THE EFFECT OF IRRIGATION ON THE PRODUCTION PARAMETERS OF SOME MAIZE HYBRIDS IN THE POLLOG REGION

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Abstract

Maize (*Zea mays*) is a highly important crop globally and also in North Macedonia due to its economic significance, nutritional value, and agronomic importance. To select the most suitable hybrids for the climatic and soil conditions of the Pollog region, a field experiment was established during the 2024 vegetative season using a randomized block design with five replications.

The experiment investigated several production parameters for various maize hybrids, including the number of ears per plant, the number of kernels per ear, the number of kernels per plant, ear weight, kernel weight per ear, cob weight, yield, and productivity.

The hybrids involved in the experiment were from different producing companies and belonged to different FAO groups: FAO-360 (GW3808), FAO 450 (P9911 AQ), and FAO 470 (Pajdash). The results obtained for the different hybrids showed significant differences in the analyzed parameters.

The results indicate that irrigation has a statistically significant impact on yield (F = 60.937, p = 0.000), as p < 0.05. The hybrids also had a statistically significant effect (F = 37.449, p = 0.000). Since p < 0.05, this indicates important differences between the hybrids. Additionally, the irrigation-hybrid interaction was statistically significant (F = 11.906, p = 0.000), with Partial Eta Squared = 0.498, indicating a moderate effect.

Keywords: variant, hybrid, yield, productivity, interaction, significance.

1. Introduction

Maize (Zea mays L.) belongs to the monocotyledonous plant family (Poaceae). It originates from Central America, from where it spread to Europe and the rest of the world. Today, maize is one of the most important cereals in the world, along with rice and wheat, and is cultivated in various areas due to its ability to adapt to different climatic and soil conditions. Maize grains contain 70–75% carbohydrates, 10% proteins, around 5% oil, 15% minerals, and 2.5% cellulose. Maize also contains several essential amino acids, such as lysine, tryptophan, methionine, etc., which significantly enhance the nutritional value of the grains.

In addition to its economic importance, maize also has agronomic significance because it serves as an excellent preceding crop for most other crops. It leaves the soil clean from weeds and does not serve as a problematic source of infections for other crops.

The largest maize producers in the world are the USA, China, Brazil, the EU-28, and Argentina. In the European Union, maize is grown on an area of over 15 million hectares, of which 60% (9.4 million ha) is grown for grain and 40% (5.9 million ha) for silage.

Maize is a very important crop in agriculture in North Macedonia as well. In recent years, around 70,000 to 80,000 hectares have been sown with maize. A primary interest for agriculture in North Macedonia is the regionalization of maize hybrids by positioning hybrids in specific regions that are characterized by high adaptability to the climatic and soil conditions of the region, as well as selecting maize hybrids with high genetic potential.

The regions with the highest maize productivity are the Pelagonia Region and the Polog Region. In North Macedonia, the demand for maize as a basic feed for livestock is significantly higher than the domestic production.

2. Materials and Methods

The material used for the experiment consisted of three maize hybrids: GW3808 (FAO-360), Pajdash (FAO-470), and P9911 AQ (FAO-450). The working method was a randomized block design with five replications.

The research aimed to determine the effect of irrigation on different types of maize hybrids and to assess, depending on the FAO hybrid group, which hybrid would yield the highest production under non-irrigated conditions.

Result and discussion

Tab.1 Descriptive Statistics for yield

Dependent Variable:

Irrigation		Mean	Std. Deviation	N
With irrigation	GW3808	18,6200	1,27161	5
	P9911 AQ	15,1900	1,32354	5
	Pajdash	18,7600	,94565	5
	Total	17,5233	2,03425	15
Without irrigation	GW3808	17,8500	1,28598	5
	P9911 AQ	11,3400	1,30019	5
	Pajdash	12,3900	1,51756	5
	Total	13,8600	3,21543	15
Total	GW3808	18,2350	1,27215	10
	P9911 AQ	13,2650	2,37639	10
	Pajdash	15,5750	3,56263	10
	Total	15,6917	3,23414	30

According to Table 1, the average yield for the irrigated variant ranges from 15.19 t/ha for the P9911 AQ hybrid to 18.76 t/ha for the Pajdash hybrid, while the GW3808 hybrid achieved a yield of 18.62 t/ha, which represents a mid-range value among the hybrids included in the experiment.

The average yield for the non-irrigated variant ranges from 11.34 t/ha for the P9911 AQ hybrid to 17.85 t/ha for the GW3808 hybrid, while the Pajdash hybrid achieved a yield of 12.39 t/ha, which is an average value between the other two hybrids.

Dependent Variable: Yield

Tab.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	263.689ᵃ	5	52,738	31,929	,000	,869
Intercept	7386,852	1	7386,852	4472,250	,000	,995
Irrigation	100,650	1	100,650	60,937	,000	,717
Hybrids	123,709	2	61,854	37,449	,000	,757
Irrigation * Hybrids	39,331	2	19,665	11,906	,000	,498
Error	39,641	24	1,652			
Total	7690,183	30				
Corrected Total	303,330	29				

a.   R Squared = .869 (Adjusted R Squared = .842)

From the ANOVA results table in SPSS for the dependent variable "Yield", we observe that irrigation has a statistically significant effect on yield (F = 60.937, p = 0.000). Since p < 0.05, irrigation has a significant impact on yield. Partial Eta Squared = 0.717, indicating a strong effect (71.7% of the variance in yield is explained by irrigation). Hybrids also have a statistically significant effect (F = 37.449, p = 0.000). Since p < 0.05, this means there are significant differences between the hybrids. Partial Eta Squared = 0.757, indicating a very strong effect (75.7% of the variance is explained by the hybrid). The Irrigation × Hybrid interaction is also statistically significant (F = 11.906, p = 0.000). Partial Eta Squared = 0.498, indicating a moderate effect. This means that the effect of irrigation varies depending on the maize hybrid; in other words, some hybrids respond better to irrigation than others.

Tab.3 Multiple Comparisons						
Dependent Variable:	Yield					
Tukey HSD						
(I) Hibrids		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
GW3808	P9911 AQ	4.9700*	,57475	,000	3,5347	6,4053
	Pajdash	2.6600*	,57475	,000	1,2247	4,0953
P9911 AQ	GW3808	-4.9700*	,57475	,000	-6,4053	-3,5347
	Pajdash	-2.3100*	,57475	,001	-3,7453	-,8747
Pajdash	GW3808	-2.6600*	,57475	,000	-4,0953	-1,2247
	P9911 AQ	2.3100*	,57475	,001	,8747	3,7453
Based on observed means. The error term is Mean Square (Error) = 1.652.						
*. The mean difference is significant at the .05 level.						

Test Analysis Post-Hoc (Tukey HSD) për Variable: "Yield"
This table presents the results of the Tukey HSD test, which compares the mean yields among the three maize hybrids (GW3808, P9911 AQ, and Pajdash).

GW3808 vs. P9911 AQ → Mean difference: 4.97, p = 0.000. The GW3808 hybrid has a significantly higher yield than P9911 AQ.

GW3808 vs. Pajdash → Mean difference: 2.66, p = 0.000. The GW3808 hybrid has a significantly higher yield than Pajdash.

P9911 AQ vs. Pajdash → Mean difference: -2.31, p = 0.001. The P9911 AQ hybrid has a significantly lower yield than Pajdash.

2. Interpretation of the 95% Confidence Interval

For each pairwise comparison, the confidence intervals do not include zero, indicating that the differences between the varieties are statistically significant.

3. Conclusions

- Irrigation significantly increases yield. There are notable differences between hybrids, meaning some produce more than others. The effect of irrigation varies by hybrid, indicating that some hybrids make better use of irrigation.
- The most productive hybrid is GW3808, as it has a higher yield than both other hybrids.
- The least productive hybrid is P9911 AQ, as it has a lower yield than both other hybrids.
- Pajdash is in between the two, performing better than P9911 AQ but lower than GW3808.
- The early-maturing hybrid GW3808 is more tolerant to lack of irrigation, and therefore it is recommended for cultivation under non-irrigated conditions compared to the later-maturing hybrids.
- Hybrids from earlier FAO groups achieved higher yields under non-irrigated conditions compared to hybrids from later FAO groups. This indicates a dependency of later-maturing hybrids on the presence of irrigation.
- All hybrids included in the experiment produced higher yields under irrigated conditions compared to non-irrigated conditions. This highlights the impact of irrigation on average yield.
- The yield difference for the same hybrid under different conditions (with and without irrigation) was greater for later-maturing hybrids (e.g., Pajdash FAO 470), whereas for the earlier-maturing hybrid (GW3808 FAO 360), the difference in yield between the two conditions was smaller.
- Based on the results obtained, it is recommended to plant early-maturing hybrids under non-irrigated conditions and to use later-maturing hybrids under irrigated conditions.

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