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Yield and uptake of sweet corn (*Zea mays* L. *saccharata*) as influenced by spacing and INM practices under south Gujarat condition

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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 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 cm x 30 cm, 60 cm x 20 cm and 60 cm x 30 cm), three nutrient management practices (100% RDF (120:60:00 NPK kg/ha, 75% RDF + 25% RDN through Biocompost and 50% RDF + 50% RDN through Biocompost) and two biofertilizers (with Azotobactor + PSB + KMB and without biofertilizers). The results revealed that, spacing 60 cm x 20 cm recorded significantly higher green cob yield (91.93 qha^{-1}), fodder yield (318.65 qha^{-1}) and NPK uptake by cob and fodder. Application of 100% RDF (120:60:00 NPK $kgha^{-1}$) recorded the significantly highest green cob yield (90.13 qha^{-1}), fodder yield (311.74 qha^{-1}) and NPK uptake by cob and fodder. Biofertlizers i.e. Azotobacter + PSB + KMB application recorded the significantly highest green cob yield (86.64 q ha^{-1}), fodder yield (299.68 q ha^{-1}) NPK uptake by cob and fodder.

Keywords: Sweet corn, spacing, fertilizer and biofertilizer

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 per plant, 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) [4]. Hence, introduction of biofertilizers is necessery 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

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 cm x 30 cm, 60 cm x 20 cm and 60 cm x 30 cm), three nutrient management practices (100% RDF (120:60:00 NPK kg/ha, 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. Sweet corn (cv. Sugar 75) was used 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 growth, yield attributes and yield were recorded at the time of harvest of crop.

Result and Discussion

Effect of spacing

The results revealed that, yield attributes *viz*. cob weight per plant with husk (202.22 g) and without husk (146.22 g), number of grains per row of cob (38.94), number of grains per cob (459.78), fresh weight of grain per cob (122.28 g) was recorded significantly higher in spacing 60 cm x 30 cm. While, green cob (91.93 q ha^{-1}) and fodder yield (318.65 qha^{-1}) was recorded significantly higher in spacing 60 cm x 20 cm. A wider spacing of 60 cm x 30 cm 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) [5]. Under high density, more numbers of plants per unit 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 cm x 20 cm (S_2) increased the cob yield by 10.7 per cent, while green fodder yield by 13.6 per cent over S_1 and S_3. These findings are in agreement with those of Thakur *et al*. (1998), Raja (2001), and Kar *et al*. (2006) [6, 3, 1]. Significantly higher N, P and K uptake recorded by cob (46.29, 10.09 and 36.42 kg ha^{-1}, respectively) and fodder (82.66, 31.22 and 102.49 kg ha^{-1}, respectively) in spacing 60 cm x 20 cm.

Effect of nutrient management

Effect of nutrient management

Application of 100% RDF (120:60:00 NPK kg ha^{-1}) recorded the significantly highest cob weight per plant with husk (200.50 g) and without husk (154.50 g), number of grains per row of cob (38.50), number of grains per cob (479), fresh weight of grain per cob (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, phytein, 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) [3] on sweet corn, Pathak *et al.* (2002) [2] on winter maize and Kar *et al.* (2006) [1] on sweet corn. The significant improvement in overall growth resulted in higher photosynthetic activity has eventually gave higher yield. Application of 100% RDF (120:60:00 NPK kg ha^{-1}) recorded the significantly highest uptake in cob (43.01, 9.82 and 34.70 kg ha^{-1}, respectively) and fodder (90.11, 34.24 and 112.30 kg ha^{-1}, respectively) with this practice.

Effect of Biofertilizers

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 (B_1). Whereas, the lowest cob weight with and without husk per plant (187.11 g and 125.07 g) were found under no bio fertilizers (B_0). The higher numbers of grains per row of cob (37.66) were found with biofertilizers i.e. Azotobacter + PSB + KMB (B_1). Whereas, significantly lowest number of grains per row of cob (35.77) were found under no biofertilizers (B_0). The higher numbers of grains per cob (458.88) were found with biofertilizers i.e. Azotobacter + PSB + KMB (B_1). Whereas, the lowest numbers of grains per cob (389.40) were found under no biofertilizers (B_0). The higher fresh weight of grain per cob (116.11 g) found with biofertilizers i.e. Azotobacter + PSB + KMB (B_1). However, the lowest fresh weight of grain per cob (101.51 g) was found under no biofertilizers (B_0). Significantly higher green cob yield (86.64 qha^{-1}) were found with biofertilizers i.e. Azotobacter + PSB + KMB (B_1). However, the lowest green cob yield (77.44 q ha^{-1}) was found under no biofertilizers (B_0). Significantly higher green fodder yield (299.68 q ha^{-1}) was found with biofertilizers i.e. Azotobacter + PSB + KMB (B_1) over no bio fertilizers (B_0) application (270.96 q ha^{-1}). This could be due to higher nutrient, availability, and higher uptake of nutrients. Biofertlizers i.e. Azotobacter + PSB + KMB application recorded the significantly highest N, P and K uptake in cob (40.81, 9.31 and 32.91, respectively) and fodder (78.03, 30.51 and 100.3, respectively) accrued with biofertilizers application.

Interaction effect

Combined effect among spacing, nutrient management and biofertilizers did not reach to the level of significance for yield attributes, cob and fodder yield and nutrient uptake

Table 1: Effect of spacing and INM practices on yield and yield attributes sweet corn

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 (qha^{-1})	Green Fodder yield (qha^{-1})
	With husk	Without husk					
Spacing (S)							
S_1 - 45 cm x 30 cm	184.72	135.83	36.43	408.89	110.55	83.68	285.62
S_2 - 60 cm x 20 cm	174.39	123.16	34.78	403.75	93.61	91.93	318.65
S_3 - 60 cm x 30 cm	202.22	146.22	38.94	459.78	122.28	70.51	251.68
S.Em.±	5.61	3.69	0.68	11.89	3.06	2.14	5.42
C.D. at 5%	16.13	10.61	1.96	34.21	8.80	6.15	15.60
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
N_2 - 75% RDF + 25% RDN through Bio-compost	181.67	138.27	36.00	409.05	109.44	81.74	285.79
N_3 - 50% RDF + 50% RDN through Bio-compost	179.17	112.44	35.67	384.37	98.88	74.25	258.42
S.Em.±	5.61	3.69	0.68	11.89	3.06	2.14	5.42
C.D. at 5%	16.13	10.61	1.96	34.21	8.80	6.15	15.60
Bio-fertilizers (B)							
B_0 - No Bio-fertilizers	187.11	125.07	35.77	389.40	101.51	77.44	270.96
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
S.Em.±	2.50	3.01	0.55	9.71	2.50	1.75	4.43
C.D. at 5%	7.19	8.66	1.60	27.93	7.19	5.0233	12.74

Table 2: Effect of spacing and INM practices on uptake by sweet corn crop

Treatments	N uptake (Kg ha^{-1})			P uptake (Kg ha^{-1})			K uptake (Kg ha^{-1})		
	Cob	Fodder	Total	Cob	Fodder	Total	Cob	Fodder	Total
Spacing (S)									
S_1 - 45 cm x 30 cm	40.1	63.40	103.48	9.08	25.81	34.89	31.32	83.98	115.30
S_2 - 60 cm x 20 cm	46.29	82.66	128.95	10.09	31.22	41.32	36.42	102.49	138.91
S_3 - 60 cm x 30 cm	27.13	61.04	88.17	6.35	23.38	29.74	22.48	77.21	99.10
S.Em.±	1.21	5.23	5.13	0.30	1.92	1.91	1.06	6.15	6.11
C.D. at 5%	3.47	15.04	14.75	0.86	5.52	5.49	3.04	17.68	17.58
Nutrient management (N)									
N_1 - 100% RDF (120:60:00 NPK kg ha^{-1})	43.01	90.11	133.12	9.82	34.24	44.07	34.70	112.30	147.00
N_2 - 75% RDF + 25% RDN through Bio-compost	37.32	67.10	105.31	8.53	26.67	35.20	29.84	87.30	117.14
N_3 - 50% RDF + 50% RDN through Bio-compost	33.10	49.00	82.10	7.17	19.50	26.67	25.68	64.08	89.76
S.Em.±	1.20	5.23	5.13	0.30	1.92	1.91	1.06	6.15	6.11
C.D. at 5%	3.47	15.04	14.75	0.86	5.52	5.48	3.04	17.68	17.58
Bio-fertilizers (B)									
B_0 - No Bio-fertilizers	34.81	60.03	94.85	7.70	23.10	30.81	27.24	75.50	102.74
B_1 - *Azotobacter* + PSB + KMB (10 ml each kg^{-1} seed)	40.81	78.03	118.84	9.31	30.51	39.82	32.91	100.3	133.20
S.Em.±	0.97	4.27	4.19	0.25	1.57	1.56	0.86	5.02	4.99
C.D. at 5%	2.84	12.28	12.04	0.71	4.50	4.48	2.48	14.44	14.36

Conclusion

From the present findings, it could be suggested that rabi sweet corn (var. Sugar-75) crop sown at 60 cm x 20 cm 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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