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Growth, Yield and Quality of Sweet Corn (*Zea mays* L. *Saccharata*) as Influenced by Spacing and INM Practices Under South Gujarat Condition

Rathod Manishaben, V. G. Bavalgave*, V. A. Patil, and S. P. Deshmukh

Dept. of Agronomy Navsari Agricultural University, Navsari, Gujarat (396 450), India

Corresponding Author

V. G. Bavalgave
e-mail: vgbavalgave@gmail.com

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Abstract

A field experiment was conducted at college farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari (GJ), during *rabi* season in 2016–17 to study the influence of spacing and integrated nutrient management on sweet corn (*zea mays* L. *saccharata*) under south Gujarat condition". The experiment was laid out in Factorial randomized blok design (FRBD) with three replications. The factors consisted of three spacing (45×30 cm², 60×20 cm² and 60×30 cm²), three nutrient management practices (100% RDF (120:60:00 NPK kg ha⁻¹, 75% RDF+25% RDN through Biocompost and 50% RDF+50% RDN through Biocompost) and two biofertilizers i.e. with Azotobacter+PSB+KMB and without biofertilizers. The results revealed that, spacing 60×20 cm² recorded significantly higher green cob (91.93 q ha⁻¹) and fodder yield (318.65 q ha⁻¹) While, Significantly higher protein content in cob (6.97%) and fodder (2.92%) was recorded in spacing 60×30 cm² (S₃). Application of 100% RDF (120:60:00 NPK kg ha⁻¹) recorded the significantly highest green cob (90.13 q ha⁻¹), fodder yield (311.74 q ha⁻¹) and protein content in cob (6.91%) and fodder (2.95%). Biofertilizers i.e. Azotobacter+PSB+KMB application recorded the significantly highest green cob (86.64 q ha⁻¹), fodder yield (299.68 q ha⁻¹) and protein content in cob (6.85%) and fodder (2.85%).

Keywords: Sweet corn, Spacing, Fertilizer and Biofertilizer

1. Introduction

Generally, maize (*Zea mays* L.) is cultivated in all seasons successfully as it is classified as C4 type crop. Among the various types of maize, sweet corn is very popular for the use of its green cobs all around the world. Sweet corn is a popular vegetable and ranks second in farm value and fourth in commercial crops. Due to rising in demand, the sweet corn is able to increase the farm income. In order to achieve higher cob yields, maintenance of stand density is the most important factor. A spatial arrangement of plant governs the shape and size of the leaf area plant⁻¹, which in turn influences efficient interception of radiant energy, proliferation, growth of roots and their activity. Maximum yield can be expected only when plant population allows individual plant to achieve their maximum inherent potential. Thus, there is need to work out an optimum population density by adjusting inter and intra row spacing in relation to other agronomic factors. India has made spectacular breakthrough in production and consumption of fertilizers during the last four decades. But consumption of renewable form of energy (chemical fertilizers) will be quite a limiting factor for increasing agriculture production in future. Because of escalating energy cost, chemical fertilizers are not available

at affordable prices to the farmers. Moreover, the problem is compounded by imbalanced and indiscriminate fertilizer use, a decline in soil organic carbon due to prolonged use of chemical fertilizers. The production efficiency gone down appreciably. Thus, higher productivity on a sustained basis can be ensured only through integrated nutrient supply system including combined judicious use of chemical fertilizers, Biocompost, and biofertilizers (Yadav, 2002). Biofertilizers have an advantage over chemical fertilizers, as they provide nutrients in addition to plant growth promoting substances like hormones, vitamins, amino acids etc. (Shivankar et al., 2000). Hence, introduction of biofertilizers is necessary for improving the soil fertility and productivity besides reducing the expenditure on chemical fertilizers. The present study was, therefore, aimed to evaluate the performance of sweet corn as influenced by spacing and integrated nutrient management.

2. Materials and Methods

A trial was conducted during *rabi* 2016–17 at College Farm, Department of Agronomy, College of Agriculture, Navsari Agricultural University, Navsari to assess the response of *rabi* sweet corn (*Zea mays* L. var. *saccharata* Sturt) to spacing and integrated nutrient management under south Gujarat condition.



The experiment comprising eighteen treatment combinations consisting three levels of plant spacing (45×30 cm², 60×20 cm² and 60×30 cm²), three nutrient management practices (100% RDF (120:60:00 NPK kg ha⁻¹, 75% RDF+25% RDN through Biocompost and 50% RDF+50% RDN through Biocompost) and two biofertilizers i.e. with Azotobactor+PSB+KMB and without biofertilizers. These treatments were replicated three times in a Factorial Randomized Block Design. Field was prepared by ploughing followed by passing the harrow and leveler. The seeds of Sweet corn (cv. Sugar 75) was sown in the present experiment.

The experimental soil was clayey and low in available N, medium in available P and high in available potash. Other agronomical operations were carried out as per recommendation. The observation on Plant height, Number of leaves plant⁻¹, Stem girth, Cob length, Cob girth, Cob weight plant⁻¹, Number of grain row cob⁻¹, Number of grains cob⁻¹, Fresh weight of grain cob⁻¹, Green cob yield, Green fodder yield were recorded at the time of harvest of crop. Protein

content of cob and fodder was calculated by multiplying the nitrogen content with a factor 6.25 as proposed by Tsen and Martin (1971). It was expressed in terms of protein (%) content.

3. Results and Discussion

3.1. Effect of spacing

The results revealed that, Growth characters like plant height (219.61 cm) was recorded significantly higher with spacing 60×20 cm². The increased plant height in narrow plant spacing might be due to thick plant stand. While 60×30 cm² was recorded significantly the highest number of leaves plant⁻¹ (14.19) and stem girth (2.12 cm). The stem girth is reduced as compared to wider plant spacing. In wider plant spacing there is abundance of available resources and hence the plants were healthier than thick plant stands. In narrow spacing there was more competition for available resources and hence plants were tall but weaker than wider plant spacing. Almost similar results were observed by Sharma and Gupta (1968) (Table 1).

Table 1: Effect of spacing and INM practices on growth characters

Treatment	Plant height (cm)	Leaves plant ⁻¹ (no.)	Stem girth (cm)	Cob length (cm)		Cob girth (cm)	
				With husk	Without husk	With husk	Without Husk
Spacing (S)							
S ₁ : 45×30 cm ²	211.39	13.22	2.07	25.51	17.17	14.10	9.99
S ₂ : 60×20 cm ²	219.61	11.93	2.03	24.05	16.90	13.16	10.03
S ₃ : 60×30 cm ²	188.28	14.19	2.12	27.18	18.11	14.94	10.67
SEm±	2.61	0.31	0.01	0.46	0.13	0.17	0.15
CD (p=0.05)	7.80	0.89	0.02	1.34	0.37	0.49	0.43
Nutrient management (N)							
N ₁ : 100% RDF (120:60:00 NPK kg ha ⁻¹)	216.72	13.37	2.11	26.64	17.99	14.81	10.64
N ₂ : 75% RDF + 25% RDN through Bio-compost	204.22	13.14	2.08	25.20	17.76	14.07	10.12
N ₃ : 50% RDF+50% RDN through Bio-compost	198.33	12.83	2.04	24.92	16.96	13.30	9.85
SEm±	3.06	0.31	0.01	0.46	0.13	0.17	0.15
CD (p=0.05)	8.80	0.92	0.02	1.34	0.37	0.49	0.43
Bio-fertilizers (B)							
B ₀ : No Bio-fertilizers	201.96	12.89	2.05	24.80	17.07	13.61	9.91
B ₁ : Azotobactor+PSB+KMB (10 ml each kg ⁻¹ seed)	210.89	13.34	2.10	26.37	18.07	14.53	10.53
SEm±	2.50	0.25	0.01	0.38	0.10	0.14	0.12
CD (p=0.05)	7.19	0.76	0.01	1.09	0.30	0.41	0.35

In case of yield attributes viz. cob length plant⁻¹ with (27.18 cm) and without husk (18.19 cm), cob girth plant⁻¹ with (14.94 cm) and without husk (10.96 cm), cob weight plant⁻¹ with husk (202.22 g) and without husk (146.22 g), number of grains

row⁻¹ of cob (38.94), number of grains cob⁻¹ (459.78), fresh weight of grain cob⁻¹ (122.28 g) was recorded significantly higher in spacing 60×30 cm². While, green cob (91.93 q ha⁻¹) and fodder yield (318.65 q ha⁻¹) was recorded significantly



higher in spacing 60×20 cm². The data showed that the cob length decreased as the plant population increased. These results indicate that there is a positive relationship between plant spacing and cob length of maize, probably due to variable plant competition. A wider spacing of 60×30 cm² can significantly increase almost all the growth and yield attributes in sweet corn but could not compensate yield obtained in narrower spacing (Thakur et al., 1997). Under high density, more numbers of plants unit⁻¹ area was responsible for higher yield. Higher plant population utilized the production resources more efficiently towards plant development. The lowest being recorded with the wider spacing. An increase in plant density there was increase in green fodder yield in sweet corn, Hence higher plant population 60×20 cm² (S₂) increased the cob yield by 10.7% while green fodder yield by 13.6% over S₁ and S₃. These findings are in agreement with those of Thakur et al. (1998), Raja (2001), et al. (2006).

Significantly higher protein content in cob (6.97%) and fodder (2.92%) was recorded in spacing 60×30 cm² (S₃). The treatment difference due to various spacing on total sugar content was found non significant.

3.2. Effect of nutrient management

Application of 100% RDF (120:60:00 NPK kg ha⁻¹) recorded the significantly highest plant height (216.72 cm), number of leaves per plant (13.37) and stem girth (2.11 cm), cob length per plant with (26.64 cm) and without husk (17.99 cm), cob girth per plant with (14.81 cm) and without husk (10.64 cm), cob weight plant⁻¹ with husk (200.50 g) and without husk (154.50 g), number of grains row⁻¹ of cob (38.50), number of grains cob⁻¹ (479), fresh weight of grain cob⁻¹ (118.11 g), green cob (90.13 q ha⁻¹) and fodder yield (311.74 q ha⁻¹). The improvement in growth and yield attributes with the application of 100% RDF might have resulted in better and timely availability of N and P for their utilization by plant as judged from nitrogen and phosphorous content of cob and fodder. Nitrogen is considered to be a vitally important plant nutrient. It is an integral part of chlorophyll which is the primary absorber of light energy needed for photosynthesis. Besides these, it is also a constituent of certain organic compounds of physiological importance. Further, phosphorous fertilization also improves the metabolic and physiological processes and thus known as “energy currency” which is subsequently used for vegetative and reproductive growth through phosphorylation. In addition to vital metabolic role, P is an important structural component of nucleic acid, phytin, phospholipids and enzymes. An adequate supply of phosphorous early in the life cycle of plant is important in laying down the primordia of its reproductive part. The present findings are in close confirmation with those of Raja (2001) on sweet corn, Pathak et al. (2002) on winter maize and Kar et al. (2006) on sweet corn. The significant improvement

in overall growth resulted in higher photosynthetic activity has eventually gave higher yield. (Table 2).

Application of 100% RDF (120:60:00 NPK kg ha⁻¹) recorded the significantly highest protein content in cob (6.91%) and fodder (2.95%). Data revealed that nutrient management had non significant effect with respect to total sugar content in grain.

3.3. Effect of biofertilizers

Application of Azotobacter+PSB+KMB biofertilizer recorded the significantly highest plant height (210.89 cm), number of leaves per plant (13.34) and stem girth (2.10 cm), cob length per plant with (26.37cm) and without husk (18.07 cm), cob girth per plant with (14.53 cm) and without husk (10.53 cm), protein content in cob (6.85%) and fodder (2.85%), Biofertilizer application increased the growth characters by virtue of fixing atmospheric nitrogen, solubilizing and mobilizing nutrients and it secretes growth promoting substances (Table 1).

The significantly higher cob weight with and without husk per plant (201.51 g and 145.07 g) were found with bio fertilizers i.e. Azotobacter+PSB+KMB (B₁). Whereas, the lowest cob weight with and without husk per plant (187.11 g and 125.07 g) were found under no bio fertilizers (B₀). The higher numbers of grains per row of cob (37.66) were found with biofertilizers i.e. Azotobacter+PSB+KMB (B₁). Whereas, significantly lowest number of grains per row of cob (35.77) were found under no biofertilizers (B₀). The higher numbers of grains per cob (458.88) were found with biofertilizers i.e. Azotobacter+PSB+KMB (B₁). Whereas, the lowest numbers of grains cob⁻¹ (389.40) were found under no biofertilizers (B₀). The higher fresh weight of grain cob⁻¹ (116.11 g) found with biofertilizers i.e. Azotobacter+PSB+KMB (B₁). However, the lowest fresh weight of grain cob⁻¹ (101.51 g) was found under no biofertilizers (B₀). Significantly higher green cob yield (86.64 q ha⁻¹) were found with biofertilizers i.e. Azotobacter+PSB+KMB (B₁). However, the lowest green cob yield (77.44 q ha⁻¹) was found under no biofertilizers (B₀). Significantly higher green fodder yield (299.68 q ha⁻¹) was found with biofertilizers i.e. Azotobacter+PSB+KMB (B₁) over no bio fertilizers (B₀) application (270.96 q ha⁻¹). This could be due to higher nutrient, availability, and higher uptake of nutrients (Table 2).

The significantly higher protein content in cob (6.85%) and fodder (2.85%) found with application of biofertilizers i.e. Azotobacter+PSB+KMB (B₁). The data regarding total sugar content in grain as presented that the different biofertilizers had non significant effect on it.

3.4. Interaction effect

Combined effect among spacing, nutrient management and biofertilizers did not reach to the level of significance for growth, yield attributes, cob and fodder yield, protein content and total sugar content.



Table 2: Yield and quality parameters as influenced by different spacing and fertilizer levels

Treatments	Cob weight plant ⁻¹ (g)		Grain row cob ⁻¹ (no.)	Grains cob ⁻¹ (no.)	Fresh weight of grain cob ⁻¹ (g)	Green cob yield (q ha ⁻¹)	Green fodder yield (q ha ⁻¹)	Protein content (%)		Total sugar content (%)
	With husk	Without husk						Cob	Fodder	
Spacing (S)										
S ₁ : 45×30 cm ²	184.72	135.83	36.43	408.89	110.55	83.68	285.62	6.78	2.73	10.39
S ₂ : 60×20 cm ²	174.39	123.16	34.78	403.75	93.61	91.93	318.65	6.56	2.59	10.02
S ₃ : 60×30 cm ²	202.22	146.22	38.94	459.78	122.28	70.51	251.68	6.97	2.92	11.00
SEm±	5.61	3.69	0.68	11.89	3.06	2.14	5.42	0.06	0.05	0.10
CD (p=0.05)	16.13	10.61	1.96	34.21	8.80	6.15	15.60	0.19	0.17	NS
Nutrient management (N)										
N ₁ : 100% RDF (120:60:00 NPK kg ha ⁻¹)	200.50	154.50	38.50	479.00	118.11	90.13	311.74	6.91	2.95	10.26
N ₂ : 75% RDF+25% RDN through Bio-compost	181.67	138.27	36.00	409.05	109.44	81.74	285.79	6.71	2.69	10.48
N ₃ : 50% RDF+50% RDN through Bio-compost	179.17	112.44	35.67	384.37	98.88	74.25	258.42	6.69	2.59	10.76
SEm±	5.61	3.69	0.68	11.89	3.06	2.14	5.42	0.06	0.05	0.10
CD (p=0.05)	16.13	10.61	1.96	34.21	8.80	6.15	15.60	0.19	0.17	NS
Bio-fertilizers (B)										
B ₀ : No Bio-fertilizers	187.11	125.07	35.77	389.40	101.51	77.44	270.96	6.69	2.64	10.22
B ₁ : Azotobacter+PSB+KMB (10 ml each kg ⁻¹ seed)	201.51	145.07	37.66	458.88	116.11	86.64	299.68	6.85	2.85	10.71
SEm±	2.50	3.01	0.55	9.71	2.50	1.75	4.43	0.05	0.04	0.08
CD (p=0.05)	7.19	8.66	1.60	27.93	7.19	5.0233	12.74	0.15	0.13	NS

4. Conclusion

From the present findings, it could be suggested that rabi sweet corn (var. Sugar-75) crop sown at 60×20 cm² spacing and application of 100% RDF (120:60:00 NPK kg ha⁻¹). It is also seen that biofertilizers i. e. Azotobacter+PSB+KMB (10 ml each kg⁻¹ seed) seems to be beneficial on clayey soil under south Gujarat condition.

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