

COMPARATIVE STUDY OF THE AGRONOMIC CHARACTERISTICS OF SIX MAIZE HYBRIDS IN THE ARAD PLAIN, WITH A VIEW TO THEIR INTRODUCTION IN TO CULTURE

Anca Maria PORUBSKI¹, A.A. CRIȘAN¹, Simona NIȚĂ^{1*}, L. NIȚĂ^{1*}

¹ University of Life Sciences "King Michael I" from Timisoara, 119 C. Aradului, 300645 Timisoara, Romania

Corresponding authors: simona_nita@usvt.ro; lucian_nita@usvt.ro

Abstract: Maize is one of the most important crops due to its multiple uses. Maize, an annual plant, is a remarkable cereal, thanks to its high production capacity, about 50% higher than other cereals, short life cycle, resistance to diseases and pests, drought resistance, monoculture support, great possibility of capitalizing production, can be grown in various ecological conditions. The paper presents the synthesis of the results from the 2021-2022 experimental cycle. The general objective of the research concerns the behavior of an assortment of corn hybrids created by the companies DEKALB, KWS, RAGT and LIMAGRAIN, in terms of the level of required harvests and quality. The area under study is part of the Arad Plain and is characterized by very good vegetation conditions for corn cultivation, being included in the very favorable area for cultivation in our country. In 2022, aflatoxin analysis was performed. Following the analyses carried out, the maize samples ranged from 54.96 ppb (Kashmir) to 173.51 ppb (HI CORN 450) (figure 3.6.), above the maximum permissible limit of 10 ppb, for total aflatoxins, according to Commission Regulation (EC) No 1881/2006 of 19.12.2022 setting maximum levels for certain contaminants in foodstuffs. *Aspergillus flavus* is a common and widespread fungus in nature and is found especially when cereals are grown in extreme climatic conditions such as drought.

Keywords: Corn, technology, economic efficiency

INTRODUCTION

The main objective of the study is to contribute to the elaboration of an intensive technology for this plant, in conditions of good favorability (BORCEAN.,2001; BORCEAN et al., 2006; BORCEAN et al., 2008.). The research carried out on the topic "Comparative study of agronomic characteristics of six corn hybrids in the Arad Plain, in order to introduce them into the crop" carried out during 2021-2022 led to important results both theoretically and practically regarding this crop (COCLEA et al., 2013; IMBREA et al., 2012; BORCEAN et al.,2004; IMBREA et al., 2004, BORCEAN et al., 2004.). The corn crop knows a spectacular developing in recent years. New discoveries in the molecular genetics applied to corn conducted to achieving of the more increased yields on the surface unit, with quality properties needed in the domains of corn uses, with genetic resistance to some pests and pathogens (PANAITESCU et al, 2014; PANAITESCU et al., 2016, NIȚĂ et al ., 2013, NIȚĂ et al., 2014).

MATERIAL AND METHODS

The general objective of the research concerns the behaviour of an assortment of corn hybrids created by the companies DEKALB, KWS, RAGT and LIMAGRAIN, in terms of the level of harvests obtained and its quality. The area under study is part of the Arad Plain and is characterized by very good vegetation conditions for corn cultivation, being included in the very favorable area for cultivation in our country (PANAITESCU et al, 2015; NIȚĂ et al, 2010; NIȚĂ et al, 2015).

The research was carried out during 2021-2022.

In order to highlight the behaviour of the corn hybrids studied, determinations were made regarding:

- grain production, depending on the hybrid (kg/ha);
- mass of 1000 grains (g);
- hectolitre weight (kg/ha);
- calculation of economic efficiency.

The studied agricultural experience is mono-factorial

The hybrids studied are: LIGETIX, HI-CORN-450, LG 1415, DKC-4943, DKC -5830 and KAŞMIR.

The precursor plant for corn was rapeseed. Fertilization was done in two stages and potassium chloride was used with an active substance 0-0-60 with an application of 200 kg / ha and a complex of NPK type 8-24-24 with a quantity of 300 kg / ha. The preparation of the germination bed was carried out with the combiner on April 2-7, complex fertilizers of the type 16-16-16 were applied at a dose of 155 kg / ha.

The complexes were distributed with a fertilizer distributor of type Axis 30.2 at a width of 24 meters, evenly applied and subsequently incorporated with the milling cutter. The sowing was done on April 5-12 with an 8-row Gaspardo seeder with a row spacing of 75cm and which was towed by a John Deere 6170 m tractor equipped with a starfire3 antenna for precision seeding (autotrack). The density used for sowing was 65 thousand germinable grains / hectare, the distance between plants in a row was 19.6 cm.

Herbicide was done with a pre-emergent herbicide of Adengo type at a dose of 0.33 l / ha. On 16.05.2022, necessary corrections were made (20% of the surface) with LADIS 2l / ha. During vegetation, a mechanical slingshot was also applied, concomitantly fertilizing with 165 kg of nitrate N34.4%. Postemergence herbicide was executed with Buctril and Equip. At the stage of full flowering - the beginning of drying, an insecticide for *Ostrinia nubilalis* was used.

RESULTS AND DISCUSSIONS

The research carried out has as main objective to bring a contribution to the elaboration of an intensive technology for this plant, in conditions of good favourability. The research carried out on the topic " Comparative study of the agronomic characteristics of six maize hybrids in the Arad plain, with a view to their introduction in to culture" carried out during 2021-2022 led to important results both theoretically and practically regarding this crop.

To characterize the climatic conditions of the territory were used climatological data existing at meteorological stations, Chisinau Criş. We mention that the Chisinau Criş meteorological station is representative for the studied territory, but since there is no more arroped and representative meteorological station, we had to use the data of the meteorological station mentioned above. In terms of rainfall amounts recorded in the last decade, it shows values that oscillate from one year to another and from area to area. Thus, in some years precipitation exceeds the limit of 700 mm.

Figure 1. shows the monthly average temperatures (0C) recorded at the Chisinau Criş Meteorological Station during 2021-2022.

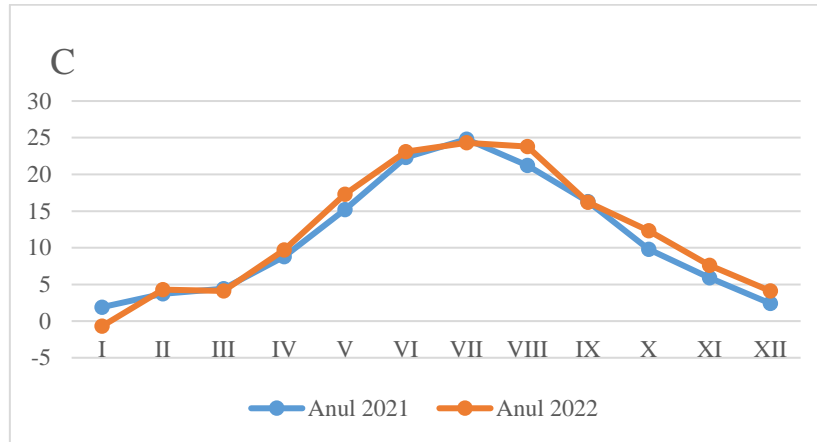


Fig. 1. Monthly average temperatures (°C) recorded at the Chisinau Criș Meteorological Station during 2021-2022

In figure 2. monthly precipitation (mm) recorded at the Chisinau Criș Meteorological Station in 2021-2022 are presented.

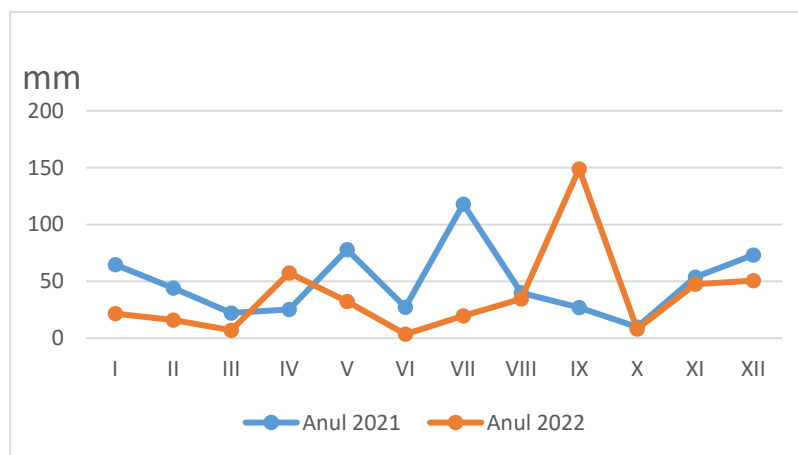


Fig. 2. Monthly precipitation (mm) recorded at the Chisinau Criș Meteorological Station in 2021-2022

The harvest results obtained in the experimental cycle 2021-2022 are presented in Table 1. Production is genetically determined but is largely influenced by climatic conditions during the growing season and applied technology. In most cases, climatic conditions positively or negatively influence crop yields. Each cultivated genotype reacts differently to different climatic conditions. The synthesis of harvest results for the experimental cycle 2021-2022, indicates an average of the experimental field of 3785 kg / ha. With yields above the field average, the DKC 4943 hybrid with 3950 kg/ha, registering a production increase of 165 kg/ha, being statistically insured as distinctly significant, and the DKC 5830 hybrid with 4600 kg/ha, registering a production increase of 815 kg/ha, being statistically insured as very significant. Hybrids HI

CORN 450 (3730 kg/ha), KAŞMIR (3515 kg/ha) and LG 1415 (3515 kg/ha) have realised yields near to the values of the field average value being without statistical significance.

Table 1

Synthesis of harvest results obtained in the experimental cycle 2021-2022

Variant	Harvest kg/ha	Relative productio n %	Production difference kg/ha	Semnification
DKC 4943	3950	104	165	xx
LIGETIX	3400	90	-385	000
LG 1415	3515	93	-270	000
X Media câmpului	3785	100	Mt.	
DKC 5830	4600	121	815	xxx
HI CORN 450	3730	98	-55	
KAŞMIR	3515	93	-270	000

DL5% =89; DL1% =135; DL 0.1%=216

RESULTS ON THE MASS OF 1000 GRAINS

MMB is an element of productivity. The size of the MMB depends on the size and weight of the grains and is different for each hybrid. Also, this characteristic of corn hybrids in general is very important especially in the process of producing seeds for intensive cultivation. In 2021, MMB values ranged from 310 g to 370 g, figure 3. The highest MMB value was obtained for the DKC 5830 hybrid of 370 g and the lowest value was recorded for the LIGETIX hybrid of 310 g.

Climatic conditions differently influence the MMB of the hybrids under study. Amid climatic conditions in 2022, MMB values were lower. The values recorded this year were 126-138g. This year too, the highest MMB value was recorded for the DKC 5830 hybrid of 138g. Each cultivated genotype reacts differently to climatic conditions. As for the interaction of year and hybrid on the mass of a thousand grains, from the data shown in figure 3. we can conclude that the DKC 5830 hybrid behaved best in both experimental years, with the highest mass values of a thousand grains.

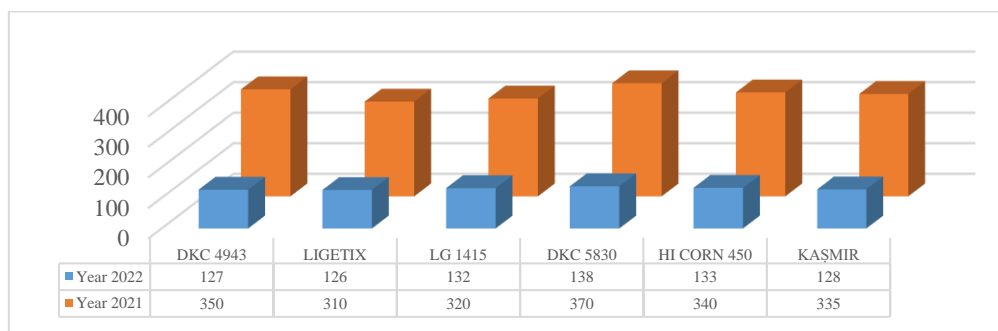


Fig. 3. MMB values over the two experimental years.

RESULTS CONCERNING THE STANDARD MASS PER STORAGE VOLUME

The mean value of the standard mass per storage volume, depending on the hybrid studied, is shown in figure 4. As with the mass of one thousand grains, the value of the standard mass per litre can be influenced by different environmental conditions for each hybrid grown.

Data shown in figure 4. It confirms that in 2021 the highest values of the hectolitre mass were recorded in all hybrids studied. The highest values were achieved in the DKC 5830 hybrid of 85 kg/hl in both experimental years. Good values of the hectolitre mass were also recorded for the HI CORN 450, Kashmir, LG 1415 hybrid, these were between 82 and 81 kg / hl. In 2022 the values of the hectolitre mass are much lower, ranging from 66 kg/hl (DKC 4943) to 74 kg/hl (DKC 5830), the reason being the climatic conditions unfavourable to the maize crop this year.

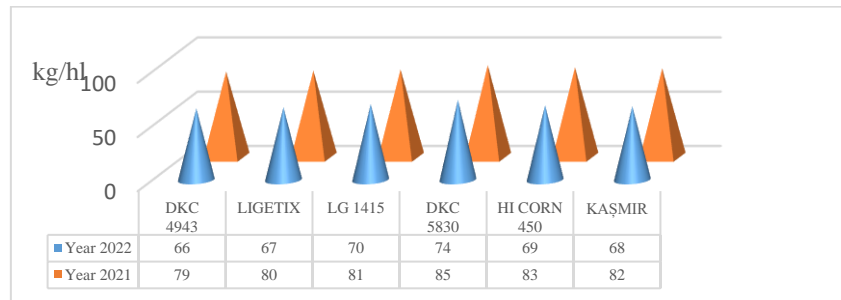


Fig. 4. Results on standard mass per storage volume (kg/hl) in experimental cycle 2021 to 2022

Aflatoxin is a natural mycotoxin produced by fungi: *Aspergillus flavus* and *Aspergillus parasiticus*.

In fact, the main factors contributing to aflatoxin contamination are drought and heat stress during the ripening period of corn. (Kebede et al., 2012). And the summer of 2022 was a dry one with very high maximum temperatures that led to the presence of very high concentrations of aflatoxins in the maize samples studied, figure 5.

Following laboratory analyses carried out within the Interdisciplinary Research Platform of the King Mihai I University of Life Sciences in Timisoara, maize samples ranged between 54.96 ppb (Kashmir) and 173.51 ppb (HI CORN 450) (figure 5.), above the maximum permissible limit of 10 ppb, for total aflatoxins, according to Commission Regulation (EC) no. 1881/2006 of 19.12.2022 setting maximum levels for certain contaminants in food.

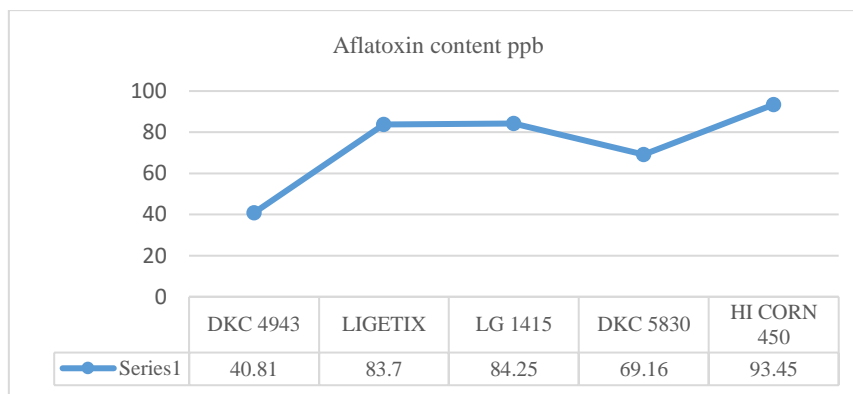


Fig. 5. Aflatoxins content (ppb) in the corn crop samples from the year 2022

Calculation of the main indicators of economic efficiency for 2021

In order to highlight the profitability of the corn crop for grains, we considered it necessary to calculate the main indicators of economic efficiency. The analysed indicators are as

follows: -main production (kg/ha); – value of main production (lei/ha); – production expenses (lei/ha); – production cost (lei/kg); – total profit (lei/ha); – profit rate (%).

The value of the main production is directly proportional to the recovery price, falling between 9000 lei/ha for the LIGETIX hybrid and 10050 lei/ha for the DKC 5830 hybrid (figure 6). Production expenses were influenced in the highest percentage by the oscillating price of materials (seeds, fertilizers and herbicides). The production cost of all hybrids is below the recovery price (1.5 lei/kg). The highest production cost of 0.37 lei/kg was recorded for the DKC 5830 hybrid. The total profit figure 7. oscillates between 5850 lei/ha (LIGETIX) and 6634 lei/ha (DKC 5836). High profit values of over 6000 lei / ha are recorded for all hybrids. These profit figures cover production expenses, and allow a new production cycle to begin.

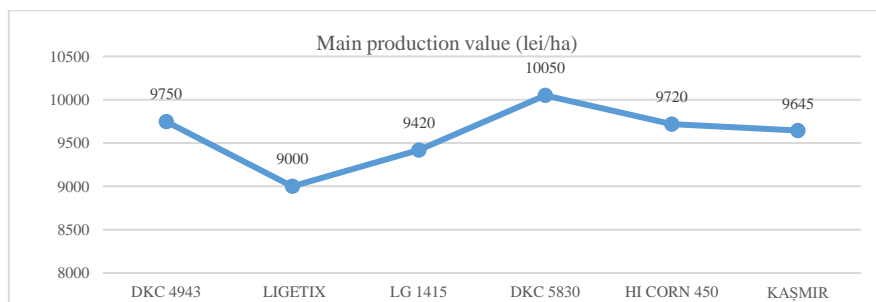


Fig. 6. Value of main production

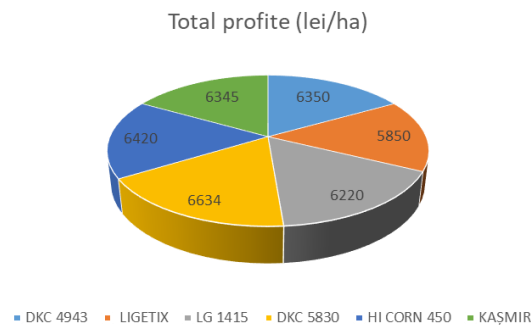


Fig. 7. Total profit (lei/ha);

The profit rate figure 8., oscillates between 185,7 % (LIGETIX) and 194,5 % (HI CORN 450).

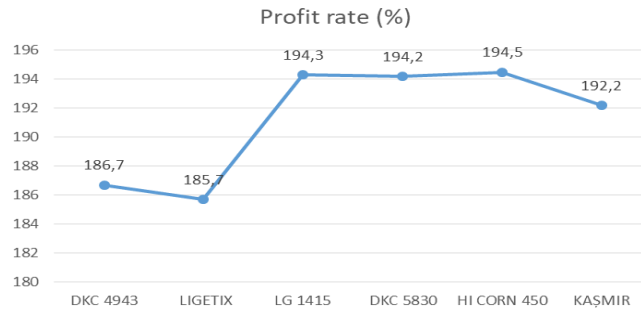


Fig. 8. Profit rate (%)

Following the analysis of the 6 hybrids (figure 9) it was concluded that the best results were obtained by the DKC 5863 hybrid, with a production of 6700 kg/ha and its value of 10050 lei/ha, production expenses of 3416 lei/ha, a production cost of 0.34 lei/kg and a profit rate of 194.2%, determined by the highest profit (6634 lei/ha).

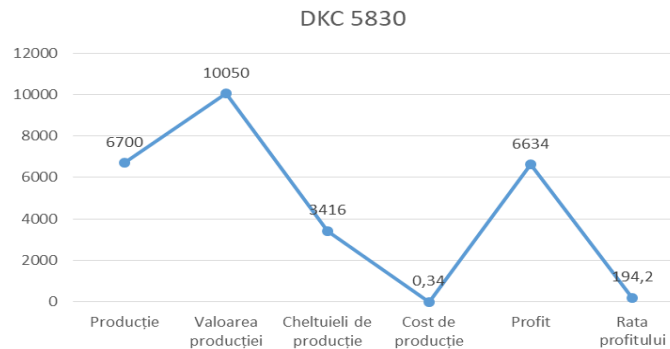


Fig. 9. The economic efficiency of the DKC 5830 hybrid

In the experimental year 2022 we analysed the same economic indicators as in 2021. The average price for capitalizing one kg of corn for grains for 2022 was 1.35 lei / kg, the sale was made in autumn 2022. In 2022 too, the highest production was for the DKC 5830 hybrid of 2500 kg/ha, and the lowest production for the Kashmir hybrid of 600 kg/ha.

The value of the main production is directly proportional to the recovery price, ranging between 810 lei/ha for the KAŞMIR hybrid and 33785 lei/ha for the DKC 5830 hybrid, figure 10.

The production cost for all hybrids is below the recovery price (1.35 lei/kg). The highest production cost of 0.74 lei/kg was recorded for the DKC 5830 hybrid.

In this experimental year, due to unfavourable climatic conditions (lack of precipitation during the planting period), a profit of 25 lei/ha was registered for the DKC 5830 hybrid, the rest of the hybrids registering losses between 1430 lei/ha (DKC 4943) and 2540 lei/ha (KAŞMIR) figure 11.

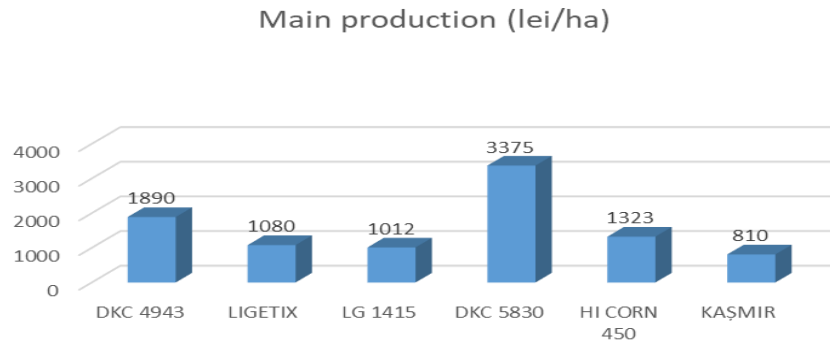


Fig. 10. Main production value

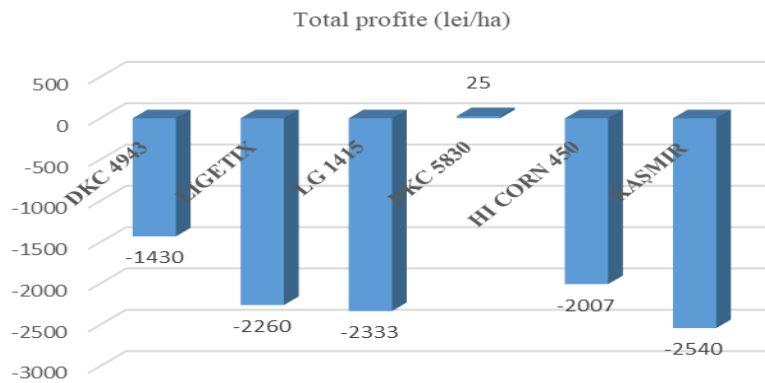


Fig. 11. Total profit (lei/ha)

Following the analysis of the 6 hybrids made this year, figure 12, it was concluded that the best results were obtained by the DKC 5863 hybrid, with a production of 2500 kg / ha and its value of 3375 lei / ha, production expenses of 3350 lei / ha, a production cost of 0.74 lei / kg, determined by the highest profit (25 lei/ha).

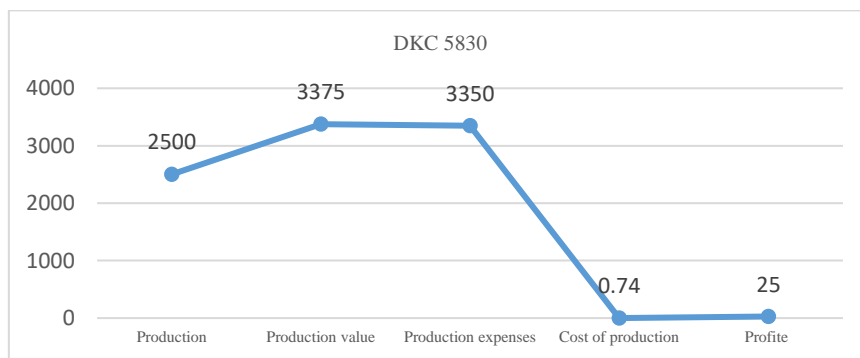


Fig. 12. The economic efficiency of the DKC 5830 hybrid

CONCLUSIONS

1. As a result of the research carried out during the two experimental years (2021 – 2022), the following conclusions were drawn.
2. The different climatic conditions during the two experimental years, particularly in terms of precipitation, strongly influenced the production obtained.
3. Production is determined genetically, but is largely influenced by climatic conditions during the growing season and the technology applied.
4. In most cases, climatic conditions influence crop yields positively or negatively.
5. Each cultivated genotype reacts differently to climatic conditions.
6. Regarding the interaction of year and hybrid on thousand grain mass, from the presented data we can conclude that the DKC 5830 hybrid performed better in both experimental years, with the highest thousand-grain mass values.
7. As with thousand grain mass, the value of standard mass per litre can be influenced by different environmental conditions for each hybrid grown. The data presented confirms that in 2021, the highest values of mass in hectolitres were recorded in all hybrids studied. The highest values were achieved in the hybrid DKC 5830 of 85 kg/hl during the two experimental years.
8. In 2022 the values of the mass in hectolitres are much lower, ranging from 66 kg/hl (DKC 4943) to 74 kg/hl (DKC 5830), the reason being the unfavourable climatic conditions for the harvest of but this year.
9. Following laboratory analysis, corn samples ranged from 54.96 ppb (Kashmir) to 173.51 ppb (HI CORN 450), above the maximum allowable limit of 10 ppb, for total aflatoxins, in accordance with Commission Regulation (EC) No. 1881/2006 of 19.12.2002 setting maximum levels for certain contaminants in foodstuffs.
10. Following the analysis of the 6 hybrids during the two experimental years, it was concluded that the best results in terms of economic efficiency were obtained by the DKC 5863 hybrid.
11. For corn cultivation, fertilization plays a vital role in achieving higher yields in terms of quantity and quality.
12. As a result of this study, we can say that the application of appropriate technology for corn cultivation must combine: balanced fertilization, depending on the expected result (quantity, quality, resistance to diseases and pests) and a valuable genotype, these in the context of constantly changing climatic conditions.

BIBLIOGRAPHY

- BORCEAN I., DAVID G., NIȚĂ SIMONA, POP GEORGETA, 2001, Studii privind comportarea unor sortimente de hibrizi autohtoni de porumb în condițiile pedoclimatice din Câmpia Timișului. Zilele Academice Timișene, Vol.XXXIII, pag. 151-154.
- BORCEAN I., DAVID G., BĂGHINĂ N., IMBREA F. NIȚĂ SIMONA, BOTOȘ L. 2006, Study on the presence of heavy metals in some crops depending on distance to ash dumping site from the thermal central in Timișoara International Symposium Metal elements in Environment Medicine and Biology. ISSN: 158-4204,6-8 November, pag. 85-90.
- BORCEAN I., DAVID G., NIȚĂ SIMONA, BORCEAN A., BĂGHINĂ N., NIȚĂ L. 2008, A study on the possible prevention of environmental pollution with mining wastes from copper mines through agricultural valorisation, International Symposium on Metal elements in Environment Medicine and Biology.5-6 Decembrie, ISSN: 158-4204, pag. 113-1116.
- COCLEA D., SIMONA NIȚĂ, IOANA MARIA MATEAȘ 2013, Production potential of grain sorghum (Sorghum B.var. Eurosorghum) under the influence of fertilization and hybrids studied, Agricultural Science International Symposium „Trends in the European agriculture

- development" Research Journal of Agricultural Science, ISSN: 2066-1843, Vol. 45 (4), pag. 30-33.
- IMBREA F., BRANKO MARINCOVIC, MONICA BUTNARIU, TABĂRĂ V., PIRȘAN P., DAVID G., BOTOȘ L.- Assessing the properties of the oil extract from maize seed germ treated with low frequency electromagnetic radiation, Agrobuletin Agir An III, nr.4 (11), 2011/2012, Index Copernicus, ISSN 2066-6179.
- BORCEAN I., G., DAVID, SIMONA NIȚĂ, F. IMBREA, A. BORCEAN, L. NIȚĂ 2004, Culturi comparative cu hibrizi de porumb în condițiile cernoziomului cambic de la Timișoara, Lucrări Științifice Zilele Academice Timișene Vol. XXXVI, pag. 43-46.
- IMBREA F. BORCEAN A. DAVID G. NIȚĂ SIMONA 2004, Rezultate privind cultura și protecția fasolei intercalate în porumb, Lucrări Științifice Zilele Academice Timișene Vol. XXXVI, pag. 81-86.
- BORCEAN I., MOISUC A., NITA SIMONA, 2003, Calitatea boabelor de porumb Buletinul AGIR, Octombrie-decembrie anul VIII Nr. 4, pag. 74-76.
- PANAITESCU L, M-L LUNGU, C ILIE, SIMONA NITA 2014 Simulation and modelling of the influence between main climatic parameters quantities and average soil temperature using artificial neural networks, Journal of Environmental Protection And Ecology Vol, ISSN 1311-5065, Vol.15. (3) pag. 1119-1129.
- PANAITESCU L., SIMONA-MARIANA PRICOP, MARIUS LAURENTIU LUNGU, IRINA MOISE, RĂZVAN PANAITESCU, 2016, Sustainable management of the grain sorghum crop – Sorghum bicolor L. in Dobrudja Plateau from Romania, International Journal of Sustainable Agricultural Management and Informatics, ISSN 2054-5819, Vol. 2, No. 1, pag. 53-65.
- PANAITESCU L., SIMONA-MARIANA PRICOP, DANIELA VIȘAN, SIMONA NIȚĂ, R. PANAITESCU 2015, The manifestation of the productive potential in corn (*Zea mays* L.) Monoculture on a typical chernozem, with some FAO 300-400 group hybrids, Research Journal of Agricultural Science, 47 (3), pag. 223-231.
- NIȚĂ LUCIAN DUMITRU, LAȚO KAREL IAROSLAV, NIȚĂ SIMONA, LAȚO ALINA, MIHUȚ CASIANA, 2013, Quantitative and qualitative assessment of soil resources in Aranca plain, Research Journal of Agricultural Science, 45 (1), pag. 45-48.
- NIȚĂ SIMONA, NIȚĂ LUCIAN DUMITRU, MIHUȚ CASIANA, KOCIS ELISABETA, PANAITESCU LILIANA, LUNGU MARIUS, 2014, Ecologic and biologic agricultural systems, Review on Agriculture and Rural Development SCIENTIFIC Journal of the University of Szeged , Faculty of Agriculture, ISSN 2063-4803, Nr. 1 Vol 3 pag. 338-343.
- NIȚĂ SIMONA, NIȚĂ LUCIAN DUMITRU, MIRCOV D. VLAD , BORCEAN ADRIAN 2010, The influence of the ash dump from the thermal power plant on the crops Proceedings of the 45th Croatian and 5th International Symposium on Agriculture, Opatija, Croatia, 15-19 February. Book 2010 pag. 120-123.
- NIȚĂ SIMONA, NIȚĂ LUCIAN, PANAITESCU LILIANA 2015, Research regarding the introduction of sorghum crops in the Almăj Depression Analele Universității din Oradea, Fascicula Protecția Mediului Vol. XXV.