Evaluation of growing of sweet maize varieties and hybrids as a repeated crop in different planting periods and schemes

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Abstract. In a comprehensive scientific study conducted in the Bukhara province, the cultivation of 12 varieties and hybrids of sweet (vegetable) corn was undertaken as a repeated crop in medium-saline meadow alluvial soils. Noteworthy varieties and hybrids evaluated in the study included "Zamin," "Mazza," "Megaton F1," and "Union F1," selected based on their suitability for the specific soil and climate conditions prevalent in the province. The research aimed to discern the optimal combinations of planting schemes and periods for maximizing yield in sweet corn production. Among the diverse planting schemes and periods tested, the study highlighted the effectiveness of the 60x30 and 70x25 cm schemes, identifying them as the optimal choices. Furthermore, the optimal planting period was pinpointed to be July 5, emphasizing the significance of timing in sweet corn cultivation in the region. The findings indicated that when varieties and hybrids like "Zamin," "Mazza," "Megaton F1," and "Union F1" were planted on July 5 using the 60x30 and 70x25 cm schemes, an impressive yield of 10.1-14.4 tons of vegetable cobs per hectare was achieved. This underscores the importance of meticulous selection of both planting schemes and periods to optimize sweet corn production in the specific agro-climatic conditions of the Bukhara province. The research outcomes contribute valuable insights for local farmers and agricultural practitioners, offering practical recommendations for enhancing crop productivity and ensuring sustainable sweet corn cultivation practices.

1 Introduction

Maize varieties are a crop of food fodder and technical importance [1]. Today, corn is planted on 201.9 million hectares of land in the world, and the total yield exceeds 1.452 billion tons [2]. In terms of corn production, the USA (460.7 million tons), China (327.1 million tons), Brazil (139.2 million tons), the European Union (84.6 million tons), Argentina (63 6 million

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tons), Ukraine (50.3 million tons), India (39.0 million tons) and Mexico (33.1 million tons) are leading [3-5].

Since sweet corn is a food (vegetable) crop that is not widely distributed in the world, but has a developing perspective, in most countries today, great attention is paid to scientific researches on the selection of varieties and hybrids suitable for cultivation in repeated crops, the determination of planting dates and planting schemes [6, 7]. The morpho biology of varieties and hybrids, planting time and planting scheme, and other factors are of great importance in obtaining a high-quality cob harvest from sweet corn [8]. Sweet corn is grown on 1,870 million hectares of land in world agriculture, and the average yield of 9.6-15.8 tons of cob per hectare is obtained [9]. In order to expand the production of food products, it is urgent to develop agrotechnologies for growing sweet corn varieties and hybrids in repeated crops.

Sweet corn contains 4-17% protein, 12-30% starch, 5-17% sugar, 1.2-1.9% oil, 19-24% carbohydrates, and 10-23% dextrin. Sweet corn grain ranks first among vegetables in terms of energy calories, one kg of its grain contains 857 calories, 323 in green peas, 332 in cauliflower [9]. All its parts, especially the grain, are an important economic product, rich in protein, carbohydrates, fat and vitamins, and are widely used as valuable raw materials in the food industry. Sweet corn cobs are eaten canned, boiled, and sometimes buried in a pile [10, 11].

2 Materials and methods

The Bukhara province (Uzbekistan), where the research was conducted, is located in the southwestern part of the Zarafshan river, in the southwestern part of the Qizilqum desert. It adjoins the Khorezm province and the Republic of Karakalpakstan for a short distance from the north-west, and the lands of the Navai province from the north and east, the Karnob and Karshi deserts from the south-east, and the borders of Turkmenistan from the south-west [6].

In the conditions of the Bukhara province, the average air temperature during the year is +14.2 ºC +18.0 ºC. The hottest air temperature is observed in July of the year with an average of +28.3 ºC; +29.6 ºC, and the cooling of the temperature was recorded in January, the air temperature was +1.5 ºC; - 0.4 ºC. Atmospheric precipitation averages around 114-205 mm, and precipitation falls mainly in the winter-spring seasons of the year. The average air humidity is 51-55%, and in summer it is 17-25% [12, 13].

Studies have been conducted (2018-2021) in the arable layer (0-30 cm) of the meadow alluvial soils of Bukhara district, the amount of humus is on average 1.20%, and in the sub-arable layer (30-50 cm) it is on average 0.56%, total nitrogen is 0.092-0.051 %, phosphorus 0.24-0.16%, potassium 1.56-1.03%, mobile nitrogen 14.61-7.52 mg/kg, mobile phosphorus 31.26- 23.21 mg/kg, and mobile potassium was 240.41-170.31 mg/kg.

Selection of promising varieties and hybrids of sweet (vegetable) corn as a repeated crop in the conditions of Bukhara province, determination of optimal planting periods and optimal planting schemes consists in scientific justification of cultivation technology.

Selection of promising varieties and hybrids of sweet corn suitable for growing as a repeated crop in medium saline meadow alluvial soils of Bukhara province, as well as determination of favorable planting periods and optimal planting schemes and feeding area for obtaining high cob yield from sweet corn.

Field experiments were conducted in 2018-2021, and 12 varieties of sweet corn "Mazza", "Zamin", "Evrika", "Sherzod", "Megaton F_1", "Sentinel F_1", "SF 201 F_1", "Landmark" was used as research objects. Seeds of varieties and hybrids of "Union F_1", "Sweet star F_1", "Monte F_1", "Candy F_1", 3 planting dates, 6 planting schemes were obtained.

The varieties and hybrids studied in the field experiments were planted in a 60×25 cm, 10 m long, 2-row planting pattern. The total area of the experiment was 156 m2. Separated 2

varieties and 2 hybrids were studied in summer in 3 planting periods and 6 planting schemes, in which 60x25cm and 70x20 cm schemes were taken as control options. The area of each field was 24 m^2 in the 60 cm planting scheme with 4 rows, and 28 m^2 when the row spacing was 70 cm, and the total area of the experiment was 7488 m^2.
In the agrochemical analyzes of the soil of the experimental field, the amount of humus (%) by Tyurin method, total nitrogen, phosphorus and potassium (%) by Maltsev-Grytsenko, N-NO3(mg/kg) by FEK by Grandwald-Lyaju method, mobile phosphorus B.P.Machigin and exchangeable potassium was determined by P.V. Protasov's method (mg/kg), soil environment (pN) was determined by potentiometric method in aqueous absorption [4].
In the conducted field experiments, phenological observations (field germination of seeds, complete appearance of plant grass, formation of the 7th leaf, budding, milk ripening, wax ripening) and biometric measurements (plant height, height of placement of 1st and 2nd cobs) , the number of lateral stems, the number of leaves on the main stem, the number of joint intervals on the main stem, the number of cobs in one bush, the wet and dry weight of the underground and above-ground parts, and the root volume) were determined [5]. Productivity indicators were statistically analyzed by the method of dispersion analysis according to B.A. Dospekhov [2].

3 Results

According to the goals and objectives of our scientific research, sweet corn varieties and hybrids were planted in the field on July 1 in a 60x25 cm scheme as a repeated crop.
Germination of sown seeds in varieties and hybrids mainly occurred on July 6-8, that is, on the 6-8th day after sowing. Relatively early germination was recorded on July 6 in the variety "Zamin" and the hybrid "Union F_1". The latest germination was recorded on July 8 in such hybrids as "Swin star F_1", "SF 201 F_1", "Megaton F_1". The earliest chinbargs were produced in such varieties and hybrids as "Zamin", "Mazza", "Sherzod", "Union F_1", "Candy F_1".
Fertilization in all studied varieties and hybrids was recorded mainly on July 26-30. The formation of cobs is observed earlier in varieties and hybrids such as "Zamin", "Sherzod", "Union F_1", and relatively later in varieties and hybrids such as "Swin star F_1", "SF 201 F_1", "Megaton F_1" mainly on the 5th of August. It was 8 days. In the experiment, when milk and wax ripening of cobs was studied, the fastest cob ripening was observed in "Zamin", "Sherzod", "Union F_1" in the second decade of September, in the other varieties in the third decade of September, and it was recorded 8-10 days later.
In the experiment, according to biometric measurements, the tallest plants were recorded mainly in "Union F_1" (230.4 cm), "Swin star F_1" (183.4 cm), "Sentinel F_1" (187.2 cm). The location of the first cob, i.e., the height of the varieties and hybrids is 26.2 - 53.7 cm, and the density is 1.2 - 3.2 pieces, the number of leaves on the main stem is 10.6 - 13.2 pieces, and the number of joint intervals is 9.6 - 12.1 pieces. The highest result on the formation of cobs per plant is shown in "Evrika" (2.1 pieces), "Mazza" (2.2 pieces), "Sherzod" (4.2 pieces) and "Zamin" (4.3 pieces) varieties. it happened.
According to the analysis of productivity indicators, the weight of one cob was recorded from 231.1 to 303.4 grams in the studied varieties and hybrids of sweet corn. The highest cob weight indicator was recorded in the hybrid "Candy F_1" (303.4 grams).
In studied varieties and hybrids, the number of grain rows on the cob was 14.8 - 20.1 rows. The highest number of grain rows was recorded in the "Candy F_1" hybrid. The number of grains in one row of variety and hybrid cob was 36.8 - 43.6 grains, the number of grains in one cob was 398.9 - 522.7 grains, the weight of grains in one cob was 190.6 - 292.2 grams.
The kernel weight in the cob varied from 61.1 to 101.6 grams, and the yield of wet grain from the cob was recorded from 59.9 to 65.8%. The highest index of wet grain yield from cob was observed in varieties and hybrids such as "Zamin", "Sherzod", "Union F_1", "Sentinel F_1".

Silage mass yield of varieties and hybrids was 26.2 - 31.3 tons per hectare, and cob yield was 8.3 - 12.4 tons per hectare observed. The highest cob productivity was recorded in such varieties and hybrids as "Zamin" (11.0 tons), "Megaton F_1" (11.8 tons), "Union F_1" (12.4 tons) (Figure 1).

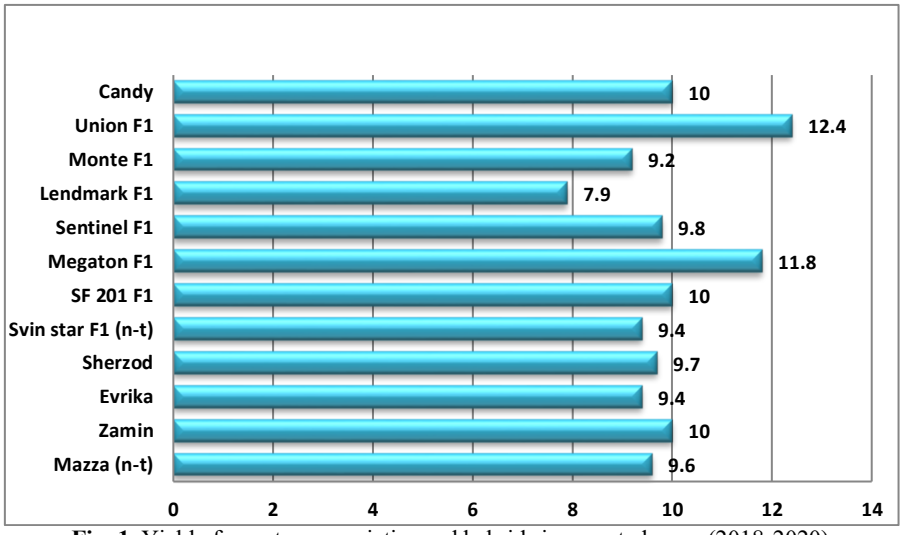

Fig. 1. Yield of sweet corn varieties and hybrids in repeated crop, (2018-2020).

The increase in the demand for sweet corn cobs is related to its high-quality biochemical composition, and since corn canning or freezing is highly profitable in processing, they are also increasing the volume of processing of this product every day [8].

In our research, the biochemical composition of sweet corn hybrids was analyzed. The dry matter was recorded from 29.0 to 32.9 percent, and the highest dry matter accumulation was observed in varieties and hybrids such as "Zamin", "Megaton F_1", "Sentinel F_1", "Candy F_1". When these varieties and hybrids were evaluated by tasting, their tasting score was estimated from 6.6 to 9.5 points [1, 3]

Table 1. Marketability and nutritional quality indicators of sweet corn cobs, (2018-2020).

Name of variety and hybrid	Dry matter, %	Tasting rating, points	Sugar content, %		Protein, %	Fiber, %
			In wet grain	In dry grain		
Mazza	30.0	8.5	8.1	2.1	2.13	0.50
Zamin	31.6	9.3	10.6	2.5	2.42	0.56
Evrika	29.8	9.0	7.3	1.9	2.16	0.53
Sherzod	30.7	9.0	8.9	2.2	2.24	0.55
Sweet star F_1	29.1	6.6	5.9	1.8	2.21	0.54
SF 201 F_1	30.1	8.0	7.3	2.0	2.42	0.45
Megaton F_1	32.3	9.5	12.8	3.3	2.96	0.52
Sentinel F_1	32.1	9.4	12.4	3.2	2.65	0.53
Landmark F_1	30.5	8.0	7.6	2.0	2.23	0.50
Monte F_1	29.0	5.2	5.8	1.9	2.53	0.52
Union F_1	30.5	9.2	7.9	2.1	2.32	0.51
Candy F_1	32.9	7.2	8.8	2.0	2.68	0.46

The valuable sign of sweet corn varieties and hybrids as a vegetable is related to the content of sugar, and when this indicator was determined during the milk wax ripening period of the

cob crop, it was observed that 5.8-12.8 percent of sugar was stored in the wet grain. The highest index of sugar content was recorded in varieties and hybrids such as "Mazza", "Sherzod", "Zamin", "Megaton F_1", "Sentinel F_1", "Candy F_1".
By the time of full ripening of the grains in sweet corn cobs, the amount of sugar in the grain decreased to 1.8-3.3%. Also, the protein content of the grain was 2.13-2.96%, and the fiber content was 0.26-0.56%. In general, it was found in our experiments that sweet corn cobs lose their edibility as a vegetable if they are not harvested at the time of milk-wax ripening (Table 1).

4 Discussion

The cob yield of the sweet corn plant is related to its growth pattern and the number of plants per hectare. Another element of intensive technologies in the cultivation of corn is the dense planting of seeds. Corn seeding density has a significant effect on plant vegetation and length of growing season and growth rate. When growing sweet corn varieties and hybrids, the correct determination of their planting thickness increases cob and stalk productivity by 20-30% [9, 11].
"Zamin", "Mazza", "Megaton F_1", "Union F_1" varieties and hybrids, selected among the sweet corn varieties and hybrids studied in our research, provided the highest index of wet grain yield from the cob, in the soil and climate conditions of Bukhara province in 3 periods (25.06; 05.07; 15.07) and grown in 6 planting schemes (60x20; 60x25; 60x30; 70x20; 70x25; 70x30) and 1 optimal planting period (05.07) and 2 optimal planting schemes (60x30; 70x25) were determined. In this case, phenological observations and biometric measurements showed that when the isolated varieties and hybrids of sweet corn were planted on the 5th of July, the germination was 7-8 days, and there was no sharp difference between the planting schemes.
Relatively early germination between varieties and hybrids was noted in the "Zamin" variety and the "Union F_1" hybrid. The seeds of "Megaton F_1" hybrid and "Mazza" variety germinated relatively late. In our experiments, the regularity of sprouting was also preserved in the formation of cypresses according to repetitions, first in "Zamin", "Mazza", "Union F_1", and then in the Megaton F_1 hybrid.
In the sweet corn varieties and hybrids studied in our experiments, fruiting was mainly recorded on August 5-8, and fruiting significantly differed depending on the sowing period and planting scheme. That is, as the planting scheme was shortened, it was shown that the flowering period of sweet corn plants was also accelerated.
In all studied cultivars and hybrids, regardless of the planting period, it was statistically proven that the mass of a single plant increased with the expansion of the feeding area. The relationship between these indicators is strong ($r>0.7$), linear in expression and direction, and the regression equation is generally obeyed by $y = a + bx$.
In addition, in our experiments, the effect of planting schemes on the formation of cobs was observed. When the planting schemes were shortened and plants were planted densely, the second and third cobs were not fully formed, or even when formed, grain rows were incomplete and small unproductive cobs were formed. It has been mathematically and statistically proven that the height of the first cob depends on the area of plant nutrition, the biological characteristics of varieties and hybrids. In the "Mazza" and "Zamin" varieties, in the "Union F_1" hybrid, it was found that the first cob is lower as the feeding area of plants increases. In all cases, it was found that the relationship is strong ($r>0.7$), and in turn, there is an inverse relationship. It was taken into account that only the "Megaton F1" hybrid does not obey this rule when the row spacing is 70 cm. When the studied varieties and hybrids of sweet corn were grown as a repeated crop in the scheme of 60x30 and 70x25 cm, the length of the cob according to the repetitions was 24.1 - 26.2; 24.4 - 26.8 cm, cob diameter 4.9 - 5.8;

5.0 - 5.9 cm, the number of grain rows in the cob circle is 15.7 - 21.2; 15.8 - 22.1 rows, the number of grains in one row of cob is 38.7 - 46.2; It was 39.0 - 46.9 pieces.

Sweet corn grown as a repeated crop was analyzed according to productivity indicators, where the wet weight of one cob among varieties and hybrids was 327.6 -363.0 grams for all variants and repetitions.

According to each variant and repetition, when it was determined whether the wet grain in the milk-wax ripening period was obtained from the cob, this indicator was 247.8 - 251.0 g or 64.6 - 65.9% in the "Mazza" variety, 255.5 - 263.7 g, in the "Zamin" variety 67.2 - 69.9%, in the "Union F_1" hybrid 282.1 - 283.5 g or 67.0 - 69.1%, in the "Megaton F_1" hybrid 255.3 - 255.7 g or 65.6 - 67.7%.

In the experiment, when the grain weight in the first cob was analyzed depending on the planting schemes at different planting periods, it was noted that the grain weight in the cob changed in varieties and hybrids.

A relationship in the form of an inverse parabola is observed between these parameters for the "Zamin" variety and the "Megaton F_1" hybrid, while a relationship in the form of both a parabola and an inverse parabola was found for the Mazza variety and the Union F_1 hybrid. From this it can be concluded that "Mazza" variety and "Union F_1" hybrid, depending on the nutritional area, that is, the use of water, nutrients and light by plants, it was found that the weight of grains in the cob changes dramatically.

According to the analysis of planting schemes in different planting periods, that is, grain yield depending on the feeding area, the grain yield in all studied varieties and hybrids, in the variants planted in a scheme with 60 cm between the rows, the increase in grain yield with the expansion of the feeding area has a straight linear relationship (y=a+ bx), and in schemes with 70 cm between rows, a decrease in productivity was found when the feeding area was large (70x30 cm). It was noted that the relationship is curvilinear, that is, in the form of an inverted parabola (y=a+bx-cx2), and in both cases the relationship is strong (r>0.7).

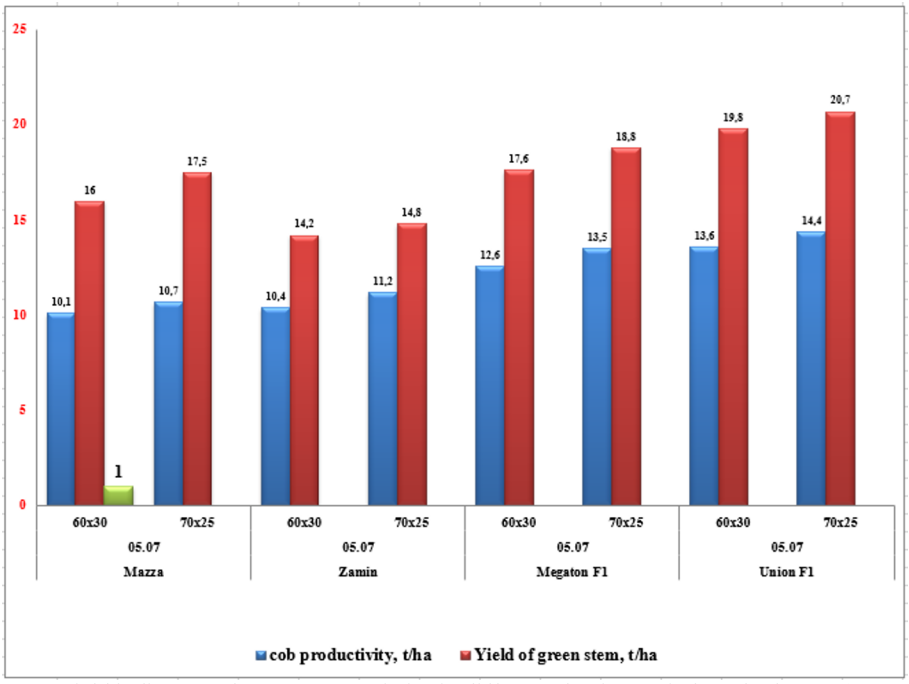

Fig. 2. Yield indicators of sweet corn varieties in different planting periods and schemes (average 2019-2021).

In our experiments, the yield of sweet corn varieties and hybrids grown as a repeated crop depends on the planting scheme in options and repetitions, and it was observed that it increased on average to 14.2 - 19.8 tons in the 60x30 cm plot, and to 14.8 - 20.7 tons in the 70x25 cm plot. high yield of blue stem was recorded in "Union F_1" hybrid and was 19.8 - 20.7 tons per hectare.

In the conditions of irrigated (saline) meadow alluvial soils of Bukhara province, when varieties and hybrids of sweet corn were grown as a repeated crop in different periods and planting schemes, the yield of cob in the milk-wax ripening period was on average 8.3-12.4 t/ha. In this case, the highest cob productivity indicator was observed when planting on July 5 in 60x30 and 70x25 cm schemes according to options and repetitions, 10.4 - 11.2 tons in "Zamin" variety, 10.1 - 10.7 tons of "Mazza" variety, 12.6 - 13.5 tons in the hybrid "Megaton F_1" and "Union F_1" hybrid was 13.6 - 14.4 tons.

5 Conclusions

In the agricultural context of the Bukhara province, the cultivation of selected varieties and hybrids of sweet corn, including "Zamin," "Mazza," "Megaton F1," and "Union F1," as a repeated crop in medium-saline meadow alluvial soils has proven to be highly productive. Employing carefully chosen planting schemes, specifically the 60x30 and 70x25 cm plots per hectare, and adhering to an optimal planting period in July, growers achieved an impressive yield of 10.1-14.4 tons of high-quality vegetable cobs per hectare.

This outcome underscores the significance of meticulous planning in crop management, with the choice of suitable varieties, precise planting schemes, and strategic timing playing pivotal roles in enhancing the overall productivity of sweet corn in this region. The success of this approach not only emphasizes the adaptability of these particular sweet corn varieties and hybrids to the local soil and climate conditions but also provides a practical and effective model for sweet corn cultivation in similar agroecological contexts.

The achievement of such substantial yields is a testament to the efficiency of the recommended practices, offering valuable insights for local farmers and stakeholders in the Bukhara province seeking to optimize their agricultural output while ensuring the production of high-quality sweet corn crops. The study's findings contribute to the ongoing efforts to refine and advance agricultural practices in the region, ultimately promoting sustainable and prosperous crop cultivation.

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