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EFFECT OF SOWING TIME AND IRRIGATION REGIMES ON YIELD COMPONENTS OF SWEET CORN

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Abstract: The objective of this study was to examine the feasibility of cultivating sweet corn in the agroecological conditions of the Šumadija region. During 2022/23, the most widespread hybrid of sweet corn on the Serbian market, 'Enterprise,' was tested. Two irrigation regimes were applied (full and reduced to 50%) along with a control treatment (natural moisture conditions). Harvest and cob analysis were conducted on average 22-25 days after pollination. Statistically significant higher values for the studied parameters were measured in the irrigated treatments across both sowing dates.

Keywords: Sweet corn, Sowing time, Irrigation regime, Yield components

1. INTRODUCTION

Sweet corn (*Zea mays* L. var. *saccharata* Sturt.), belonging to the Poaceae family and Zea genus, is a valuable vegetable crop (Sidahmed et al., 2024). It is grown and consumed fresh, either on the cob or as frozen kernels (Rattin et al., 2018). The kernels of sweet corn are harvested during the milk stage, characterized by a sweet flavour, thin endosperm and pericarp, soft texture, and high nutritional value (Oktem et al., 2004; Kwiatkowski and Clemente, 2007; Ugur and Maden, 2015). Due to its high sugar and nutrient content and extensive use in the food industry (Budak and Aydemir, 2018), sweet corn is among the most significant crops. Optimal productivity and quality of this crop depend greatly on several factors, particularly sowing time and irrigation regime, which influence key production characteristics such as cob length, diameter, weight, kernel weight, and dry matter content. With a short growth period, especially in early hybrids, sweet corn can be cultivated across multiple sowing dates under irrigated conditions (Shibzukhov et al., 2021).

In agricultural practice, the introduction of optimal sowing times and an appropriate irrigation system can significantly impact yield and cob quality, enhancing adaptation to agro-climatic conditions. Sowing time, hybrid selection, soil fertility, and irrigation are the main factors with the greatest influence on sweet corn productivity (Dekhane and Dumbre, 2017). The success of stable production largely depends on the level of applied agronomy, the skilful choice of hybrids, and weather conditions during the growing season (Stojiljković et al., 2023). For successful sweet corn production, irrigation is essential, and its advantage lies in adaptability to various cultivation systems (main, succession, or intercropped) as noted by Revilla et al. (2021).

Previous research suggests that adjusting sowing time can play a critical role in sweet corn's morphological, productive, and chemical characteristics. Optimal use of moisture and nutrients, along with achieving stable yields, relies heavily on adapting the sowing date (Kara, 2011; Banotra et al., 2021; Kılınç et al., 2023). Additionally, selecting an appropriate irrigation method and water amount is vital for improving yield and cob quality. Numerous studies have demonstrated the positive impact of irrigation on cob length, showing that additional watering during flowering and growth stages increases cob length, while reduced irrigation during these periods shortens it (Nemeskeri et al., 2019).

Beyond increasing cob diameter and length, research has also shown the significant impact of optimal irrigation on cob and kernel weight. Given the importance of sweet corn production, it is evident that sowing time and irrigation regime are critical to its productive characteristics. This study aimed to examine the impact of different sowing dates and irrigation regimes on cob length, diameter, total cob weight, kernel weight, and dry matter content in sweet corn.

2. MATERIAL AND METHODS

A two-year study was conducted during 2022 and 2023 in the fields of the village of Bresje, Velika Plana municipality. The experiment was set up using a randomized block design with four replications. Sowing was performed in two planting periods: the first in the regular (spring) season and the second in the successive (summer) season. The row spacing was 70 cm, and the plant spacing was 22 cm. The study focused on the most widely cultivated sweet corn hybrid in Serbia, Enterprise F_1.

Irrigation was applied using a drip system with tapes having a capacity of 10 L m^{-1} h^{-1}. Two irrigation norms were applied: (I) full irrigation norm (100%), (II) 50% of the full irrigation norm, and a control treatment under natural moisture conditions. To maintain soil moisture at 60% field capacity, measurements were made with tensiometers in all treatments at a depth of 0.3 m. The irrigation norm was calculated using the formula:

$$Nz = 10 \cdot D \cdot (FC\% \text{ vol} - \theta z) = mm \cdot m^{-2}$$

Where represents the irrigation norm (mm m^{-2}), is the depth of the soil layer (m), is the field capacity limit in percentage by volume, and is the soil moisture read from the tensiometer curve at the measured water retention force. The field capacity limit was determined in the laboratory at the Faculty of Agriculture in Zemun.

The irrigation duration was calculated from the irrigation norm and the flow rate of the drip tape system (10 L h^{-1} or 10 mm h^{-1}). By halving the irrigation duration, the duration for the reduced irrigation volume (50% of the full norm) was determined. Standard agronomic practices for sweet corn production were applied throughout the growing season.

Morphological and productive traits of the cobs were measured 22-25 days after pollination on 30 cobs per treatment. The dry matter content of sweet corn was estimated using the conventional drying method at 105 °C to a constant mass. The obtained research results were statistically processed using analysis of variance and tested by the LSD test (Least Significant Difference) in IBM SPSS Statistics, version 26.0, and are presented in tables and graphs.

3. RESULTS AND DISCUSSION

Table 1 presents the average values of the investigated yield components of sweet corn, which were influenced by the sowing date and irrigation norms during the two-year study. The sowing date factor did not have a statistically significant impact on the cob length of sweet corn (Table 2). The average cob length was approximately 20 cm for both sowing dates. The irrigation factor, however, had a statistically significant effect on this trait, with the highest value measured in the IR 100% treatment (22.05 cm).

There were no significant differences between the irrigation norms (IR 100% and IR 50%), as shown by the measured approximate values in these treatments. Water deficiency negatively affected the cob diameter and length (Moosavi, 2012). Deng et al. (2009) note that cob length is a highly variable trait, while Kara (2011) suggests that cob length is dependent on the sowing date.

Table 1. Investigated parameters in both sowing dates under different irrigation norms

Date of sowing (A)	Irrigation (B)	Cob length (cm)	Cob diameter (cm)	Total mass cob (g)	Grain weight (g)	Dry matter (%)
I	Control	19.70	4.26	213.4	122.80	32.57
	IR 50%	21.52	4.80	306	188.00	35.61
	IR 100%	22.05	4.88	318.9	207.40	33.56
Average		21.90	4.65	279.4	172.70	33.91
II	Control	19.29	4.69	230.00	146.50	34.44
	IR 50%	21.73	5.16	343.30	242.20	34.16
	IR 100%	21.85	5.27	345.30	236.90	39.18
Average		20.96	5.01	306.20	208.50	35.93
Average/Average		21.43	4.83	292.80	190.60	34.92

Table 2. Impact of sowing date and irrigation on sweet corn yield components

Parameters of sweet corn	Cob length (cm)		Cob diameter (cm)		Total mass cob (g)		Grain weight (g)		Dry matter (%)	
Factors	A^{nz} B^{**} AB^{**}		A^{**} B^{**} AB^{**}		A^{**} B^{**} AB^{**}		A^{**} $B^{**}AB^{**}$		A^{**} B^{**} AB^{**}	
LSD	p< 0.05	p< 0.01	p< 0.05	p< 0.01	p< 0.05	p< 0.01	p< 0.05	p< 0.01	p< 0.05	p< 0.01
Date of sowing (A)	0.61	0.80	0.86	0.11	17.22	22.69	14.25	14.25	0.99	1.36
Irrigation (B)	0.61	0.80	0.86	0.11	17.22	22.69	14.25	18.78	1.21	1.66
A x B	1.05	1.38	0.15	0.20	29.82	39.30	24.69	32.54	1.71	2.35

Regarding cob diameter (Figure 1), the average value ranged from 4.88 to 5.01 cm, with sowing date and irrigation norms having a statistically very significant impact on this trait. The highest value was measured on the second sowing date, under the IR 100% treatment (5.27 cm). Water deficiency negatively affects sweet corn development, cob diameter, and mass, as concluded by Nemeskeri et al. (2019). Luchinger and Kamilo (2008) state that cob diameter varies depending on the hybrid and sowing date.

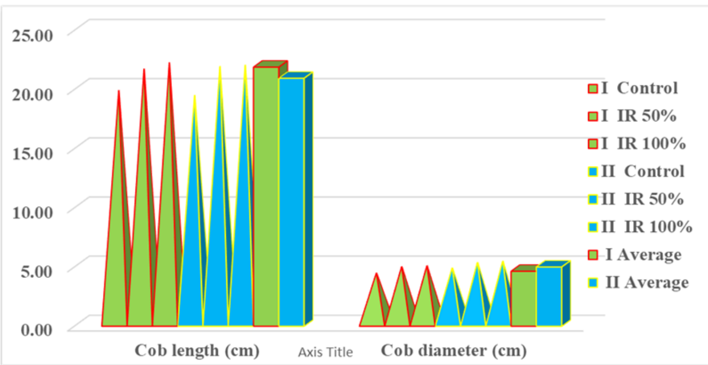

Figure 1. Average values of sweet corn cob length and diameter (cm)

Total cob weight (Figure 2) varied significantly by sowing date, with values ranging from 279.40 g for the first sowing date to 306.20 g for the second sowing date. In the non-irrigated treatment, the total ear weight was 213.40 g on the first sowing date and 230.00 g on the second, which is considerably lower than the values obtained in the irrigated treatments. The highest average value was recorded on the second sowing date under the IR100% treatment, which amounted to 345.30 g. There were no statistically significant differences between the total cob mass in the reduced and full irrigation norms. Kara (2011), in an experiment with five sowing dates, observed significant differences between sowing dates regarding cob length, diameter, and mass. The largest cob diameter, length, mass, and number of grains per cob were achieved with sowing on May 1, while the smallest parameters were obtained with sowing on June 1.

In the non-irrigated treatment, a decrease in grain yield was observed, particularly in terms of the number and mass of grains, which aligns with the results of Illés et al. (2022). In the control treatment, the average grain mass was 122.80 g on the first sowing date and 146.50 g on the second sowing date. The treatments with different irrigation norms resulted in significantly higher values in both sowing dates (207.40 g and 242.20 g). Both investigated factors (sowing date and irrigation) and their interaction had a statistically significant effect on this trait. Irrigation, especially in post-sowing treatments, influences yield components, contributing to higher farm income and maintaining crop rotation practices (Aydinsakir et al., 2013). Water deficit conditions negatively affect the yield and yield components of sweet corn, as noted by Ertek et al. (2013). They also mention that the highest yield is achieved with full irrigation, and any reduction in irrigation norm leads to a direct decrease in yield. In non-irrigated conditions, yield and yield components vary significantly across years and sowing dates (Biberdžić et al., 2018), with the highest yield achieved by sowing in mid-and late April in the first year of research, and early and mid-April in the second year. Stojiljković et al. (2024) also found that late sowing under non-irrigated conditions resulted in a drastic yield reduction for all sweet corn hybrids. Recent years, with significant temperature fluctuations and irregular rainfall distribution during the growing season, have made irrigation crucial for achieving stable yields in sweet corn production. Tupajić et al. (2024) confirmed that in both sowing dates, all three sweet corn hybrids under the non-irrigated condition produced the lowest values for the investigated parameters.

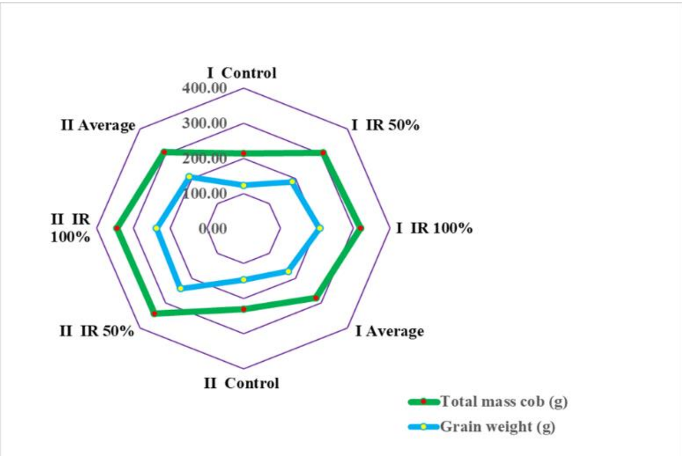

Figure 2. Presents the dry matter content in sweet corn for both sowing dates and all treatments.

Dry matter content in sweet corn kernels (Figure 3) showed a statistically significant effect from both the individual factors and their interaction. The content of dry matter is crucial for evaluating the quality and nutritional value of the grain, because it is the dry matter that affects the energy value and nutritional properties of the product. The highest average values were recorded in the first sowing date under the IR 50% treatment, amounting to 35.61%, while the best result in the second sowing date was achieved in the IR 100% treatment, with a value of 39.18%. Kara et al. (2012)

found that dry matter content decreases with later sowing dates in a two-year study. The highest dry matter content was achieved with sowing on April 1, which contrasts with the results of this study. Water deficiency significantly reduces dry matter content in sweet corn, as noted by Karam et al. (2003), whose findings align with those presented in this study.

Drip irrigation allows efficient water to be used by reducing surface water evaporation (Visvanatha et al., 2002; Oktem et al., 2003). In the study by Kılınç et al. (2023), optimal sowing times were studied in relation to the corn hybrid. They found that later sowing negatively affected ear yield and quality in certain hybrids.

Muslimah et al. (2023) state that drip irrigation is a highly productive and economical agricultural practice in sweet corn production. Dagdelen et al. (2006) determined that water deficiency significantly impacted corn yield, with the highest yield achieved in the irrigated treatments. Pandei et al. (2000) found that non-irrigated conditions led to a yield reduction of 22.6-26.4%.

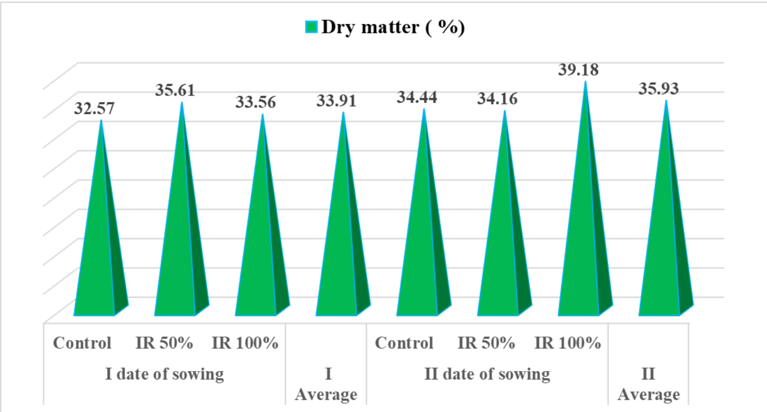

Figure 3. Dry matter content in sweet corn in both sowing dates across all treatments.

4. CONCLUSION

Based on the results of the research, it can be concluded that sweet corn can be successfully grown in the agroecological conditions of the Šumadija region in both sowing periods. The sowing date had a statistically significant impact on the examined parameters, with the best results, on average, achieved in the post-sowing period in both years of the study. In treatments with different irrigation norms (reduced and full norm), statistically significantly higher values for yield components were observed compared to those in the control treatment. Good results were also achieved with the application of drip irrigation, even with a reduced irrigation norm (50% of the full norm). This indicates favourable economic aspects in sweet corn production, ensuring more stable yields in dry years, which are a consequence of the significant climate changes witnessed in recent years.

5. ACKNOWLEDGMENT

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