivity, *Fusarium* spp. infection, and *Ostrinia nubilalis* attack under the experimental conditions.

The experiment was conducted in a randomized complete block design (RCBD) with three replications. Sowing was performed during the last decade of April, while harvesting took place during the second half of October in each experimental year (Table 2).

Table 2. Classification of maize hybrids according to FAO maturity subgroup and breeding origin

Year	Sowing date	Harvest date
2018	26 April 2018	18 October 2018
2019	29 April 2019	24 October 2019
2020	23 April 2020	22 October 2020

Assessment of the degree of attack

The severity of *Fusarium* ear rot was assessed by calculating the degree of attack (Ga) according to the equation:

$$\mathbf{Ga = (F \times I) / 100}$$

where:

F represents the attack frequency, calculated as $\mathbf{F = (n/N) \times 100}$,

I represents the attack intensity, determined as $\mathbf{I = \Sigma(i \times f) / N}$ (Puia, 2005).

In these formulas, **n** is the number of infected ears, **N** is the total number of evaluated ears, **i** is the disease rating class, and **f** is the number of ears within each rating class.

The frequency of attack by *Ostrinia nubilalis* was calculated using the formula:

$$\mathbf{F = (n/N) \times 100}$$

where **n** is the number of attacked ears and **N** is the total number of assessed ears.

Following harvest, the grain obtained from each plot was weighed and its moisture content was determined. To eliminate the effect of differences in grain moisture at harvest, yield data were corrected to a standard moisture content of 15%. The adjusted yields were extrapolated to a hectare basis and expressed as kilograms per hectare (kg ha^{-1}), providing a standardized measure for comparing the productivity of the experimental variants.

Statistical Analysis

The data obtained from field observations and measurements were centralized and statistically processed using Microsoft Excel and STATISTICA software. Microsoft Excel was employed for data organization, validation, descriptive statistical analysis, and graphical representation of the results. To evaluate the significance of differences among the studied hybrids and experimental variants, the data were further analyzed using the STATISTICA software package. Analysis of Variance (ANOVA) was performed to determine the effects of the investigated factors and their interactions on the measured traits. When significant differences were detected, mean comparisons were conducted using Duncan's Multiple Range Test (DMRT) at the 5% probability level ($p \leq 0.05$), allowing the classification of treatments and hybrids into statistically homogeneous groups. This statistical approach ensured a reliable assessment of variability among genotypes and experimental conditions and facilitated the identification of superior hybrids with enhanced productivity and reduced susceptibility to *Fusarium* sp. and *Ostrinia nubilalis*.

Weather conditions during the experimental period (2018-2020)

The temperatures recorded in the three experimental years are close to the values mentioned in the literature, which favoured plants' growth and the normal development of corn cobs.

The average monthly temperature during the corn's vegetation period was over 15.7°C in the three experimental years (Table 3). The warmest month was August with an average temperature of over 21°C (21.8°C in 2018, 21.9°C in 2019 and 21.1°C in 2020).

From June to August, the temperature above 30°C contributes significantly to the decrease in corn productions (Chuang et al., 2017). In the area of experience, the average

monthly temperatures from June to August lower than 30°C, which favoured the growth and formation of maize production. We can mention that in 2018 there were only six days in which the temperature exceeded 30°C while in 2019 there were 29 days. The year 2020 stood out with only nine days in which the temperature exceeded 30°C.

Climate change will influence the amount and distribution of precipitation (Huang et al., 2015). Rainfall is the main factor affecting production (Munodawafa, 2012).

Table 3. Temperature 2018-2020 (°C)

Period	2018	2019	2020	Rating			Period mean	Rating	Multiannual (60 years)
				2018	2019	2020			
January	-0.1	-2.1	-2.4	b	a	a	-1.5	a	-3.4
February	-0.1	1.8	2.5	n	b	b	1.4	a	-0.9
March	3.3	7.0	5.9	d	b	a	5.4	n	4.7
April	14.9	11.5	9.8	c	a	n	12.1	b	9.9
May	18.1	13.9	13.1	b	d	d	15.0	n	15
June	18.9	21.3	18.8	a	b	n	19.7	a	17.9
July	19.9	20.1	19.0	n	n	n	19.7	n	19.7
August	21.8	21.9	21.1	b	b	a	21.6	b	19.3
September	16.0	16.4	17.1	n	a	b	16.5	a	15.1
October	12.3	11.3	11.1	b	a	a	11.6	b	9.5
November	5.6	9.2	3.2	a	c	n	6.0	b	3.9
December	-0.6	0.9	1.9	n	b	b	0.7	b	-1.4
Corn vegetation period mean	17.4	16.6	15.7	b	a	n	16.6	a	15.2
Year average	10.8	11.1	10.1	a	b	a	10.7	a	9.1

In Romania, most corn is grown without irrigation, corn production depending on rainfall.

There is a positive correlation between the annual amount of precipitation and the corn harvest (Munodawafa, 2012; Hălmajan et al., 2017). The rains of May, June and July are of great importance (Hălmajan et al., 2017). In the eco-pedagogical conditions of Romania, the minimum amount of precipitation over the entire corn vegetation period is 250-300 mm, optimal 300-380 mm, with the following distribution per month: 60-80 mm in May, 100-120 mm in June, 100-120 mm in July and 40-60 mm in August (Muntean et al., 2008).

Table 4. Rainfall 2018-2020 (mm)

Period	2018	2019	2020	Rating			Period mean	Rating	Multiannual (60 years)
				2018	2019	2020			
January	9	61	9				26	a	21.8
February	28	17	38	c	n		28	c	18.8
March	41	17	50		f		36		23.6
April	23	73	30			g	42	n	45.9
May	36	135	58	g		e	76	a	68.7
June	174	36	109			b	106	b	84.8
July	67	37	62	e		f	55	f	77.1
August	21	57	89		n		56	n	56.5
September	47	19	44	n		n	37	e	42.5
October	61	18	51			c	43	b	35.6
November	33	19	20	a	g	g	24	e	28.5
December	75	16	1		g		31	a	27.1
Corn vegetation period sum	429	375	443	n	n	n	416	n	411.1
Year sum	615	505	561	a	n	n	560	n	530.9

During the corn vegetation period, the amount of precipitation was over 400 mm in 2018 and 2020 and 375 mm in 2019, these values ensuring production. The rainfall in April ensured the uniform emergence of corn. The wettest month was June (174 mm of rainfall) in 2018 and 109 mm in 2020 and May 2019 with 135 mm of rainfall totalled.

Table 4 shows the uneven distribution of precipitation, alternating the stormy months with the arid ones.

In the three years of the experiment, it was observed that during the vegetation period of corn the number of days without precipitation increased from 130 days in 2018 to 136 days in 2019 and 140 days in 2020.

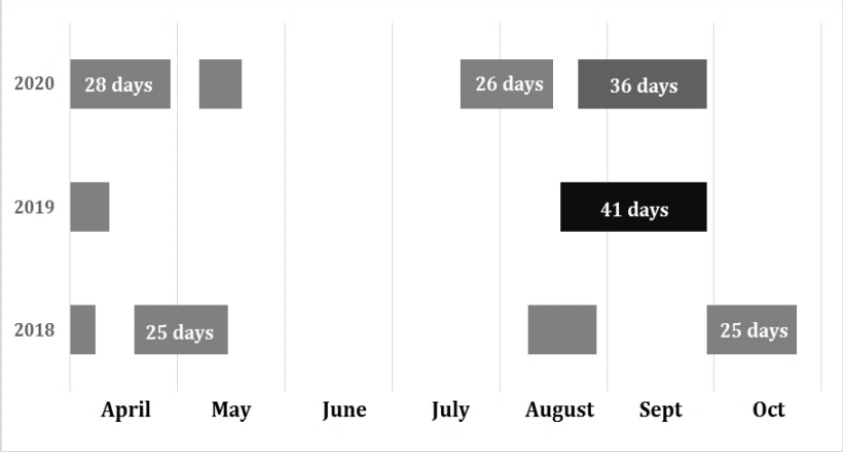


Figure 1. Distribution of days without precipitation during the corn vegetation period (2018-2020)

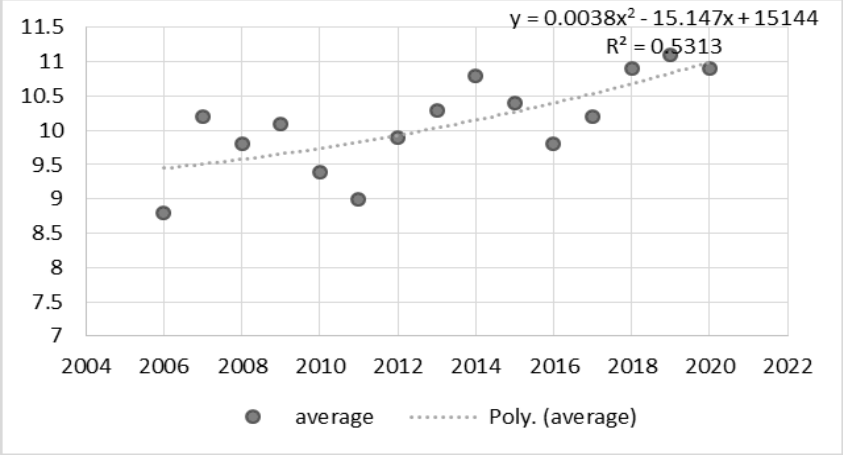


Figure 2. Average annual temperature (2006-2020) (°C)

If in 2018 the periods without precipitation did not exceed 25 days, in 2019, the most prolonged period of drought was recorded (41 days) and in 2020 the most extended period of drought was 36 days. The distribution of dry periods (more than ten days without precipitation) is shown in Figure 1.

The impact of climate change, especially rising temperatures, will influence agricultural production, in the sense of their decrease, with substantial differences between crop areas. Similar assessments indicate that crop yields in tropical locations generally decline even with minimal temperature increases (McCarthy et al., 2001).

Figure 2 shows that in the last 14 years there is a tendency to increase the average annual temperatures, the correlation being positive, with a few exceptions in 2006, 2010 and 2011 and 2016 and 2017. The highest average temperature was recorded in 2019, the year in which the lowest productions were obtained, in our experiment.

RESULTS AND DISCUSSION

First experiment results

In the conditions of the years 2018-2020, the degree of *Fusarium* sp. attack on the four hybrids analyzed, it manifested mainly in 2018, with a maximum of 0.41% (Figure 3A). Analysis of variance reveals no differences in the attack between the three years (p = 0.0984). However, the Duncan comparison highlights differences between 2018 and 2020 (p = 0.0485). This aspect can be correlated with the fact that the precipitations in June and July positively influenced the manifestation of *Fusarium* sp., while the dry periods of 2020, from July to August, stopped the fungus' development.

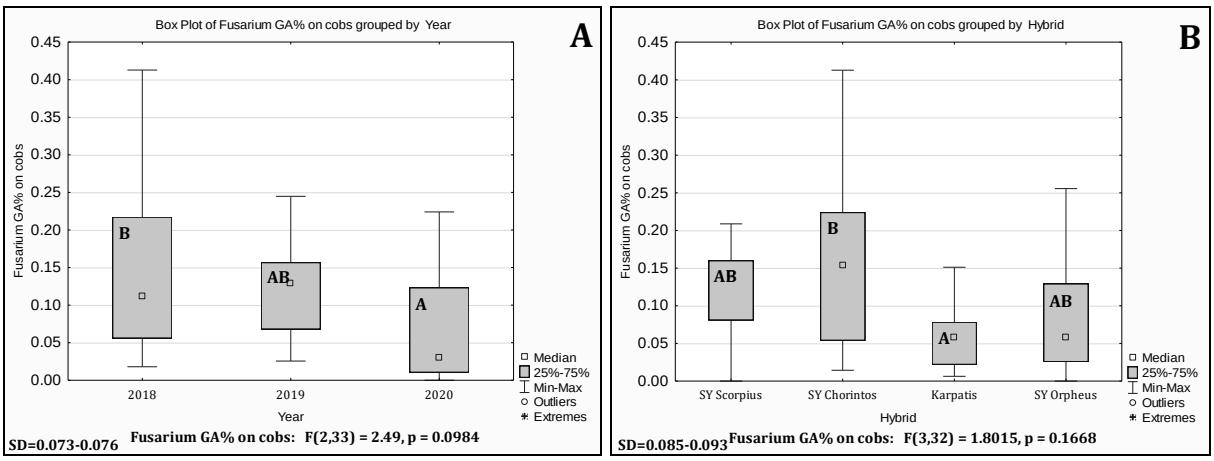


Figure 3. Fusarium sp. attack degree depending on climatic conditions (A) and corn hybrids (B)

Figure 3B shows no significant differences between the four hybrids tested, according to the analysis of variance (p = 0.1668). By using the Duncan test, we can find differences between the Karpatis hybrid (hybrid with high resistance to *Fusarium* sp. attack) and SY Chorintos (p = 0.0437).

There is a positive relationship between the attack of *Ostrinia nubilalis* and *Fusarium* sp. (Figure 4A). Even in the European corn borer attack case, there is no significant difference between the three years of monitoring (p = 0.0693). As in the case of the Fusarium ear rot attack, the Duncan test highlights the year 2020 with the lowest level of the frequency of the *Ostrinia nubilalis* attack (p = 0.0285).

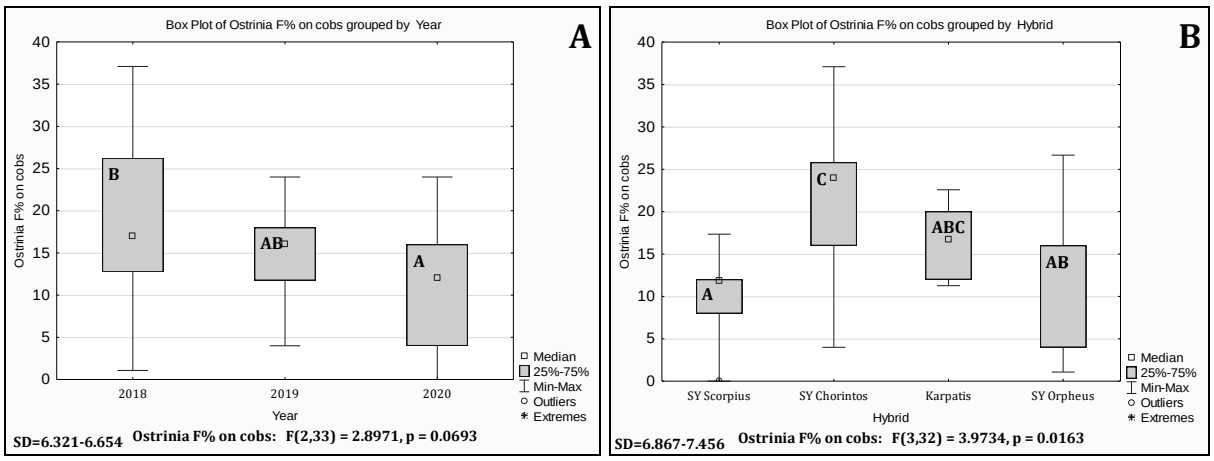


Figure 4. Ostrinia nubilalis attack frequency depending on climatic conditions (A) and corn hybrids (B)

The frequency of the pest *Ostrinia nubilalis* was between 0-37%. Both the variance analysis and the Duncan test reveal significant differences between the four hybrids tested (Figure 4B). It can be seen that at SY Chorintos hybrid, there is a positive correlation between the frequency of *Ostrinia nubilalis* attack and the degree of fusariosis attack. At this hybrid, the two monitored parameters' highest values were recorded (Figure 3B, 4B).

Climatic conditions have influenced the production of corn hybrids (Figure 5A). High temperatures (Table 3) and uneven distribution of precipitation (Table 4) led to different yields. Thus, in 2018, the highest productions were registered with values, in the vast majority, between 11400 kg/ha and 13040 kg/ha. The high productivity can be attributed to the fact that the average temperature during the vegetation period was over 17°C and the drought manifested itself only at the beginning of the vegetation period. The low production in 2019 is primarily due to the prolonged drought of August and September (41 days without rainfall) (Figure 1).

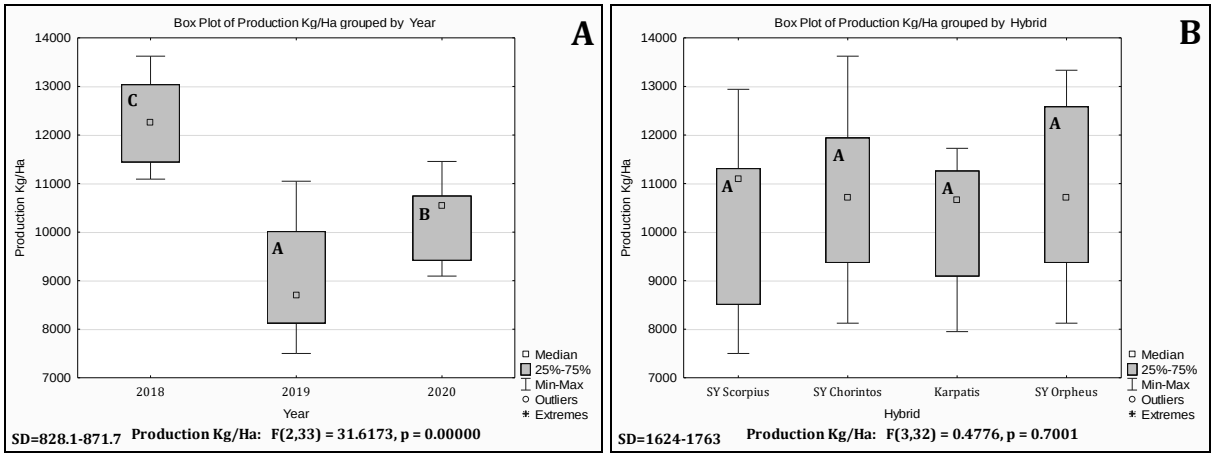


Figure 5. Corn production depending on climatic conditions (A) and corn hybrids (B)

The average yields recorded in the three years for the four hybrids tested do not show differences highlighted by the analysis of variance and the Duncan test (Figure 5B).

The second experiment results

Fusarium sp. attack degree

The climatic conditions in 2019 positively influenced the degree of attack of Fusarium ear rot but not exceeding values of 0.6%. Under these conditions, a correct statistical interpretation is difficult to achieve. Figure 6A shows the difference between the two experimental years.

The low values of the average degree of attack in the two experimental years did not allow a classification (ranking) of the tested hybrids. Analysis of variance did not reveal significant differences between hybrids (p = 0.3257) (Figure 6C). However, the Duncan analysis highlights the hybrids SY Infinite-SC 3477 and EXP 3702 as the only hybrids between which there are significant differences (p = 0.0470) (data are not shown).

As mentioned, the hybrids were divided into three groups to see if the vegetation period influences the attack of pathogens and pests in the climatic conditions of the tested period. Thus the attack of *Fusarium* sp. recorded the lowest values for hybrids in the intermediate late subgroup (IL) (FAO 361-400), the difference compared to hybrids in the other subgroups being statistically covered, both by analysis of variance (p = 0.0074) and by the Duncan test (Figure 6B).

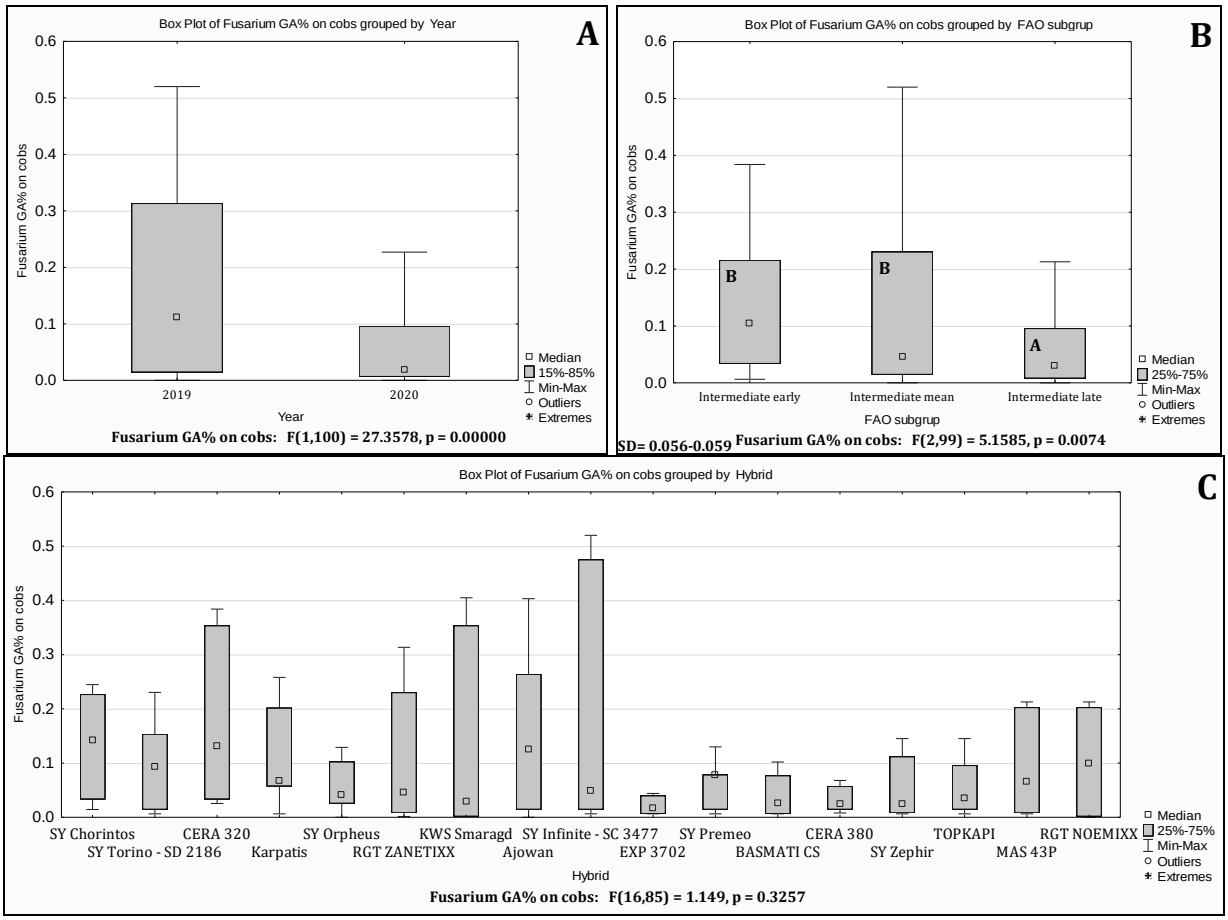


Figure 6. Fusarium sp. attack degree depending on climatic conditions (A), FAO subgroup (B) and corn hybrids (C)

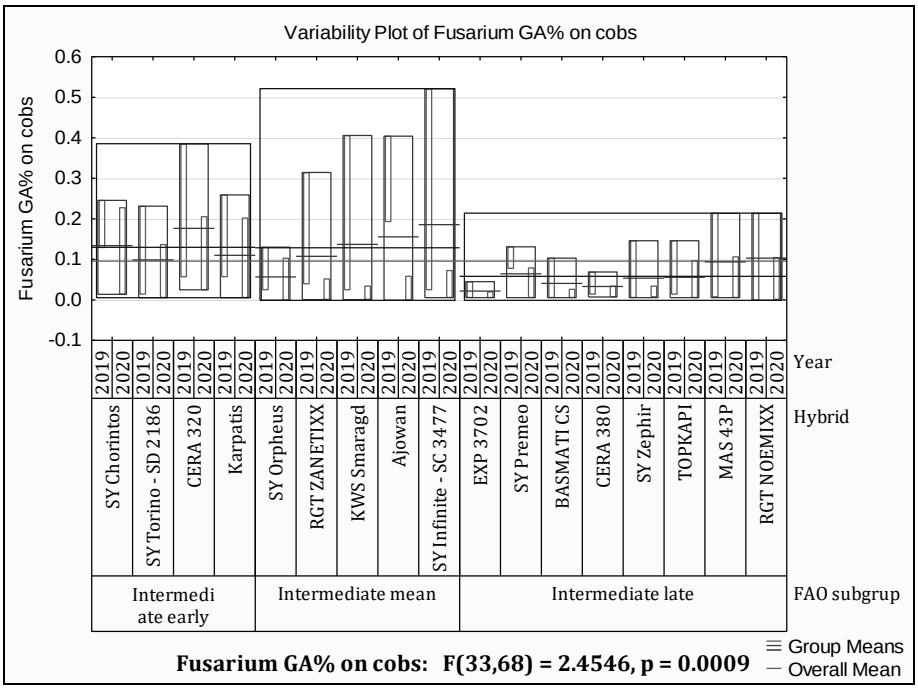


Figure 7. The interaction of the variables studied on the *Fusarium* sp. attack degree

The interaction between the climatic conditions and the tested cultivars highlights a significant difference (p = 0.0009) (Figure 7). As previously mentioned in the Intermediate late (IL) group's hybrids, the low degree of attack was noted. The average of this group is lower than the average of the experience.

Ostrinia nubilalis attack frequency

As expected, the frequency of *Ostrinia nubilalis* attack was higher in 2019 than 2020, which confirms the relationship between this pest attack and *Fusarium* sp. infection (Shpanev et al., 2019; Živanov et al., 2019). The difference between the two years is statistically assured (p = 0.0088).

The average frequency of *Ostrinia nubilalis* attack in the 17 hybrids was between 0-32%. The lowest values were in the hybrids Cera 380 and KWS Smaragd in which the frequency of the attack of the European corn borer did not exceed 4% (Figure 8C). The attack frequency values show significant differences between the tested hybrids, a fact confirmed by the analysis of variance (p = 0.0023).

Among the hybrid subgroups, the Intermediate early (IE) subgroup stands out with the highest value of *Ostrinia nubilalis* attack frequency (Figure 8B), the difference compared to the other groups being statistically assured (p = 0.0004).

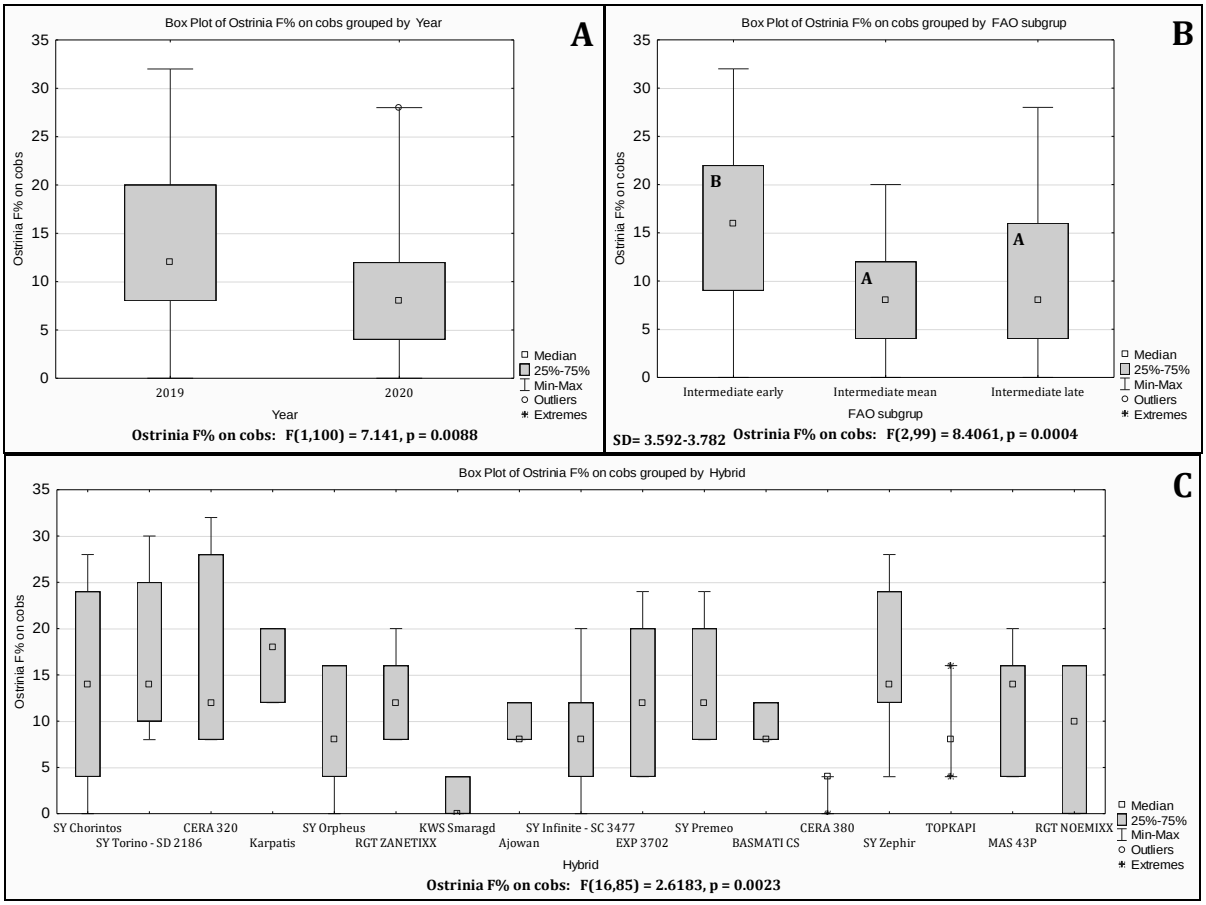


Figure 8. Ostrinia nubilalis attack frequency depending on climatic conditions (A), FAO subgroup (B) and corn hybrids (C)

Although it is known that there is a direct relationship between the attack of *Ostrinia nubilalis* and *Fusarium* sp. it is noted that the vast majority of hybrids follow this rule. However, there are exceptions: hybrids SY Zephir and EXP 3707 with a low degree of *Fusarium* sp. attack but with a higher frequency of *O. nubilalis* attack and hybrids KWS Smaragd and Ajowan with a low frequency of *O. nubilalis* attack and a higher degree of attack of *Fusarium* sp. (Figures 7, 9).

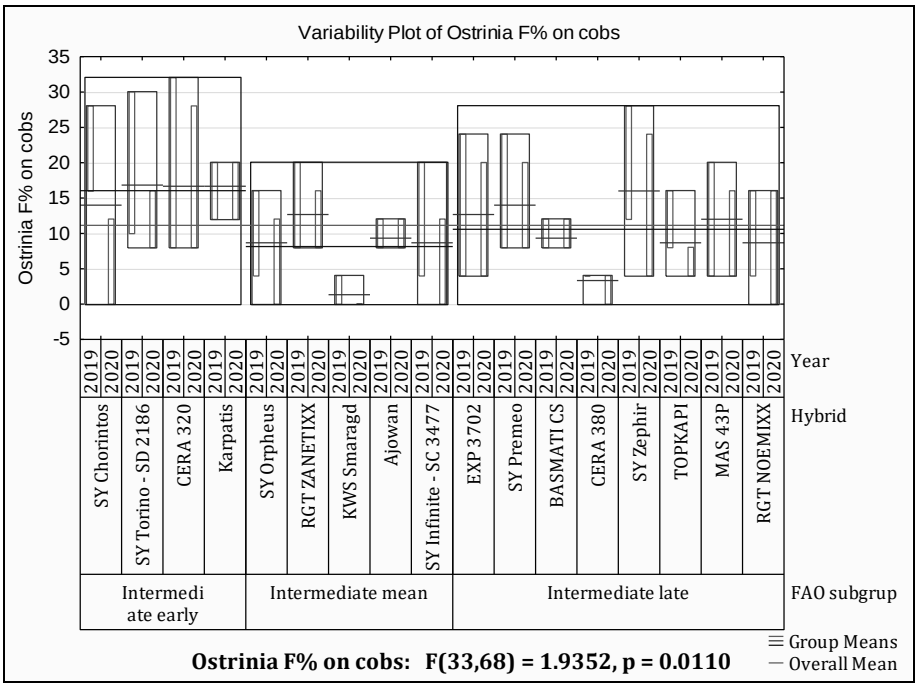


Figure 9. The interaction of the variables studied on the *Ostrinia nubilalis* attack frequency

Corn production

Corn production is the result of high-performance genetics and modern technologies (Hălmajan et al., 2017). The quantity and quality of production are strongly influenced by environmental factors such as temperature, total rainfall and soil water storage (Butts-Wilmsmeyer et al., 2019).

According to the average productions presented in figure 10, we can say that the Transylvanian Plain area is favorable for corn cultivation. Climate change manifested by increases in average annual temperature can increase the area's favorable, conditioned by providing the necessary water. Early research conducted (Liu et al., 2018) has shown that additional irrigation has led to higher maize yields in sub-humid regions, conditioned by providing the necessary water.

The productions calculated in 2019 were between 9190 kg/ha and 11040 kg/ha with an average of 10110 kg/ha, reaching, in exceptional cases, 12400 kg/ha. In 2020, the productions were between 9460 kg and 10900 kg/ha, with an average of 10230 kg/ha and a maximum of 12370 kg/ha. There are no statistically assured differences between the productions obtained in the two years.

Hybrids stand out with high productions were: SY Infinite-SC 3477, Premo and Basmati CS. In these hybrids, in all experimental trials, the production exceeded 10000 kg/ha, in both experimental years. At the opposite pole is the CERA 380 hybrid at which the maximum production did not exceed 10000 kg (Figure 10C). This hybrid also records the lowest values of *Fusarium* sp. attack degree and *Ostrinia nubilalis* attack frequency. In this case, we can say that the production was not influenced by the main biotic factors but by its genetic potential, in interaction with the pedo-climatic conditions in the Transylvanian Plain.

As expected, the hybrids from the intermediate late subgroup (IL), with a longer vegetation period, obtained superior yields, between 9470 kg/ha and 12470 kg/ha (Figure 10B). Yields correlate with low values of Fusarium ear rot and *Ostrinia nubilalis* attack (Figure 7, 9).

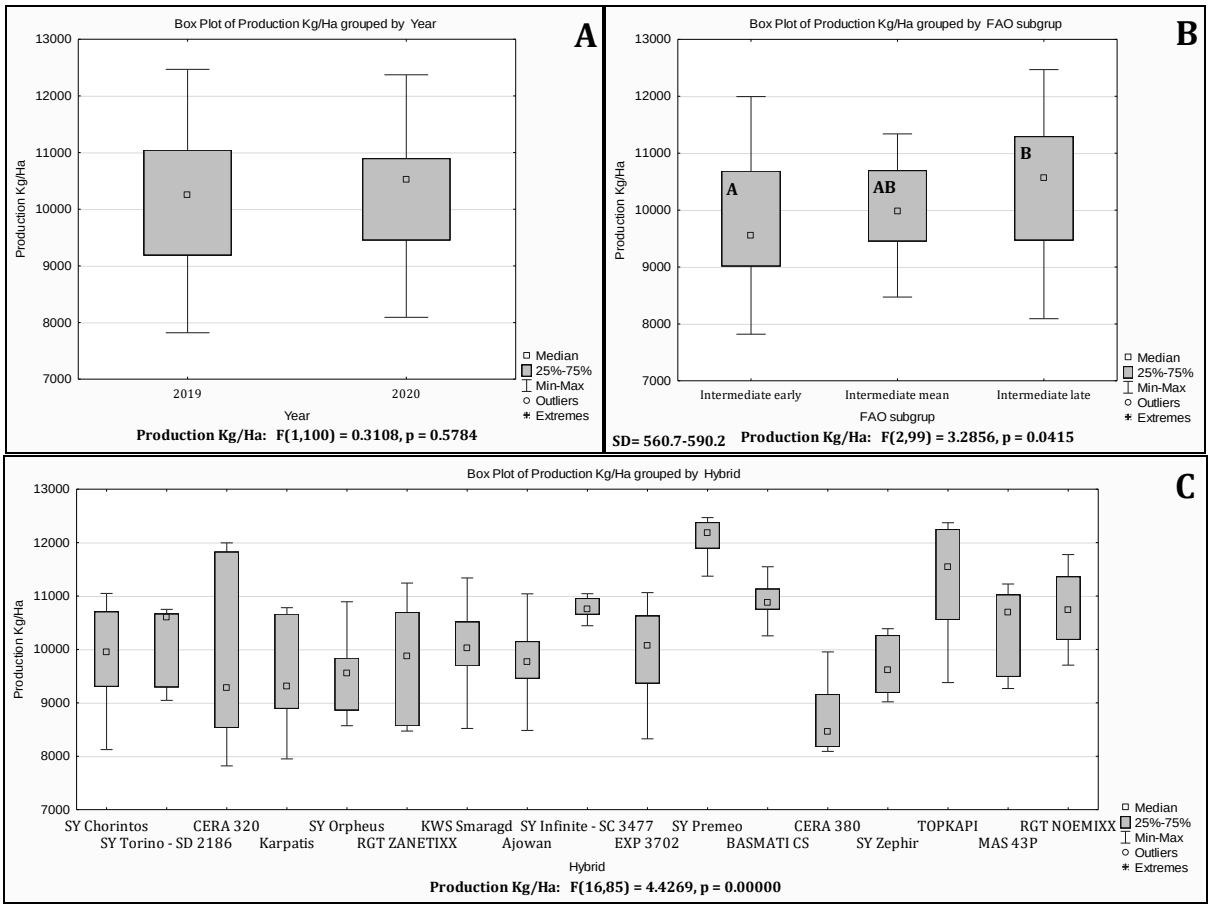


Figure 10. Corn production depending on climatic conditions (A), FAO subgroup (B) and corn hybrids (C)

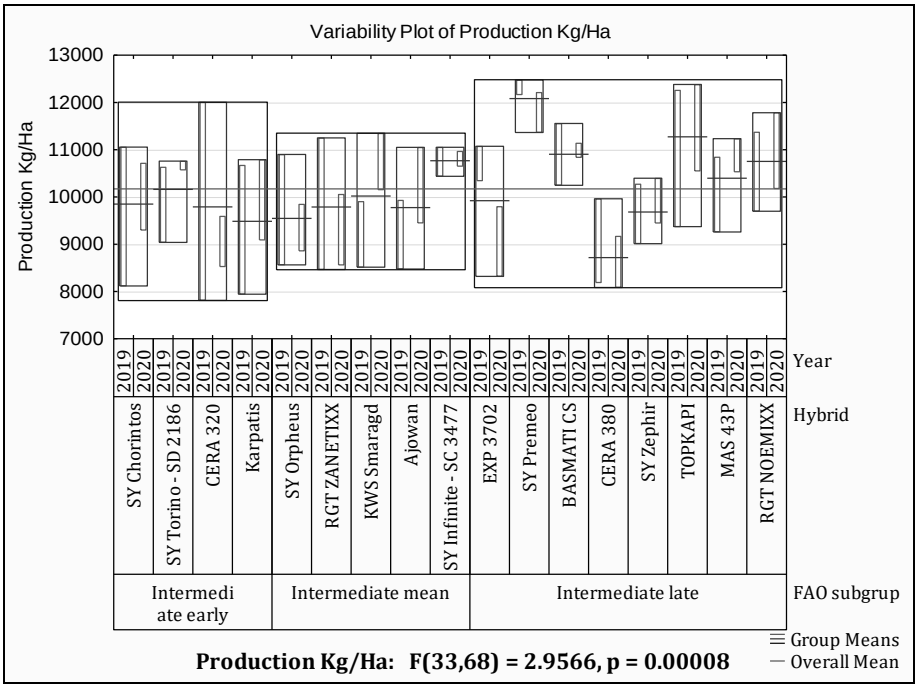


Figure 11. The interaction of the variables studied on the corn production

Under these conditions, we can say that hybrids from the upper FAO group can be successfully cultivated in the experimental area (Transylvanian Plain) although it is recommended to cultivate in this area 75% early hybrids and only 25% medium hybrids (Roman, 2011).

In the climatic conditions of 2019, a dry year, the hybrids reacted differently. Thus hybrids such as KWS Smaragd, Ajowan, SY Torino - SD 2186, MAS 43P, and SY Chorintos, recorded a regression in production, which does not correlate with the attack of *Ostrinia nubilalis* and *Fusarium* sp. but especially with the lack of water for a long period (Figure 1).

Abiotic factors influence maize production as follows: the average temperature, by 0.5-2.2°C during the vegetation period, higher than the multiannual average, leads to production increases recorded especially in late hybrids; uneven distribution of rainfall and exceptionally extended periods of drought can negatively affect the production of corn plants.

CONCLUSIONS

During the studies, there was an uneven distribution of precipitation and even their lack in specific periods of the year with adverse effects on production. The obtained production results urge us to recommend the extension in the culture of the Intermediate late hybrids 361-400 in the Transylvanian Plain, hybrids in which the lowest *Fusarium* sp. and *Ostrinia nubilalis* attack was noted.

REFERENCES

Anderson, R., Bayer, P.E., Edwards, D., 2020. *Climate change and the need for agricultural adaptation.* Current Opinion in Plant Biology, 56: 197-202. https://doi.org/10.1016/j.pbi.2019.12.006

Aydinalp, C.S., and Cresser, M.S., 2008. *The Effects of Global Climate Change on Agriculture.* American-Eurasian J. Agric. & Environ. Sci., 3 (5): 672-676.

Borcean, I., 2003. *Phytotechnics*. Ed. Ion Ionescu de la Brad, Iași, România: 218. (In Romanian)

Butts-Wilmsmeyer, C.J., Seebauer, J.R., Singleton, L., Below, F.E., 2019. *Weather during key growth stages explains grain quality and yield of maize.* Agronomy, 9, 16.

Chabala, L.M., Kuntashula, E., Kaluba, P., Miyanda, M., 2015, *Assessment of Maize Yield Variations Due to Climatic Variables of Rainfall and Temperature.* Journal of Agricultural Science, 7(11): 143-155.

Challinor, A., 2014. *A meta-analysis of crop yield under climate change and adaptation*. Nat. Clim. Chang., 4(4): 287-291.

Chuang, Z., Liu, B., Piao, S., Wang, X., Lobell, D.B., Huang, Y., Huang, M.Y., Yao, Bassu, S., Ciais, P., Durand, J.L., Elliott, J., Ewert, F., Janssens, I.A., Li, T., Lin, E., Liu, Q., Martre, P., Müller, C., Peng, S., Peñuelas, J., Ruane, A.C., Wallach, D., Wang, T., Wu, D., Liu, Z., Zhu, Y., Asseng, Z.S., 2017. *Temperature increase reduces global yields of major crops in four independent estimates.* Proceedings of the National Academy of Sciences of the United States of America, 114(35): 9326-9331.

Cristea, M., 2004. *Economic importance, geographical spread, production and trade in maize, Maize - Monographic study*. Ed. Academiei Române, București, România: 17. (In Romanian)

Czembor, E., 2010. *Prevention of Ear Rots Due to Fusarium Spp. on Maize and Mycotoxin Accumulation.* ENDURE Maize Case Study - Guide Number 3.

Fischer, G., Shah, M., Tubiello, F.V.H., 2005. *Socio-economic and climate change impacts on agriculture: An integrated assessment, 1990-2080*. Philos. Trans. R. Soc. Lond., 360: 2067-2083.

Georgescu, E., Toader, M., Cană, L., Rîşnoveanu, L., 2019. *Researches concerning European corn borer (Ostrinia nubilalis Hbn.) control, in south-east of the Romania*. Scientific Papers, Series A, Agronomy, 62(1).

Gheţe, Al., Haș, V., Vidican, R., Copândean, A., Ranta, O., Moldovan, C., Crișan, I., Duda, M., 2020. *Influence of detasseling methods on seed yield of some parent inbred lines of Turda maize hybrids*. Agronomy, 10, 729.

Hălmajan, H.V., Sitaru, B., Dosinescu, S., Surca, E., Petre, I., 2017. *Maize yield evolution in Romania and farmers' involvement to increase it*. Scientific Papers, Series A, Agronomy, LX: 270-274.

Huang, C., Duiker, S.W., Deng, L., Fang, C., Zeng, W., 2015. *Influence of Precipitation on Maize Yield in the Eastern United States*. Sustainability, 7: 5996-6010.

Ji, F., He, D., Olaniran, A.O., Mokoena, M.P., Xu, J., Shi, J., 2019. *Occurrence, toxicity, production and detection of Fusarium mycotoxin: a review.* Food Production, Processing and Nutrition, 1: 6.

Liu, Y., Yang, H., Li, J., Li, Y., Yan, H., 2018. *Estimation of irrigation requirements for drip-irrigated maize in a subhumid climate*. Journal of Integrative Agriculture, 17(3): 677-692.

Lizaso, J.I., Ruiz-Ramos, M., Rodríguez, L., Gabaldon, Leal, C., Oliveira, J.A., Lorite, I.J., Sáncheza, D., García, E., Rodríguez, A., 2018. *Impact of high temperatures in maize: Phenology and yield components*. Field Crop Research, 216: 129-140.

Marin, L., Birsan, M.V., Bojariu, R., Dumitrescu, A., Micu, D.M., Manea, A., 2014. *An overview of annual climatic changes in Romania: trends in air temperature, precipitation, sunshine hours, cloud cover, relative humidity and wind speed during the 1961-2013 period.* Carpathian Journal of Earth and Environmental Sciences, 9(4): 253-258.

McCarthy, J.J., Canziani, O.F., Leafy, N.A., Dokken, D.J., White, K.S., 2001. *Summary for Policymakers, Climate Change 2001. Impacts, Adaptation, and Vulnerability.* Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK: 10.

Munodawafa, A., 2012. *The effect of rainfall characteristics and tillage on sheet erosion and maize grain yield in semiarid conditions and granitic sandy soils of Zimbabwe*. Applied and Environmental Soil Science, 2012(1), 243815.

Muntean, L.S., Cernea, S., Morar, G., Duda, M.M., Vârban, D., Muntean, S., 2008. *Phytotechnics*. Ed. AcademicPres, Cluj-Napoca, România: 180. (In Romanian)

Nagy, E., 2004. *Corn diseases, Corn - Monographic study*. Ed. Academiei Române, București, România: 548-588. (In Romanian)

Nikolaou, G., Neocleous, D., Christou, A., Kitta, E., Katsoulas, N., 2020. *Implementing Sustainable Irrigation in Water-Scarce Regions under the Impact of Climate Change*. Agronomy, 10: 1120.

Osborne, L.E., and Stein, J.M., 2007. *Epidemiology of Fusarium head blight on small-grain cereals*. International Journal of Food Microbiology, 119: 103-108.

Puia, C., 2005. *Phytopathology, pathography, etiology*. Ed. Risoprint Cluj-Napoca, România: 83-84. (In Romanian)

Roman, G.V., Tabără, V., Robu, T., Pîrșan, P., Ștefan, M., Axinte, M., Morar, G., Cernea, S., 2011. *Phytotechnics - vol I, Cereals and legumes for grains*. Ed. Universitară, București, România: 215. (In Romanian)

Scarpino, V., Reyneria, A., Vanaraa, F., Scopelb, C., Causinb, R., Blandino, M., 2015. *Relationship between European Corn Borer injury, Fusarium proliferatum and F. subglutinans infection and moniliformin contamination in maize*. Field Crops Research, 183: 69-78.

Shpanev, A.M., Laptiev, A.B., Baibakova, N.Y., 2019. *Development and Harmfulness of the European Corn Borer, Ostrinia nubilalis Hb. (Lepidoptera, Pyralidae), in the Central Chernozem Region*. Entomological Review, 99: 437-445. doi:10.1134/s001387381904002x

Șimon, A., Chețan, F., Oltean, V., 2018. *Climate characterization of 2018 and its influence on production in the main agricultural crops.* Agricultura Transilvana, România: 11-17. (In Romanian)

Şimon, A., 2019. *Climatic particularities of the year 2019 in Turda*. Agricultura Transilvana, România: 9-14. (In Romanian)

Szőke, C., Zsubori, Z., Pók, I., Rácz, F., Illés, O., Szegedi, I., 2002. *Significance of the European corn borer (Ostrinia nubilalis Hübn.) in maize production*. Acta Agronomica Hungarica, 50: 447-461. doi:10.1556/aagr.50.2002.4.8

Tărău, A., Păcurar, A.M., Mureșanu, F., Isopteran, L., Chețan, F., Varga, A., Porumb, I., Russu, F., Suciu, L., 2019. *The research on the chemical control of the Ostrinia nubilalis, in natural and artificial infestation conditions, important link in integrated pest management.* Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 19(3): 585.

Tărău, A.D., Sopterean, L., Valean, A.M., Suciu, L., Russu, F., Varga, A., Crisan, I., Popa, C., 2024. *Behavior of Some Maize Hybrids to the Attack of the European Corn Borer (Ostrinia nubilalis Hbn.) and Fusarium Ear Rot (Fusarium sp.)*. Romanian Agricultural Research, 41: 33-45. https://doi.org/10.59665/rar4104

Vălean, A., Mureșanu, F., Tărău, A., Suciu, L., Șopterean, L., Oltean, I., 2017. *Research on the relationship between the degree of european corn borer (Ostrinia nubilalis Hbn.) attack and maize fusariosis (Fusarium spp.) at ARDS Turda*. Bulletin USAMV, Series Agriculture, 74: 57-64. doi:10.15835/buasvmcn-agr:12659

Zayan, S.A., 2019. *Impact of Climate Change on Plant Diseases and IPM Strategies*. Open access peer-reviewed chapter: 83-91.

Zhukovskaya, M.I., Selitskaya, O.G., Shchenikova, A.V., Frolov, A.N., 2020. *Pheromone responses of Ostrinia nubilalis (Hübner) from north of its range in Europe*. BIO Web of Conferences, 18, 00031.

Živanov, S.T., Lalošević, M., Jevtić, R., Franeta, F., Milovac, Ž., Stanisavljević, D., Purar, B., 2019. *Fungal biodiversity on maize kernels in an insecticide evaluation trial*. Pestic. Phytomed. (Belgrade), 34(1): 31-37.

*** APPR annual report, 2019, 2020.

*** https://primariajucu.ro/comuna-jucu/prezentare-generala/