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INFLUENCE OF BIOTIC AND ABIOTIC FACTORS ON MAIZE CROP YIELD IN TRANSYLVANIAN PLAIN CONDITIONS

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Abstract

The yield of a crop is dependent on the interaction of biotic and abiotic factors, the most important being the pedo-climatic conditions and the attack of diseases and pests. The aim of this paper is to evaluate the impact of the interaction of biotic and abiotic factors on the yield of the Turda 332 maize hybrid in the period 2018-2020. A multifactorial experiment was organized, with the following graduations: factor A - climatic conditions in the experimental years (2018-2019-2020), factor B - tillage system (conventional, minimum tillage with chisel, minimum tillage with disc, no-tillage), factor C - foliar fertilizers (different grades of mineral fertilization with macro and microelements). The obtained results indicate that the way of processing the soil has an influence on the water reserve in the soil and on the yield elements, but the biggest impact has the environmental conditions, in 2018 and 2020, favorable years for maize cultivation, the yield was 8971 kg/ha respectively 8578 kg/ha, and in 2019, a less favorable year, the yield was 5581 kg/ha. The frequency and intensity of the attack of diseases and pests are influenced by the variation of climatic conditions, in 2018 and 2020 registering the highest frequency of attack, the tillage system as well by the level of fertilization, in the variants with foliar fertilization registering the lowest attack.

***Key words**: maize, yield, tillage systems, Fusarium sp., Ostrinia nubilalis.*

INTRODUCTION

In the current climatic conditions, the identification of new technological solutions for the cultivation of maize, are important premises for increasing the stability of yield.The appearance and installation of temperatures of 32ºC or above this threshold, determines the appearance of the heat phenomenon, a phenomenon that manifests itself quite frequently in the Transylvanian Plain. According to the data of the National Meteorological Agency (NMA), the evolution of heat intensity in Romania, in the period 1961-2010, highlights an upward trend, started in 1981, a trend that continues today (Sin and Popescu, 2015).Sandu and Mateescu (quoted by Sin and Popescu, 2015), states that for maize, according to climate predictions of rising air temperatures, there will be a shortening of the vegetation period by seven days until 2020 and 12 days until 2050 and decrease in yield with 14% by 2020 respectively 21% by 2050, depending on soil water deficits, especially in the grain filling phase (July-August).

From sowing to harvesting maize is subject to many stressors, both biotic and abiotic, these factors together make up an ecosystem.

Crop yields depends by many environmental factors (Ranjan et al., 2006; Espósito et al., 2009) such as temperature, precipitations, tillage or soil type and moisture and whose effects are difficult to predict (Marin et al., 2012; Rusu, 2014).

The introduction of conservative agriculture systems seeks to improve, conserve and make more efficient use of natural, biological and water resources (Guş et al., 2003; Rusu et al., 2009).

Soil conservation systems have specific characteristics in different areas and countries, related to the specifics of ecology and cultivated plants, thus requiring different implementation models (Florea, 2003; Guș et al., 2004; Feiza et al., 2005; Jităreanu et al ., 2006; Rusu et al., 2009; Moraru and Rusu, 2010).

The yielding of plants cultivated in no-tillage systems is, generally, lower than of plants from conventional tillage systems (Woźniak, 2013).

In addition to the genetic factor, the cultivation technologies adapted to the zonal ecological conditions, can make an important contribution in limiting the yield losses, from one year to another.

At the same time, it is known that technological elements can influence in one way or another the evolution of biotic factors in an agro-ecosystem, factors that can manifest under certain conditions a significant impact on maize yield.Also, climate change and extreme phenomena increase the vulnerability of plants to the attack of pests and pathogens.

Biotic factors also have a high impact on the formation of yield, as they are the living parts of an environment, such as plants, animals and microorganisms, especially specific diseases and pests.

Maize infection with *Fusarium* sp. it can occur throughout its cultivation. This can cause different types of diseases in the vegetative and generative organs of the plant.Along with these infections, mycotoxins are often produced and accumulated in the affected tissues, which could pose a significant risk to human and animal health upon entering the food and feed chain (Oldenburg et al., 2017).

The rot of cobs is the most common disease of maize, caused by several species of the genus *Fusarium*. The symptoms are those of mold, white to pink or salmon, which appears on isolated caryopsis, scattered or grouped on several caryopsis (CPN, 2021).

The penetration of agents into the plant is more frequent through wounds, produced by insects, such as corn borer, poultry or hail (Oldenburg et al., 2017).

Factors contributing to *Fusarium* spp. Infections are climatic/meteorological conditions, plant cultivation technology/protection measures and stress conditions. Agricultural practices that allow effective management to reduce the risk of *Fusarium* infection and the accumulation of mycotoxins are: tillage that ensures rapid decomposition of plant residues infected and contaminated with *Fusarium*, selection of hybrids with low sensitivity, extensive crop rotation, a balanced fertilization and insecticide treatment alone or in combination with fungicides, where appropriate (Oldenburg et al., 2017).

The corn borer (*Ostrinia nubilalis* Hbn.) is the main pest of maize cultivation in areas of Transylvania, one of its favorable areas (Barbulescu et al., 2001; Georgescu et al., 2015), which in certain climatic conditions and non-compliance agrophytotechnical measures can cause significant damage.Due to the climatic conditions of May-June-July, which have changed in recent years and no longer fit the pattern of recent decades, the corn borer attack can be carried out with a different intensity from one year to another, so maoze hybrids, tolerant to pest attack, may become sensitive in favorable years (Ivaş et al., 2013).

All the attack parameters of the corn borer ultimately lead to significant crop losses (Tărău et al., 2019). The application of chemical treatments against this pest could negatively influence the quality of yield. Thus, efforts to find alternative methods of limiting the harmful effects of diseases and pests are an important link in agricultural practices. One such method is the diversified use of mineral fertilization (Bocianowski et al., 2016).

Given these, the paper aims to investigate the influence of technological elements (soil tillage and fertilization system) on maize yield and the evolution of diseases and pests specific to this crop in the Transylvanian Plain, in 3 years of experimentation (2018-2020).

MATERIALS AND METHODS

The researches took place in the period 2018-2020, at the Agricultural Research and Development StationTurda (ARDS Turda), on a Faeoziom type soil.

The experience is a three-factor one, and the surface of an experimental plot is 48 m^2. During the experiment, the sowing of maize was done with the machine MT6-Maschio Gaspardo. The sowing density was 65000 plants/ha and the seed incorporation depth was 5 cm.The preplant was winter wheat. The biological material was represented by the maize hybrid Turda 332, created at ARDS Turda.

To meet the proposed objectives, a multifactorial experiment was organized, with the following graduations: factor A-climatic conditions in the experimental years: a_1-2018; a_2-2019; a_3-2020; factor B-tillage system: b_1-conventional tillage system (plowing with turning the furrow), b_2-minimum tillage system (with chisel), b_3-minimum tillage system (with disk harrow), b_4-no-tillage system; factor C-foliar fertilizers: c_1-mineral fertilization (control); c_2-mineral fertilization + Haifa 19:19:19 + Mg + Microelements (5 kg/ha); c_3-mineral fertilization + Folimax Oleo 12-04-24 + 2.0% MgO + 36.5% SO_3 + Microelements (1.5 kg/ha), c_4-mineral fertilization + Folimax Gold 27.0% N + 1.5% MgO + 0.02% B + 0.2% Cu + 0.02% Fe + 1.0% Mn + 0.02% Mo + 0.02% Zn (3 l/ha). Two foliar treatments were performed, the first treatment was performed in the 8-10 leaf phenophase, and the second treatment was performed in the 10-12 leaf phenophase.

Mineral fertilization was carried out in two phases: simultaneously with sowing, applying a complex fertilizer type NPK (27%N:13.5%P_2O_5:0) at a dose of 250 kg/ha, and on vegetation in the phenophase of 6-8 leaves administering a CAN type fertilizer (27% N: 7% CaO: 5% MgO) in a dose of 120 kg/ha, in all variants.

The climatic conditions in the three experimental years were different, with temperature variations from one month to another even from one decade to another, often registering temperatures higher than normal (Table 1).

From a thermal point of view, the 3 years studied were characterized as warm years, with an increase in the average annual temperature, compared to the average of 60 years during the vegetation period of 2.7^{0}C (2018), of 1.6^{0}C (2019) and 1.0^{0}C (2020).

During the vegetation period of maize crops, the average monthly temperatures increased compared to the multiannual average, except for May (in 2019 and 2020) which had a cool character with negative deviations from the average of 1.4^{0}C, respectively 1.3^{0}C.

Regarding the amount of precipitation from April to October, a variation can be observed from one month to another, which causes the maize to be affected by the transitions from one extreme to another, meaning from significant amounts of precipitation to days with prolonged drought.

The monthly precipitations registered in 2018 and 2020 had negative deviations from the normal in April and May, and in 2019 in the period June-July the lowest values were registered from a quantitative point of view (Table 2).

Although they were oscillating, still the temperatures recorded in the vegetation period correlated with the precipitations fallen in the same period met favorable conditions for the optimal development of the maize crop in 2018 and 2020, in 2019 the lack of precipitation was felt by the plants during the most important, from the second decade of August until the physiological maturity of the plants.

Table 1. The average air temperature (^{0}C) during the period 2018-2020, ARDS Turda

Experimental year	Average air temperature (°C)						
	Moon/Decade	April	May	June	July	August	September
2018	Decade I	12.4	19.6	20.5	18.5	23.2	19.6
	Decade II	16.6	15.6	20.5	20.5	22.3	18.8
	Decade III	17.0	20.7	17.5	22.0	21.6	11.5
	Monthly average	15.3	18.7	19.4	20.4	22.3	16.7
	Average 60 years	9.9	15.0	17.9	19.7	19.3	15.1
	Deviation	5.4	3.7	1.5	0.7	3.0	1.6
2019	Decade I	11.9	10.8	19.7	21.2	20.6	20.4
	Decade II	9.5	14.6	23.6	17.4	22.2	16.5
	Decade III	12.6	15.2	22.1	22.4	23.5	14.4
	Monthly average	11.3	13.6	21.8	20.4	22.1	17.1
	Average 60 years	9.9	15	17.9	19.7	19.3	15.1
	Deviation	1.4	-1.4	3.9	0.7	2.8	2
2020	Decade I	8.7	12.1	17.4	20.9	22.9	19.1
	Decade II	11	16.5	19.2	18.4	20.6	19.3
	Decade III	11.1	12.5	20.8	21.1	21	15.1
	Monthly average	10.3	13.7	19.1	20.2	21.5	17.8
	Average 60 years	9.9	15	17.9	19.7	19.3	15.1
	Deviation	0.4	-1.3	1.2	0.5	2.2	2.7

Table 2. The amount of precipitation (mm) during the period 2018-2020, ARDS Turda

Experiemntal year	Precipitation (mm)						
	Moon/Decade	April	May	June	July	August	September
2018	Decade I	5.4	16.8	13.8	51.9	20.6	15.2
	Decade II	14.4	33.4	67.5	28.2	0.0	10.0
	Decade III	6.4	6.6	17.0	5.6	17.6	4.6
	Monthly amount	26.2	56.8	98.3	85.7	38.2	29.8
	Average 60 years	45.9	68.7	84.8	77.1	56.5	42.5
	Deviation	-19.7	-11.9	13.5	8.6	-18.4	-12.7
2019	Decade I	3.8	34.8	30.6	7.6	59.6	0
	Decade II	34.8	38.8	5.6	25.2	3	0.4
	Decade III	24	78.8	32.6	2.2	1.2	19
	Monthly amount	62.6	152.4	68.8	35	63.8	19.4
	Average 60 years	45.9	68.7	84.8	77.1	56.5	42.5
	Deviation	16.7	83.7	-16	-42.1	7.2	-23.1
2020	Decade I	0	10.2	16	23	3.6	6.6
	Decade II	0.8	11.2	115	51.6	53.6	0
	Decade III	17	23	35.6	12.2	0.8	50.8
	Monthly amount	17.8	44.4	166.6	86.8	58	57.4
	Average 60 years	45.9	68.7	84.8	77.1	56.5	42.5
	Deviation	-28.1	-24.3	81.8	9.7	1.5	14.9

RESULTS AND DISCUSSIONS

In addition to the amount of rainfall during the vegetation period and the water reserve in the soil is a decisive factor in achieving production. Monitoring the water supply in the soil, even before sowing the crop, is very important because all stages of development are dependent on rainwater and soil, taking into account the fact that in the research perimeter it is the only source of water.

According to data from the literature (Guş et al., 2004; Feiza et al., 2005; Jităreanu et al., 2006; Rusu et al., 2009; Moraru and Rusu, 2010) by applying conservative tillage systems reserve of water in the soil registers an increase compared to the conventional tillage system, this fact is also confirmed by the data recorded in this experiment, where it can be seen that both on the depth of 0-20 cm (Figure 1) and on the depth of 0-50 (Figure 2) the water reserve is higher in most conservative tillage variants.

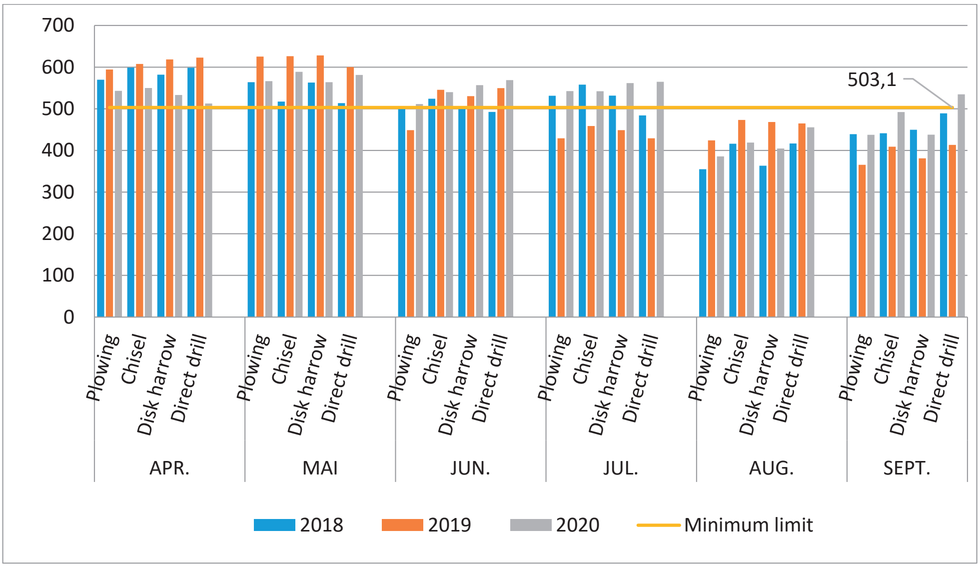

Figure 1. Momentary soil moisture reserve on the layer 0-20 cm (m^3/ha)

In 2018, the soil water reserve exceeded the minimum limit, on both layers, during the sowing period and until the beginning of August, when there were decreases in the values below the minimum limit level, the maizer being in that period in the phenophase baking in milk and staying below this limit until harvest.

The year 2019 was quite similar to 2018 in terms of soil water supply, in the early stages of development, but since July the values have started to fall below the minimum limit.

Maize cultivation has been affected by the lack of water since the split phenophase to harvested, the most visible effect being grain ripening, which implicitly leads to decreased yield.

And in the third experimental year the soil water supply was at appropriate values for a good development of the crop, until the end of August, when the corn was in the milk-wax phenophase, when the first decreases in water supply. These low values remained until the end of September.

The lack of precipitation correlated with the high temperatures means that the yield obtained from the maize crop are negatively affected, and the plants consume more energy in order to obtain significant yield increases, the climatic conditions being still the most important factor determining the yield of a cultures.

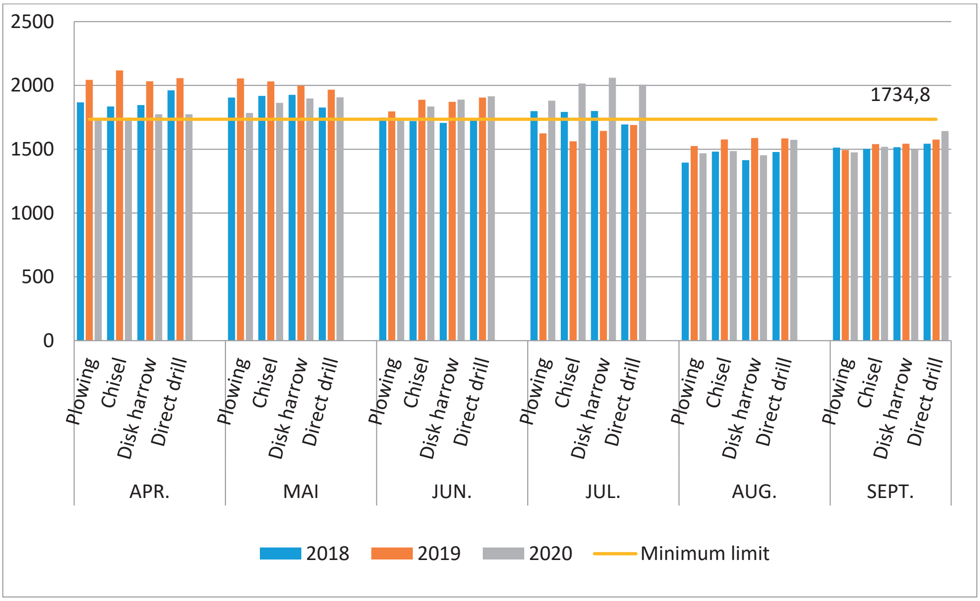

Figure 2. Momentary soil moisture reserve on the layer 0-50 cm (m^3/ha)

As can be seen in Table 3, the yield recorded in the three years studied varied, the years 2018 and 2020 having more favorable conditions for culture and 2019 being less favorable.

The lack of precipitation during the ripe-maturity period left its mark on the yield achieved in 2019, registering the smallest increase in yield, of only 5581 kg/ha, with a very significant negative difference of 2129 kg/ha compared to the average of those 3 years.

Although the precipitation regime in the milk-baking phenophase was deficient in 2018 and 2020, the crop still managed to overcome this period and record significant increases in yield, with very significant positive differences of 1261 kg/ha (2018) respectively 868 kg/ha (2020) compared to the average of the 3 years.

The application of conservative tillage systems, from the point of view of the obtained yields is not efficient, in all the 3 variants of conservative tillage registering very significant decreases of yield from 603 kg/ha in case of tillage with disc harrow and up to 1780 kg/ha in the case of direct sowing.

Although conservation systems are seen as a way to protect and preserve the soil and its properties, in some cases the benefits of conservation systems are not visible in the short term.

In addition to the basic fertilization applied simultaneously with sowing, the maize crop reacts positively to the application of foliar fertilizers, registering very significant yield increases of up to 611 kg/ha when applying the Folimax Gold product at a dose of 3 l/ha.

The tillage system influences the obtained yield, so that in the classical system an average production of over 8000 kg/ha was obtained in all fertilization variants, the lowest yields being registered in the no tillage system with differences of over 1000 kg/ha, in all fertilization variants. The application of foliar fertilizers can bring an increase in yield of up to 766 kg/ha when applying the Haifa product (Table 4).

Table 3. The influence of experimental factors on maize yield, Turda 2018-2020

Factor	Yield (kg/ha)	%	Difference
Experimental years			
Years average (control variant)	7710	100	0.00
2018	8971***	116	1261
2019	5581^{000}	72	-2129
2020	8578***	111	868
LSD (p 5%) 118; LSD (p 1%) 157; LSD (p 0.1%) 204			
Tillage sistems			
Conventional (control variant)	8480	100	0.00
Minimum tillage (chisel variant)	7789^{000}	91	-691
Minimum tillage (disk harrow variant)	7871^{000}	93	-609
No-tillage	6700^{000}	79	-1780
LSD (p 5%) 119; LSD (p 1%) 180; LSD (p 0.1%) 290			
Foliar fertilization			
Basic fertilization (control variant)	7342	100	0.00
Basic fertilization + Haifa	7887***	107	545
Basic fertilization + Folimax Oleo	7658***	104	317
Basic fertilization + Folimax Gold	7953***	108	611
LSD (p 5%) 141; LSD (p 1%) 191; LSD (p 0.1%) 256			

The 3 experimental years were different, the climatic factor having a great influence on the yield. The years 2018 and 2019 were close in terms of yield values, the highest yield was recorded in 2018 in the classical tillage system 9565 kg/ha, and the lowest yield was recorded in 2019 in the no tillage system of 3986 kg/ha (Table 5).

Table 4. The influence of the interaction of tillage system and foliar fertilization factors on maize yield, Turda 2018-2020

Variant	Yield(kg/ha)	%	Difference
Conventional x Basic fertilization (control variant)	8011	100	0.00
Minimum tillage (chisel variant) x Basic fertilization	7315^{000}	91	-696
Minimum tillage (disk harrowvariant) x Basic fertilization	7499^{00}	94	-512
No-tillage x Basic fertilization	6543^{000}	82	-1467
Conventional x Basic fertilization Haifa (control variant)	8777	100	0.00
Minimum tillage (chisel variant)x Basic fertilization + Haifa	7998^{000}	91	-779
Minimum tillage (disk harrow variant) x Basic fertilization + Haifa	8028^{000}	92	-750
No-tillage x Basic fertilization + Haifa	6744^{000}	77	-2034
Conventional x Basic fertilization + Folimax Oleo (control variant)	8365	100	0.00
Minimum tillage (chisel variant) x Basic fertilization + Folimax Oleo	7870^{00}	94	-495
Minimum tillage (disk harrow variant) x Basic fertilization + Folimax Oleo	7747^{000}	93	-619
No-tillage x Basic fertilization + Folimax Oleo	6651^{000}	80	-1714
Conventional x Basic fertilization + Folimax Gold (control variant)	8767	100	0.00
Minimum tillage (chisel variant) x Basic fertilization + Folimax Gold	7973^{000}	91	-793
Minimum tillage (disk harrow variant)x Basic fertilization + Folimax Gold	8210^{000}	94	-557
No-tillage x Basic fertilization + Folimax Gold	6861^{000}	78	-1906
LSD (p 5%) 270; LSD (p 1%) 375; LSD (p 0.1%) 520			

Table 5. The influence of the interaction between the soil tillage and the experimental years factors on maize yield, Turda 2018-2020

Variant	Yield(kg/ha)	%	Difference
Conventional x 2018(control variant)	9565	100	0.00
Minimum tillage (chisel variant) x 2018	9472	99	-94
Minimum tillage (disk harrow variant) x 2018	9473	99	-92
No-tillage x 2018	7374^{000}	77	-2191
Conventional x 2019 (control variant)	6553	100	0.00
Minimum tillage (chisel variant) x 2019	5865^{000}	90	-687
Minimum tillage (disk harrow variant) x 2019	5920^{000}	90	-632
No-tillage x 2019	3986^{000}	61	-2566
Conventional x 2020 (control variant)	9323	100	0.00
Minimum tillage (chisel variant) x 2020	8031^{000}	86	-1292
Minimum tillage (disk harrow variant) x 2020	8219^{000}	88	-1103
No-tillage x 2020	8739^{000}	94	-583
LSD (p 5%) 226; LSD (p 1%) 310; LSD (p 0.1%) 428			

Results on cob fusarium wilt.

From the data presented in Table 6 we can observe that the frequency and intensity of the attack of *Fusarium* sp. were influenced differently by climatic conditions. The highest value of the attack frequency was recorded in 2018 (48.63). Compared to this, in 2019 and 2020 the frequency of the attack was reduced, with statistically assured differences compared to the control. The climatic conditions in 2018 were favorable for the fusariosis attack, this year the highest value was registered (5.55). Against the background of the climatic conditions from 2020, the frequency of the attack of *Fusarium* sp. was the lowest, with a significantly negative difference from the control variant.

The tillage system can influence the attack of pathogens. Data from the literature specify that by tillage are incorporated plant residues that may contain resistance spores of the pathogen.The data presented in Table 7 confirm the data in the literature, the frequency of the attack of fusariosis has the lowest value if the plot was shown and plant debris incorporated into the soil. In the case of the intensity of the attack, the highest value was recorded in the case of the undeveloped plot (5.06) followed by the plot in which a disc passage was made (4.91). Even if the plot shows that the intensity was slightly higher, the low value of the degree of attack is given by the product between frequency and intensity.

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To prevent the attacks of phytopathogens, a balanced fertilization is recommended, respecting the specific doses of each plant. A properly "fed" plant fights better against pests.

Additional fertilization can negatively or positively influence the attack of phytopathogens. The mean frequency of fusariosis attack was higher in the case of fertilization with Haifa and lower in the case of fertilization with Folimax Oleo and Folimax Gold, but the differences from the control were not statistically assured (Table 8). The intensity of the attack had the highest value (5.01) in the variant where no additional fertilization was done (Table 8).

Table 6. The influence of climatic conditions on the *Fusarium* attack, Turda 2018-2020

Year	Freqency (arcsin√%)	Differeces compared to control %	Differeces compared to control	Intensity (arcsin√%)	Differeces compared to control %	Differeces compared to control
2018	48.63	100	0.00	5.55	100	0.00
2019	33.47	68.8	-15.17[00]	4.61	83.0	-0.95
2020	39.47	81.1	-9.17[0]	4.48	80.8	-1.07[0]
LSD (p 5%)			6.02			0.95
LSD (p 1%)			9.96			1.58
LSD (p 0.1%)			18.64			2.95

Table 7. The influence of tillage systems on the *Fusarium* attack, Turda 2018-2020

Variant	Freqency (arcsin√%)	Differeces compared to control %	Differeces compared to control	Intensity (arcsin√%)	Differeces compared to control %	Differeces compared to control
Conventional (control variant)	39.79	100	0.00	4.83	100	0.00
Minimum tillage (chisel)	40.38	101.5	0.60	4.72	97.8	-0.11
Minimum tillage (disk harrow)	41.61	104.6	1.82	4.91	100.6	0.08
No-tillage	40.32	101.3	0.53	5.06	103.8	0.23
LSD (p 5%)			2.14			0.41
LSD (p 1%)			2.98			0.57
LSD (p 0.1%)			4.00			0.77

Table 8. The influence of foliar fertilization on the *Fusarium* attack, Turda 2018-2020

Variant	Freqency (arcsin√%)	Differeces compared to control %	Differeces compared to control	Intensity (arcsin√%)	Differeces compared to control %	Differeces compared to control
Mineral fertilization (control variant)	41.36	100	0.00	5.01	100	0.00
Mineral fertilization + Haifa	42.75	103.4	1.39	4.70	97.7	-0.31
Mineral fertilization + Folimax Oleo	38.69	93.6	-2.67	4.96	98.9	-0.05
Mineral fertilization + Folimax Gold	39.30	95.0	-2.06	4.85	96.8	-0.16
LSD (p 5%)			2.93			0.39
LSD (p 1%)			3.90			0.52
LSD (p 0.1%)			5.05			0.68

Results of *Ostrinia nubilalis* Hbn. attack.

Little information is available in the literature on the effect of fertilization on corn borer damage. Previous studies (Kolmanič, 2017; Bocianowski et al., 2016) report increases in the percentage of cobs attacked with supplemental doses of mineral nitrogen (Slovenia) or insignificant differences between fertilized variants with mineral fertilizer (Poland).

The results obtained in this paper are similar to those in Poland, even in the case of the interaction between the tillage system and fertilization, the corn borer attack being insignificant. The highest percentage of attacked cobs was registered in the foliar fertilized variants with the commercial product Haifa, while the lowest percentage appeared in the variants fertilized with the Folimax Gold product (Figure 3).

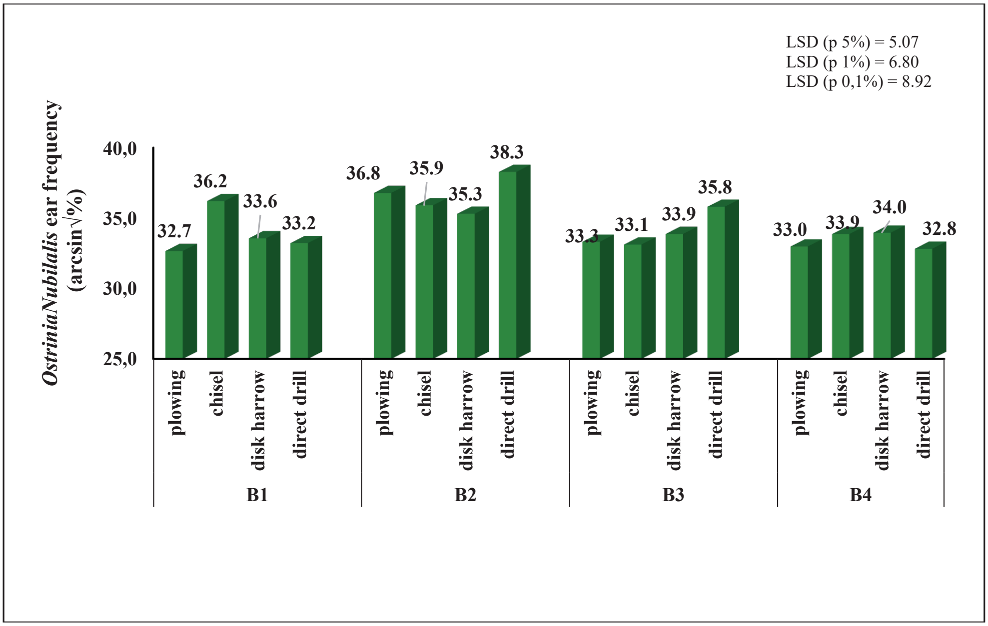

Figure 3. The influence of the interaction between the tillage system and fertilization on the frequency of the corn borer (*Ostrinia nubilalis* Hbn.) attack on cobs (ARDS Turda, 2018-2020)

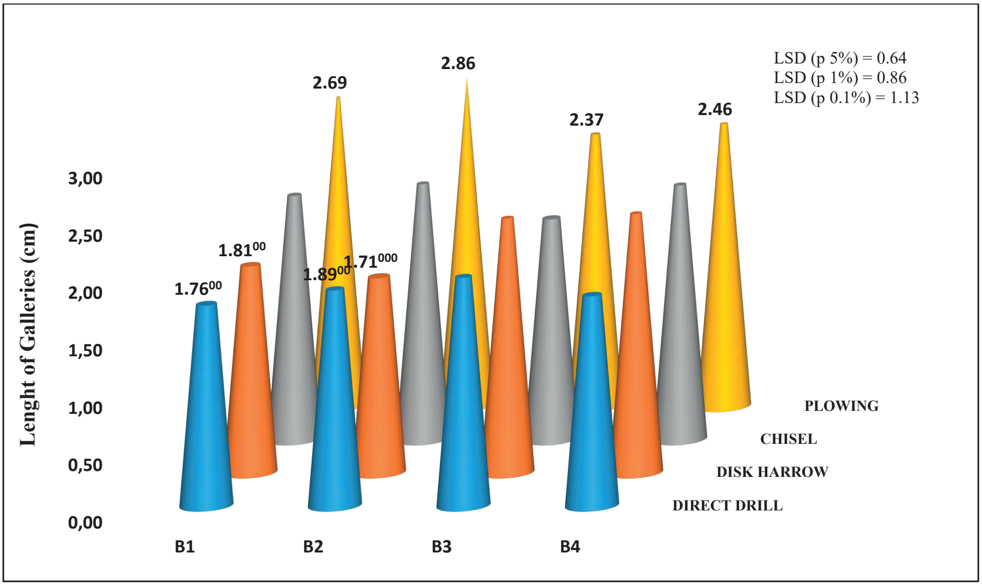

Figure 4.The influence of the interaction between the tillage system and fertilization on the length of the galleries produced by the corn borer (*Ostrinia nubilalis* Hbn.)(ARDS Turda, 2018-2020)

Regarding the intensity of the corn borer attack, represented by the length of the galleries (Bažok et al., 2009), (Figure 4), all interactions between systems and fertilization to some extent limit the corn borer attack to the control (Conventional tillage x fertilization). The highest values of the length of the galleries are registered in the control variant fertilized with the Haifa product. Due to this fact, the variants fertilized with this product had the highest statistically significant meanings as negative (Minimum tillage -disk variant x Haifa) (Figure 4).

Phelan et al. (1995) showed that sowing maize in the conventional system (plowing) did not influence the massive egg laying of *Ostrinia nubilalis*, but increased its probability, depending on the fertilizer used.

These results suggest that soil management practices and mineral fertilization may differently affect the attack of the corn borer, significantly in the case of the stem attack, represented by the length of the galleries, and insignificantly in the case of the cob attack.

CONCLUSIONS

The lack of precipitation during the ripe-maturity period is an important factor that leads to the decrease of the realized yield, in 2019 registering the smallest increase of yield, of only 5581 kg/ha, with a very significant negative difference compared to the 3 years.

The low amount of precipitation correlated with the high temperatures makes the plants consume more energy in order to obtain significant yield increases, the climatic conditions being still the most important factor that determines the yield of a crop.

Plowing with the return of the furrow is still the best agrotechnical method by which the attack of diseases and pests can be reduced, by tillage being incorporated the vegetal remains that can contain spores of resistance of the pathogen.

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