UNIVERSITY OF KRAGUJEVAC

FACULTY OF AGRONOMY ČAČAK

SYMBIOTECH

2nd INTERNATIONAL SYMPOSIUM ON BIOTECHNOLOGY

14–15 March 2024

Faculty of Agronomy in Čačak, University of Kragujevac, Serbia

- PROCEEDINGS -

2nd INTERNATIONAL SYMPOSIUM ON BIOTECHNOLOGY

XXIX Savetovanje o biotehnologiji sa međunarodnim učešćem

- PROCEEDINGS -

ORGANIZER AND PUBLISHER

University of Kragujevac, Serbia
Faculty of Agronomy in Čačak

Honorary Committee

Prof. Dr. Marina Pintar, Slovenia; Prof. Dr. Andrej Bončina, Slovenia; Prof. Dr. Branko Kramberger, Slovenia; Prof. Dr. Tomaž Langerholc, Slovenia; Prof. Dr. Ivica Kisić, Croatia; Dr. Kristina Kljak, Croatia; Prof. Dr. Krunoslav Zmaić, Croatia; Prof. Dr. Zvonko Antunović, Croatia; Prof. Dr. Muhamed Brka, B&H; Prof. Dr. Enisa Omanović-Mikličanin, B&H; Prof. Dr. Ivan Ostojić, B&H; Dr. Adrijana Filipović, B&H; Prof. Dr. Božidarka Marković, Montenegro; Prof. Dr. Sanja Radonjić, Montenegro; Prof. Dr. Vjekoslav Tanaskovik, North Macedonia; Prof. Dr. Ivana Janeska-Stamenkoska, North Macedonia; Prof. Dr. Zlatan Kovačević, B&H; Prof. Dr. Željko Vaško, B&H; Prof. Dr. Dragutin Đukić, Serbia; Prof. Dr. Nedeljko Tica, Serbia; Prof. Dr. Branko Ćupina, Serbia; Prof. Dr. Dušan Živković, Serbia; Prof. Dr. Vladan Bogdanović, Serbia; Dr. Darko Jevremović, Serbia; Dr. Marijana Pešaković, Serbia; Prof. Dr. Cosmin Salasan, Romania;

Technical editors

Prof. Dr Vladimir Kurćubić; Prof. Dr Pavle Mašković; Dr Marija Gavrilović; Dušan Marković, BSc

Print-run: 30

Printed by
MEDIGRAF - Čačak, Aleksandra Savića 42, 32000 Čačak

ISBN 978-86-87611-91-7

Year of publication: 2024

DOI: 10.46793/SBT29.05JS

THE EFFECT OF CLIMATE FACTORS ON MAIZE YIELD OF LATE SOWING DATE

Jelena Stojiljković[1], Vera Rajičić[2], Nenad Đurić[1], Milan Biberdžić[3], Kristina Luković[1], Vladimir Perišić[1], Veselinka Zečević[1]

Abstract: Two-year research was carried out in 2014 and 2015 on the territory of the municipality of Leskovac, on alluvium land type. In the experiment, 6 maize hybrids of different vegetation lengths 400-600 were sown (ZP 434, NS 4023, ZP 555, NS 5051, ZP 666, NS 6030). The hybrid NS 6030 (10.248 t ha-1) had the highest average yield in 2014, while the hybrid FAO group 400 NS 4023 (9.467 t ha-1) had the lowest. The highest average yield in the year 2015, unfavorable for corn production, was achieved by the hybrid FAO group 400 ZP 434 (6.938 t ha-1), and the smallest yield by hybrid FAO group 600 NS 6030 (4.980 t ha-1). In 2015, being that the average temperatures were warmer than in 2014, and it had fewer amounts and worse distribution of precipitation, late sowing had a very bad effect on all hybrids, especially on FAO 600 hybrids.

Keywords: corn, precipitation, temperatures, sowing time, yield

Introduction

Meteorological conditions have the greatest influence on the stability of corn yields, primarily the amount and distribution of precipitation during the vegetation period of plants, as shown by the results of numerous studies (Branković-Radojčić et al., 2017; Ikanović et al., 2018; Božović et al., 2020; Madić et al., 2021).

Sowing time is one of the factors that have a significant impact on the level of corn yield (Glamočlija and Ugrenović, 2016; Biberdzić et al., 2018; Stojiljković, 2022). The optimal sowing period which could be defined as the sowing time, ensures the sprouting of corn at the most favorable moment, to make use of the conditions of the growing season and form the highest possible yield (Videnović et al., 2011). To achieve high and stable yields, numerous

[1]Institute for vegetable Crops, Karađorđeva 71, 11420 Smederevska Palanka (jstojiljkovic@institut-palanka.rs)
[2]University of Niš, Faculty of Agriculture, Kosančićeva 4, 37000 Kruševac, Serbia
[3]University of Priština-Kosovska Mitrovica, Faculty of Agriculture, Kopaonička bb, 38228 Lešak

researchers have studied the vegetation length of certain corn hybrids in different weather conditions from germination to maturation, because not all hybrids can be grown equally successfully in all production areas (Babić et al. 2013; Grčak et al., 2020; Petrović et al., 2023).

It very often happens that producers are late with corn sowing due to organizational reasons or weather conditions, so, it was necessary, based on the results of the experiment, to guide them on which hybrids are recommended to choose in conditions of late sowing.

The goal of the research was to determine the effects of hybrids of different FAO ripening groups and climatic conditions on the yield of certain corn hybrids in the late sowing period.

Materials and methods

The research was carried out in 2014 and 2015 in the area of the municipality of Leskovac. 6 maize hybrids of FAO group 400-600 were included in the experiment, namely: FAO 400 (ZP 434, NS 4023); FAO 500 (ZP 555, NS 5051) and FAO 600 (ZP 666, NS 6030).

Sowing of corn hybrids was done on April 30 according to a random block system, in three repetitions. 4 rows of each hybrid were sown with an inner-row distance of 70 cm. FAO group 400 hybrids were sown with a distance between plants of 20 cm, FAO 500 (25 cm), and FAO 600 (30 cm).

The basic processing and fertilization were carried out based on the agrochemical analysis of the soil in the autumn-winter period. Pre-sowing preparation was done with a disc harrow in two passes on the day of sowing.
The recommended amount of nitrogen fertilizer for feeding (200 kg ha^{-1} KAN) is divided into two feedings. The first feeding was done when the plants were in the stage of 3-4 leaves, with 60% of the recommended amount for feeding. The second feeding was done with the remaining amount of KAN when the corn was in the stage of 7-8 formed leaves. When the crop was in the stage of 6 formed leaves, the crop was protected against weeds with herbicides (Motivell, in the amount of 0.75 l ha^{-1} + Callisto 0.25 l ha^{-1}).

The yield was calculated and reduced to 14% moisture and statistically processed using the IBM SPSS program version 21.

Results and discussion

The Leskovac meteorological station is located near the test plots and served us to obtain data on average daily temperatures and precipitation (table 1).

Table 1. Average monthly air temperatures (°C) and precipitation (mm) in Leskovac (2014-2015)

	April	May	June	July	Aug.	Sept.	A./S.
Average monthly temperatures and precipitation during 2014							
mm	214	117	64.3	86	47.1	121.2	464.1
°C	11.40	15.55	19.59	21.60	21.50	17.00	17.77
Average monthly temperatures and precipitation during 2015							
mm	64.5	38	33	6	63.2	51.2	255.9
°C	10.78	18.03	19.60	24	23.50	20.00	19.31
Average monthly temperatures and precipitation - ten-year average							
mm	50	60.8	61.2	38.7	32.7	64.8	308.2
°C	12.30	16.20	20.3	22.8	22.2	17.4	18.53

Based on the data from Table 1, we can notice that during the two-year research and the ten-year average of temperature and precipitation, differences were observed both in terms of the total amount of precipitation during the growing season, and in terms of the distribution of precipitation by month. The total amount of precipitation during the growing season in 2014 was 464.1 mm, with an average temperature of 17.77 °C. It is particularly important to note that 197 mm of precipitation fell in June, July, and August, which is 65 mm more than the multi-year average for the same period. This period is of particular importance for the process of formation of corn yield. Based on the data on the amount of precipitation and average temperatures, we can state that this year was favorable for corn production. This is supported by the fact that 155.9 mm more precipitation fell in 2014 than the ten-year average.

In 2015, during the growing season, 255.9 mm fell, which is 208.2 mm less than in 2014, while the average monthly temperature during the growing season was 19.31°C, which is 1.54°C higher than in 2014. During 2015, it fell 52.3 mm less compared to the ten-year average, and the average temperature in 2015 was 0.78°C higher than the ten-year average. A particularly unfavorable period was during June, July, and August, with 102.8 mm of precipitation, and an average monthly temperature of 22.36°C during these three months, which

classifies the year 2015 as extremely unfavorable for corn production. The importance of production conditions, especially temperature, and precipitation, is crucial according to Maitah et al. (2021), who claim that yield is negatively correlated with temperatures during July and August.

Table 2. Yield of corn hybrids of different FAO ripening groups (t ha^{-1}) in 2014 and 2015

Yield of corn hybrids of different FAO ripening groups (t ha^{-1}) in 2014						
	H1	H2	H3	H4	H5	H6
Mean	9.717	9.467	9.989	10.057	10.142	10.249
Median	9.692	9.471	9.967	10.053	10.208	10.288
Mode	9.58[a]	9.36[a]	9.89[a]	9.96[a]	9.90[a]	10.15[a]
Std. Deviation	0.152	0.103	0.107	0.098	0.220	0.083
Variance	0.023	0.011	0.011	0.010	0.048	0.007
Minimum	9.58	9.36	9.89	9.96	9.90	10,15
Maximum	9.88	9.57	10.11	10.16	10.32	10.31
Yield of corn hybrids of different FAO ripening groups (t ha^{-1}) in 2015						
Mean	6.938	6.912	6.135	5.725	5.307	4.980
Median	6.954	7.005	6.156	5.750	5.450	4.920
Mode	6.75[a]	6.45[a]	5.35[a]	5.42[a]	4.88[a]	4.67[a]
Std. Deviation	0.180	0.422	0.775	0.293	0.376	0.344
Variance	0.033	0.178	0.601	0.086	0.141	0.118
Minimum	6.75	6.45	5.35	5.42	4.88	4.67
Maximum	7.11	7.28	6.90	6.01	5.59	5.35

The average yield for all hybrids in 2014, which according to the amount of precipitation, especially in June, July, and August, was above the long-term average, was 9.936 t ha^{-1}. The highest average yield was achieved by hybrid NS 6030 (10.249 t ha^{-1}) and the lowest hybrid FAO group 400 NS 4023 (9.467 t ha^{-1}). The average yield in 2015 was 5.999 t ha^{-1}. The highest average yield was achieved by the hybrid of FAO group 400 ZP 434 (6.938 t ha^{-1}), and the lowest hybrid of FAO group 600 NS 6030 (4.980 t ha^{-1}). The year 2015 had average temperatures warmer than the year 2014 and also had a smaller amount and

worse distribution of precipitation, so late sowing had a very bad effect on all hybrids by reducing yields, especially on hybrids FAO 600. Based on the results of numerous research and stability analyses of maize yields in Republic of Serbia, hybrids of mid-early ripening groups show better adaptability to unfavorable conditions during the growing season, while hybrids of later ripening groups achieve higher yields and exhibit positive characteristics in more favorable production conditions (Ikanović et al., 2018; Božović et al., 2020) which is in agreement with our experimental results.

Table 3. Comparison of the influence of hybrids and sowing year on grain yield (t ha^{-1}) in 2014 and 2015

H_2014-H_2015	Average values	Std. Deviation	Std. Error	95% Confidence Interval of the Difference		t	p
H1	8.327	0.305	0.176	2.021	3.536	15.780	0.004
H2	8.190	0.321	0.185	1.758	3.352	13.791	0.005
H3	8.062	0.881	0.509	1.664	6.042	7.573	0.017
H4	7.891	0.196	0.113	3.845	4.819	38.259	0.001
H5	7.725	0.532	0.307	3.514	6.156	15.747	0.004
H6	7.615	0.333	0.192	4.442	6.096	27.409	0.001

From a total of 6 pairs used for comparison (all 6 hybrids in both 2014 and 2015), all results had a statistically significant difference (table 3). In all cases, the yields of corn in 2014 were higher than in 2015, which indicates that the weather has an important influence in determining the yield of corn grains. The difference in yield over the years was more pronounced in the hybrids of FAO group 600. Meteorological conditions had a great influence on the yield. Hybrids with a shorter growing season achieved satisfactory yields in 2015, which was unfavorable for corn production. The reason for this is the earlier passing of the stages of silking, pouring, and grain formation. That the weather conditions affect the yield is stated by Filipović et al., 2015, adding that the average annual decrease in yield caused by drought, and other stress factors associated with it, ranges from 10% to 20%, even up to 50% compared to expected yields.

Conclusion

Based on the results of a two-year study on the influence of climatic factors on the yield of corn in the late sowing period, we conclude the following:

The yields of all corn hybrids in 2014 were higher than in 2015, which indicates that the weather has an important impact on determining the yield of corn grains. The average yield for all hybrids in 2014 was 9.936 t ha^{-1}, while in 2015, which was unfavorable in terms of the amount and distribution of precipitation, an average yield of 5.999 t ha^{-1} was achieved.

The hybrid NS 6030 had the highest average yield in 2014, and the hybrid FAO group 400 NS had the lowest. The highest average yield in 2015 was achieved by the hybrid of FAO group 400 ZP 434, and the lowest hybrid of FAO group 600 NS 6030.

Bearing in mind that corn production mostly takes place in dry tillage and late sowing conditions, it is recommended to sow hybrids with a shorter vegetation period in which the stages of threshing, silking, and grain formation occur faster.

Acknowledgement

The research presented in this article is part of the research project number 451-03-66/2024-03/200216, 200189 and 451-03-66/2024-03/200383 funded by the Ministry of Education and Science, Republic of Serbia.

References

Babić V., Prodanović S., Babić M., Deletić N., Anđelković V. (2013). The identification of bands related to yields and stability in maize hybrids and their parental components. Genetika, 45 (2), 589-599.

Biberdžić M., Barać S., Lalević D., Stojiljković J., Knežević B., Beković D. (2018). Uticaj tipa i sabijenosti zemljišta na prinos kukuruza. Journal of Agricultural Sciences, 63 (4), 323-334.

Božović, D., Popović, V., Rajičić, V., Kostić, M., Filipović, V., Kolarić, Lj., Ugrenović, V., Spalević, V. (2020). Stability of the expression of the maize productivity parameters by AMMI models and GGE-biplot analysis. Notulae Botanicae Horti Agrobotanici Cluj- Napoca, 48 (3), 1387-1397.

Branković-Radojčić, D., Srdić, J., Milivojević, M., Šurlan-Momirović, G., Radojčić, A., Živanović, T., Todorović, G. (2017). Variability of agronomic traits of maize hybrids influenced by the environmental factors. Journal on Processing and Energy in Agriculture, 21 (3), 149-153.

Filipović M., Jovanović Ž., Tolimir M. (2015). Pravci selekcije novih ZP hibrida. XX Savetovanje o biotehnologiji sa međunarodnim učešćem. Univerzitet u Kragujevcu, Agronomski fakultet Čačak, 13. -14. mart 2015. 7-15.

Glamočlija, N., Ugrenović, V. (2016). Morfološke i produktivne osobine kukuruza crvenog zrna u promenljivim vremenskim uslovima. Selekcija i semenarstvo, 22 (1), 1-9.

Grčak M., Grčak D., Penjišević A., Simjanović D., Orbović B., Đukić N., Rajičić V. (2020). The trends in maize and wheat production in the Republic of Serbia. Acta Agriculturae Serbica, 25 (50), 121–127.

Ikanović J., Živanović Lj., Popović V., Kolarić Lj., Dražić G., Janković S., Pavlović S. (2018). Possibility of greater use of maize as a bioenergy. Institute of PKB Agroekonomik, 24 (1-2), 49-59.

Madić M., Đurović D., Stevović V., Tomić D., Biberdžić M., Paunović, A. (2021). Grain yield in maize hybrids of different FAO maturity groups. Proceedings of the XII International Scientific Agricultural Symposium "Agrosym 2021", Jahorina, October 07-10, 2021; [editor in chief D. Kovačević]. - East Sarajevo: Faculty of Agriculture, 254-259.

Maitah M., Malec K., Maitah K. (2021). Influence of precipitation and temperature on maize production in the Czech Republic from 2002 to 2019. Sci Rep. 2021; 11: 10467. doi: 10.1038/s41598-021-89962-2

Petrović G., Ivanović T., Knežević D., Radosavac A., Obhođaš I., Brzaković T., Golić Z., Dragičević Radičević T. (2023). Assessment of Climate Change Impact on Maize Production in Serbia. Atmosphere, 14, 110. https://doi.org/10.3390/atmos14010110

Stojiljković J. (2022). Uticaj gustine i roka setve na neke morfološko - produktivne osobine i brzinu otpuštanja vode iz zrna kod različitih hibrida kukuruza. Fakultet za biofarming, Bačka Topola. Doktorska disertacija.

Videnović Ž., Dumanović Z., Simić M., Srdić J., Babić M., Dragičević V. (2013). Genetic potential and maize production in Serbia. Genetika, 45 (3): 667-677.