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Bashma EK
Department of Agronomy,
College of Agriculture,
Vellanikkara, Kerala, India

Vandana Venugaopal
Department of Agronomy,
College of Agriculture,
Vellanikkara, Kerala, India

Prameela P
Department of Agronomy,
College of Agriculture,
Vellanikkara, Kerala, India

Latha A
Agricultural Research Station,
Mannuthy

Beena VI
Department of Soil Science &
Agricultural Chemistry College
of Agriculture, Vellanikkara,
Kerala, India

Pratheesh P Gopinath
Department of Agricultural
Statistics, College of
Agriculture, Vellayani, Kerala,
India

Corresponding Author:
Bashma EK
Department of Agronomy,
College of Agriculture,
Vellanikkara, Kerala, India

Yield and quality of sweet corn as influenced by hybrids and different planting geometry

Bashma EK, Vandana Venugaopal, Prameela P, Latha A, Beena VI and Pratheesh P Gopinath

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Abstract

The field investigation entitled “Agro techniques for sweet corn hybrids (*Zea mays* Var. *Saccharata*) was conducted during the Rabi season (November 2023-January 2024) at the Agronomy Farm, Department of Agronomy, College of Agriculture, Vellanikkara, Thrissur, Kerala, India, to evaluate the effect of sweet corn hybrids and planting geometry on yield and quality parameters. The experiment was laid out in a factorial randomized block design with three hybrids (H₁-JK Athimadhur, H₂-INDAM Suruchi, and H₃-Sugar 75) under four planting geometries (G₁-single row planting with a spacing of 60 cm × 20 cm; G₂-single row planting with a spacing of 60 cm × 30 cm; G₃-twin row planting with a spacing of 60 cm × 20 cm and 90 cm between twin rows; G₄-twin row planting with a spacing of 50 cm × 25 cm and 90 cm between twin rows), replicated thrice. The experimental results revealed that significant variation among hybrids for yield attributes and quality traits. Among the hybrids, INDAM Suruchi recorded significantly higher cob weight with husk (239.19 g), cob weight without husk (189.09 g), number of kernels per cob (411.73), and total cob yield (36,202.37 kg ha⁻¹), indicating superior yield potential. In contrast, Sugar 75 exhibited superior quality attributes, recording the highest ascorbic acid content (6.47 mg 100 g⁻¹), starch content (16.60%), and total sugars (11.61%), reflecting better nutritional and eating quality. Planting geometry significantly influenced yield parameters, whereas quality parameters were not affected by planting geometry or interaction.

Keywords: Sweet corn, planting geometry, hybrids, yield, quality

1. Introduction

Sweet corn (*Zea mays* var. *saccharata*) is a specialized form of maize that originated from a naturally occurring recessive mutation of field corn, characterized by elevated sugar accumulation in the endosperm. Sweet corn differs from other corns, the primary difference is gene expression that determines endosperm carbohydrate content as well as many other genes that affect maize growth (Znidarcic, 2012) [19]. Unlike conventional maize, the kernels of sweet corn are tender, sweeter, and more palatable, which enhances its desirability for human consumption. Owing to these attributes along with its appealing ear characteristics and nutritional advantages, it is commonly classified as a vegetable rather than a cereal (Tracy, 2001) [17]. The crop is consumed fresh and is widely utilized in processing industries, particularly for canning and freezing. Additionally, the stover serves as a valuable source of green fodder, contributing to its overall economic importance.

Although sweet corn was initially cultivated in temperate regions such as the United States and Canada, its cultivation has expanded significantly into tropical and subtropical areas. The rising consumer preference and higher market value have positioned sweet corn as a remunerative crop, especially in peri-urban farming systems. However, its productivity is often limited by the lack of location-specific agronomic practices, particularly in terms of appropriate hybrid selection and optimum planting geometry.

The adoption of improved hybrids plays a pivotal role in enhancing productivity and ensuring sustainability. These hybrids offer greater tolerance to biotic and abiotic stresses, including pests, diseases, drought, and elevated temperatures. As a C₄ plant, sweet corn exhibits superior photosynthetic efficiency and better utilization of solar radiation, which supports higher biomass accumulation and yield potential. Efficient crop geometry further complements these advantages by facilitating optimal use of soil moisture and nutrients through balanced root distribution, while also improving canopy architecture for enhanced

light interception and photosynthate production. Nevertheless, suboptimal seed quality and improper spacing continue to be major factors contributing to reduced yields. Quality parameters in sweet corn, particularly sugar content, are influenced by genetic makeup, stage of harvest, and management practices. Among these, planting geometry plays a significant role in regulating plant growth, canopy development, and resource-use efficiency. In this context, the present investigation was undertaken to assess the performance of different sweet corn hybrids under varying planting geometries, with emphasis on growth, yield, and quality traits, in order to identify suitable combinations for improved productivity and produce quality.

2. Material and Methods

A field experiment was conducted during the Rabi season (November 2023-January 2024) at the Agronomy Farm, Department of Agronomy, College of Agriculture, Vellanikkara, Thrissur, Kerala, India. The experimental site is located at 10°54' N latitude and 76°28' E longitude, at an altitude of 40 m above mean sea level, and falls under Agro-Ecological Unit (AEU)-10 (Northern Central Laterites) of Kerala. The soil of the experimental field was sandy clay loam in texture, acidic in reaction with a pH of 4.3, and had an electrical conductivity of 0.085 dS m⁻¹. The experiment was laid out in a factorial randomized block design comprising 12 treatment combinations with three replications. The plot size was 3.2 m × 2.4 m. The treatments consisted of three sweet corn hybrids, namely JK Athimadhur, INDAM Suruchi, and Sugar 75, and four planting geometries: single-row planting at 60 cm × 20 cm, single-row planting at 60 cm × 30 cm, twin-row planting at 60 cm × 20 cm with 90 cm spacing between twin rows, and twin-row planting at 50 cm × 25 cm with 90 cm spacing between twin rows.

Before sowing, farmyard manure at 25 t ha⁻¹ was uniformly applied and incorporated into the soil. Fertilizers were applied as per the recommendations of the Indian Institute of Maize Research (IIMR), New Delhi, at a rate of 120:60:60 kg N:P₂O₅:K₂O ha⁻¹, using urea, Rajphos, and muriate of potash as sources of nitrogen, phosphorus, and

potassium, respectively. The entire dose of phosphorus was applied as a basal application at planting, while nitrogen and potassium were applied in three equal splits at planting, 25 days after sowing, and at flowering (40 DAS). All other agronomic practices were followed uniformly for all treatments in accordance with the recommended package of practices.

2.1 Observation on Sweet Corn

Cob length: The cob length from selected five plants was measured from the base to tip of the cob and the mean was computed as cob length in centimeters.

Cob girth: The cob girth from selected five plants was measured at the centre of the cob and the mean was expressed as cob girth in centimeters.

Cob Weight with husk (g): The green cobs with husk from five labelled plants were weighed and average weight was expressed in grams per plant.

Cob Weight without husk (g): The green cobs without husk from five labelled plants were weighed and average weight was expressed in grams per plant.

Number of kernels per cob: The number of kernels per cob was calculated for five cobs from each plot and the mean value was taken and recorded as the number of kernels per cob.

Hundred fresh kernel weight (g): Hundred fresh kernel weight of the selected cob from each plot were recorded and their mean was expressed in grams.

Cob yield (kg/ha): Cob yield was obtained by addition of yield after harvest from each plot and expressed in Kg ha⁻¹.

Stover yield (kg/ha): After the final harvest of cobs, the plants of each net plot were cut close to the ground, weighed and the weight was expressed in kg ha⁻¹.

Ascorbic acid content, Starch, total sugars, reducing sugars and anthocyanin in sweet corn kernels was estimated by the method described by Sadasivam and Manickam (1996) [14].

The experimental data generated were subjected to analysis of variance (ANOVA) using the statistical package KAU GRAPES (General Rshiny-based Analysis Platform Empowered by Statistics) developed by Kerala Agricultural University

Table 1: yield and yield attributes of sweet corn as influenced by hybrids and different planting geometry

Treatments	Cob length (cm)	Cob girth (cm)	Cob weight with husk (g)	Cob weight without husk (g)	Number of kernels per cob	Hundred fresh kernel weight (g)
Hybrids (H)						
H ₁ -JK Athimadhur	16.02	10.12	226.96	184.57	375.51	40.64
H ₂ -INDAM Suruchi	16.20	10.11	245.84	214.41	411.73	39.95
H ₃ -Sugar 75	15.07	9.97	231.09	195.29	355.28	45.56
SE(m)	0.083	0.133	1.657	1.985	3.806	0.455
CD(0.05)	0.244	NS	4.859	5.822	11.163	1.335
Planting geometry (G)						
G ₁ -60 x 20 cm	16.70	10.09	244.76	215.78	412.36	45.66
G ₂ -60x 30 cm	15.08	9.83	228.71	185.65	360.51	39.20
G ₃ -90x 60x20 cm	15.27	9.91	233.79	196.49	342.30	42.56
G ₄ -90x50 x25cm	16.00	10.43	231.25	194.43	408.19	40.06
SE(m)	0.096	0.153	1.913	2.292	4.395	0.526
CD(0.05)	0.282	0.45	5.611	6.723	12.89	1.541
Interaction (H x G)						
SE(m)	0.166	0.266	3.313	3.97	7.612	0.911
CD(0.05)	0.488	0.779	9.718	11.644	22.326	2.673

3. Results and Discussion

3.1 Yield attributes

Yield attributing characters of sweet corn viz., cob length, cob girth, cob weight with husk and without husk, number of kernels per cob and hundred fresh kernel weight were influenced by hybrids and planting geometry, are presented in Table 1.

3.2 Effect of hybrids

The direct effect of hybrids and plant geometry varied significantly in yield attributing characters of sweet corn. INDAM Suruchi (H2) recorded a significantly higher cob length (16.20 cm), which was statistically on par with JK Athimadhur (16.02 cm). Cob girth remained not significant with hybrids. INDAM Suruchi (245.84 g) recorded the highest husked cob weight, which was significantly superior to JK Athimadhur (226.96 g) and Sugar 75 (231.09 g). INDAM Suruchi (411.73) recorded the highest number of kernels per cob, which was significantly superior to JK Athimadhur (375.51) and Sugar 75 (355.28). The highest hundred fresh kernel weight was recorded in H₃ (45.56g), which was significantly superior to H₁ (40.64 g) and H₂ (39.95 g). INDAM Suruchi (245.84g) recorded significantly highest cob weight with husk and INDAM Suruchi (214.41 g) recorded the highest cob weight without husk, which was significantly superior to JK Athimadhur (184.57g) and Sugar 75 (195.29 g).

Characters such as cob girth, cob length, number of kernel rows per ear, number of kernels per row, and cob weight without husk have been identified as important selection criteria for sweet corn genotypes due to their high heritability and genetic advance. The variability expressed by the hybrids for these traits therefore reflects their inherent genetic potential and suitability for selection. Further, some of these characters exert a direct positive effect on cob weight with husk, which ultimately contributes to enhanced green cob yield. Similar observations highlighting the role of these traits in determining yield have been reported by Chavan *et al.*, (2020) [7]. The variation in cob length among hybrids may be attributed to differences in their genetic makeup and inherent yield potential. Similar variability in cob length among sweet corn and corn hybrids has also been reported by Hanmanth (2014) [10], Abuzar *et al.*, (2011) [1], and Mandic *et al.*, (2024) [12]. Hybrids differ genetically in kernel boldness, endosperm development, and sugar accumulation, which directly influence individual kernel weight. The higher fresh kernel weight may be attributed to its inherent genetic ability for efficient assimilate translocation and better kernel filling during grain development. Similar observations were reported by Hamoda and Dabbour (2025) [9]. The number of grains per cob was significantly influenced by the hybrid, as also reported by Hamoda and Dabbour (2025) [9]. INDAM Suruchi possess superior genetic potential for larger cob size, efficient assimilate translocation, and better kernel filling, resulting in higher cob weight both with and without husk. Similar observations on genetic variability of cob weight with husk and without husk among sweet corn hybrids were reported by Bhatt (2012) [6], Chougale (2013) [8], and Hanmanth (2014) [10].

3.3 Effect of planting geometry

Cob length (16.70 cm), hundred fresh kernel weight (45.66 g), number of kernels per cob (412.36), cob weight with

husk (244.76 g), and cob weight without husk (215.78 g) were highest at a spacing of 60 × 20 cm. Cob girth (10.43 cm) was higher in G₄, which was on par with G₁ (10.09 cm), G₂ (9.83 cm), and G₃ (9.91 cm). The highest cob yield (14,150 kg/ha) and stover yield (17,793 kg/ha) were also recorded at a spacing of 60 × 20 cm. Plant geometry had a significant influence on cob length, with the wider spacing of 60 cm × 20 cm recording significantly highest cob length. Its might have improved growth attributes such as plant height and number of leaves, thereby enhancing assimilate production and translocation towards cob development. These findings are in close conformity with Bhatt (2012) [6], Bhatnagar *et al.*, (2023) [5] and Wananda and Wahditiya (2023) [18] in sweet corn. The increased cob girth observed under G₄ (twin row planting with 50 cm × 25 cm spacing and 90 cm between twin rows), which was on par with G₁, G₂ and G₃ could be attributed to reduced inter-plant competition for nutrients, moisture, light, and space. These findings are in close conformity with the reports of Mathukia *et al.*, (2014) [13] in sweet corn. Higher values of hundred fresh kernel weight under 60 cm × 20 cm spacing, due to a favourable and relatively stress-free growing condition in sweet corn, were also reported by Shintri (2013) [16] in sweet corn.

3.4 Yield

Data in Table 2 revealed that cob yield and stover yield of sweet corn was affected significantly due to hybrids and planting geometry.

3.5 Effect of hybrids

Among different hybrids INDAM Suruchi (12940 kg/ha) recorded the highest cob yield, which was significantly superior to Sugar 75 (11169 kg/ha) and JK Athimadhur (11030 kg/ha). Sugar 75 (16277 kg/ha) produced maximum stover yield among hybrids evaluated. Hybrids differ genetically in growth habit, yield attributes, and assimilate partitioning efficiency. High-yielding hybrids such as INDAM Suruchi possess superior sink strength, better cob development, and more efficient conversion of photosynthates into economic yield, resulting in higher total cob yield. Variation in total cob yield among hybrids may be attributed to inherent differences in growth rate, ear initiation, photosynthetic efficiency, duration of effective grain filling, and assimilate partitioning. These findings are in conformity with the results reported by Bhatt (2012) [6] and Hanmanth (2014) [10] in sweet corn.

3.6 Effect of planting geometry

The spacing of 60 cm × 20 cm (G₁) resulted in the highest cob yield and was markedly superior to the other planting geometries. Plant geometry influenced the availability of growth resources such as light, nutrients, moisture, and space. Optimum spacing ensures a balance between plant number and individual plant performance, leading to higher cob yield per hectare. Similar results were reported by Arabhanvi and Hulihalli (2019) [3], Khubna *et al.*, (2021) [11]. Increased plant density enhances total leaf area index and light interception at the canopy level, thereby increasing overall stover production per hectare. Stover yield is determined by plant population per hectare and dry matter accumulation. These results are in agreement with Bhatt (2012) [6] and Bhatnagar *et al.*, (2023) [5].

3.7 Quality aspects of grain

The quality aspects of grain such as ascorbic acid content, starch, anthocyanin content, total sugars and reducing sugars were affected significantly due to hybrids, are presented in Table 2.

3.8 Effect of hybrids

Sugar 75 recorded the highest values for quality parameters, with ascorbic acid (6.47 mg/100 g), starch content (16.60%), total sugars (11.61%), and reducing sugars (2.32%), and was significantly superior to other hybrids. However, INDAM Suruchi recorded a higher anthocyanin content (0.85 mg/100 g), which was on par with Sugar 75 (0.80 mg/100 g). Kernel quality in sweet corn is largely governed by genetic factors, including varietal and genetic group differences with limited influence from agronomic practices. Sweetness, the key component of sweet corn flavour, depends on the balance between sugar and starch in the endosperm. Genotypes with

higher sugar and lower starch content produce more tender, crispy kernels with better aroma, thereby improving overall eating quality. Similar result were reported by Azanza *et al.*, 1994^[4] and Alan *et al.*, 2014^[2].

3.9 Effect of planting geometry

Planting geometry did not exert any significant influence on the quality parameters of sweet corn. The variations in spacing failed to bring about statistically meaningful differences in traits such as ascorbic acid, starch content, total sugars, reducing sugars, and anthocyanin content. This indicates that these quality attributes are largely governed by genetic factors of the hybrids rather than the spatial arrangement of plants in the field. Similar results were reported by Sheikh and Dar (2017)^[15], indicating that these quality parameters are mainly influenced by genetic factors rather than plant spacing.

Table 2: Cob yield (kg/ha), stover yield (kg/ha) and quality aspects of grain of sweet corn as influenced by different treatments.

Treatments	Cob Yield (kg/ha)	Stover Yield (kg/ha)	Ascorbic acid content (mg/100 g)	Starch (%)	Anthocyanin (mg/100 g)	Total sugars (%)	Reducing sugars (%)
Hybrids (H)							
H ₁ -JK Athimadhur	11030	13080	6.15	13.33	0.45	10.47	2.09
H ₂ -INDAM Suruchi	12940	14344	6.20	16.17	0.85	11.03	2.21
H ₃ -Sugar 75	11169	16277	6.47	16.60	0.80	11.61	2.32
SE(m)	170.529	410.10	0.087	0.052	0.019	0.09	0.018
CD(0.05)	500.144	1202.79	0.255	0.153	0.056	0.263	0.054
Planting geometry (G)							
G ₁ -60 x 20 cm	14150	17793	6.20	15.35	0.69	11.00	2.203
G ₂ -60 x 30 cm	10103	13353	6.39	15.37	0.69	11.04	2.209
G ₃ -90x60x20 cm	11956	13305	6.25	15.40	0.69	11.02	2.200
G ₄ -90x50 x25cm	10643	13816	6.26	15.33	0.72	11.07	2.217
SE(m)	196.91	473.54	0.1	0.06	0.022	0.104	0.021
CD (0.05)	577.516	1388.863	NS	NS	NS	NS	NS
Interaction (H x G)							
SE(m)	341.057	820.206	0.174	0.104	0.038	0.179	0.037
CD(0.05)	1000.287	NS	NS	NS	NS	NS	NS

4. Conclusion

From the above results, it can be concluded that among the different hybrids, INDAM Suruchi recorded the highest yield attributes and cob yield. However, most of the quality characters of sweet corn were significantly superior in Sugar 75. Among the spacings, yield-attributing characters were superior at 60 cm × 20 cm. Planting geometry did not have a significant influence on the quality characters of sweet corn.

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