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Response of *rabi* sweet corn to plant geometry and fertilizer

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Specialty corns (*viz*., sweet corn, pop corn, baby corn, high-oil corn *etc*.) assume tremendous market potential not only in India but also in the international market. These specialty corns with their high market value are perfectly suitable to *peri*-urban agriculture. Thus they promise higher income to maize growers. Out of the various specialty corns, sweet corn (*Zea mays* L. var. *saccharata* Sturt*)* has a big market potential. It is a hybridized variety of maize specifically bred to increase the sugar content(Anand *et al*., 2013).

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 as well as proliferation and 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.

Judicious use of fertilizer is a key to bumper maize crop production as they alone contribute 40-60 per cent of the crop yield (Dayanand, 1998). Maize is an exhaustive crop and requires high quantities of nitrogen and phosphorus. The agronomic requirement like optimum plant geometry and nitrogen and phosphorous requirement for maize crops has been worked out, but the recommended plant spacing and fertilizer dose for normal maize may not be applicable to sweet corn. In India much work has not been done so far for the sweet corn (Kumar, 2009). Therefore, the present experiment is conducted to work out the plant geometry and nitrogen and phosphorus requirement of sweet corn.

A field experiment was conducted during *rabi* 2010 at Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh. The experimental soil was clayey in texture and slightly alkaline in reaction with pH 7.8 and EC 0.33 dS m^{-1}. It was low in available nitrogen (237 kg ha^{-1}), available phosphorus (32.5 kg ha^{-1}) and medium in available potash (269 kg ha^{-1}). The experiment comprised of twelve treatment combinations consisting three levels of plant geometry (60 × 15 cm, 45 × 20 cm and 30 × 30 cm) and four fertility levels (control, 90-45, 120-60 and 150-75 kg N-P_2O_5 ha^{-1}). These treatments were replicated four times in a split plot design. The sweet corn hybrid ‘Sugar-75’ was used for this study. The gross plot size was 5.0 × 3.6 m and net plot sizes were 4.0 × 2.7 m for 30 × 30 cm and 45 × 20 cm spacing, and 4.0 × 2.4 m for 60 × 15 cm spacing. The entire dose of phosphorus and half dose of nitrogen were applied as basal application in form of urea and DAP at just before sowing in the furrows. Remaining half dose of nitrogen was top dressed as urea at 30 DAS.

Growth attributes

The data presented in Table-1, indicated that plant geometry did exert significant influence on growth attributes of sweet corn *viz*., plant height, leaf area index (LAI) and dry matter per plant. However, number of leaves per plant and stem diameter remained unaffected under various spacings. Sowing of the crop at 30 × 30 cm spacing enhanced plant height (173 cm) and LAI (3.65), however, it remained at par with 45 × 20 cm spacing. Whereas, significantly highest dry matter per plant (141 g) was observed in 45 × 20 cm spacing, which was statistically at par with 30 × 30 cm spacing. The significant reduction in plant growth with inter row spacing and decreased intra row spacing seems to be the resultant of mutual shading due to overcrowding of plants, which might have reduced the availability of light within the crop canopy and inhibited elongation of lower internodes. The results are in close accordance with finding of Sahoo and Mahapatra (2007) and Kumar (2009).

The data furnished in Table-1, revealed significantly highest plant height (178 cm), number of leaves per plant (14.7), stem diameter (2.15 cm), LAI (3.64) and dry matter per plant (144 g) with application of 150-75 kg N-P_2O_5 ha^{-1}, which remained

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at par with that of 120-60 kg N-P_2O_5 ha^{-1}. Profound influence of N and P, a component of fertility management, on crop growth seem to be due to maintaining congenial nutritional environment of plant system on account of their greater availability from soil media that might have resulted in greater synthesis of amino acids, proteins and growth promoting substances, which seem to have enhanced the meristematic activity and increased cell division and their elongation. Further application of 150-75 or 120-60 kg N-P_2O_5 ha^{-1} might have increased interception, absorption and utilization of radiant energy which in turn increased photosynthesis and thereby plant height, stem diameter and finally accumulation of dry matter. The enhanced growth with nitrogen was reported by Massey and Gaur (2006) and Khazaei *et al.* (2010).

Yield attributes

The data presented in Table-2, showed that

Table 1: Effect of plant geometry and fertilizer on growth attributes of sweet corn

Treatments	Plant height (cm)	No. of leaves $plant^{-1}$	Stem diameter (cm)	Leaf area index	Dry matter $plant^{-1}$ (g)
Plant geometry (cm)					
G_1 - 60 x 15	162	12.8	2.01	3.41	129
G_2 - 45 x 20	167	12.9	2.05	3.60	141
G_3 - 30 x 30	173	13.0	2.10	3.65	140
LSD(0.05)	**8**	**NS**	**NS**	**0.18**	**9**
Fertilizer (kg N-P_2O_5 ha^{-1})					
F_0 - Control	154	10.7	1.91	3.41	129
F_1 - 90-45	164	11.7	2.02	3.55	132
F_2 - 120-60	175	14.5	2.12	3.60	141
F_3 - 150-75	178	14.7	2.15	3.64	144
LSD(0.05)	**6**	**0.2**	**0.09**	**0.11**	**7**
G x F					
LSD(0.05)	**NS**	**NS**	**NS**	**NS**	**NS**

Table 2: Effect of plant geometry and fertilizer on yield attributes of sweet corn

Treatments	No. of cobs $plant^{-1}$	Cob length (cm)	Cob girth (cm)	Fresh weight of cob (g)	No. of kernels cob^{-1}	Fresh weight of 100-kernels (g)
Plant geometry (cm)						
G_1 - 60 x 15	1.16	15.5	14.0	116	247	21.7
G_2 - 45 x 20	1.43	16.9	15.5	129	279	24.3
G_3 - 30 x 30	1.31	16.7	14.9	123	262	23.2
LSD(0.05)	**0.13**	**1.1**	**1.1**	**9**	**19**	**2.0**
Fertilizer (kg N-P_2O_5 ha^{-1})						
F_0 - Control	1.10	15.3	14.0	116	242	21.4
F_1 - 90-45	1.22	16.1	14.5	120	258	22.5
F_2 - 120-60	1.40	16.8	15.2	127	273	24.1
F_3 - 150-75	1.47	17.2	15.3	128	278	24.2
LSD(0.05)	**0.11**	**0.8**	**0.8**	**7**	**12**	**1.4**
G x F						
LSD(0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 3: Effect of plant geometry and fertilizer on yield and economics of sweet corn

Treatments	Green cob yield ($q\ ha^{-1}$)	Green fodder yield ($q\ ha^{-1}$)	Gross return ($Rs\ ha^{-1}$)	Cost of cultivation ($Rs\ ha^{-1}$)	Net return ($Rs\ ha^{-1}$)	B:C ratio
Plant geometry (cm)						
G_1 - 60 x 15	71.3	340.0	105061	36840	68221	2.85
G_2 - 45 x 20	79.8	351.1	114678	36840	77838	3.11
G_3 - 30 x 30	77.1	349.3	111764	36840	74924	3.03
LSD(0.05)	**5.1**	**NS**	**-**	**-**	**-**	**-**
Fertilizer (kg N-P_2O_5 ha^{-1})						
F_0 - Control	67.9	314.8	99366	36840	62526	2.70
F_1 - 90-45	75.2	334.3	108595	39618	68977	2.74
F_2 - 120-60	80.2	366.6	116836	40477	76359	2.89
F_3 - 150-75	81.1	371.7	118206	41337	76869	2.86
LSD(0.05)	**4.0**	**31.4**	**-**	**-**	**-**	**-**
G x F						
LSD(0.05)	**NS**	**NS**	**-**	**-**	**-**	**-**

Market price: Green cob: Rs. 10.00 kg^{-1}, Green fodder: Rs. 1.00 kg^{-1}, Urea: Rs. 5.87 kg^{-1}, DAP: Rs. 19.50 kg^{-1}

different spacings did cause significant influence on yield attributes of sweet corn *viz*., number of cobs $plant^{-1}$, cob length, cob girth, fresh weight of cob, number of kernels cob^{-1} and fresh weight of 100-kernels. The plant geometry of 45 × 20 cm, being at par with 30 × 30 cm, recorded significantly the highest number of cobs $plant^{-1}$ (1.43), cob length (16.9 cm), cob girth (15.5 cm), fresh weight of cob (129 g), number of kernels cob^{-1} (279) and fresh weight of 100-kernels (24.3). The enhanced yield components under 45 × 20 cm might be due to significant improvement in overall growth of the crop expressed in terms of plant height, leaf area index and dry matter accumulation by virtue of increased photosynthetic efficiency. The present findings are in close agreement with the results obtained by Kar *et al.* (2006) and Kumar (2009).

A perusal of data furnished in Table-1, revealed that application of 150-75 kg N-P_2O_5 ha^{-1}, being *at par* with that of 120-60 kg N-P_2O_5 ha^{-1}, significantly enhanced yield attributes *viz*., number of cobs $plant^{-1}$ (1.47), cob length (17.2 cm), cob girth (15.3 cm), fresh weight of cob (128 g), number of kernels cob^{-1} (278) and fresh weight of 100-kernels (24.2) over application of 90-30 kg N-P_2O_5 ha^{-1} and control. Fertility levels of 150-75 and 120-60 kg N-P_2O_5 ha^{-1} did cause about significant improvement in overall growth of the crop by virtue of increased photosynthetic efficiency. Thus greater availability of photosynthates, metabolites and nutrients to develop reproductive structures seems to have resulted in increased productive plants, cob girth, cob length and cob weight with these fertility levels. The present findings are within the close vicinity of those reported by Massey and Guar (2006) and Khazaei *et al.* (2010), and Behere *et al*., 2013.

Cob and fodder yield

An appraisal of data (Table-3) showed that different spacings imparted their significant influence on green cob yield. Significantly the highest green cob yield (79.8 q ha^{-1}) was recorded under spacing of 45 × 20 cm and it was found at par with spacing of 30 × 30 cm. The plant geometry of 45 × 20 cm and 30 × 30 cm increased green cob yield by 12.0 and 8.1% over 60 × 15 cm spacing, respectively. While, different spacings did not exert significant influence on green fodder yield. Since plant density per unit area was same under different spacings, improved individual plant performance under 45 × 20 cm and 30 × 30 cm ultimately reflected in higher cob yield over 60 × 15 cm. The present findings are in close agreement with the results obtained by Khan *et al.* (2002) and Kar *et al.* (2006).

Table-3 indicated that significantly the highest green cob yield (81.1 q ha^{-1}) and green fodder yield (371.7 q ha^{-1}) was recorded with application of 150-75 kg N-P_2O_5 ha^{-1}, which remained *at par* with that of 120-

60 kg N-P_2O_5 ha^{-1}. Application of 150-75 and 120-60 kg N-P_2O_5 ha^{-1} increased green cob yield by 19.4 and 18.1% and green fodder yield by 18.0 and 16.5% over control. Significant increase in green fodder yield under these fertility levels appears to be on account of their influence on dry matter production and indirectly via increase in plant height, functional leaves, leaf area, stem diameter and possibly a result of higher uptake of nutrients. The present findings are in close agreement with the results obtained by Massey and Gaur (2006) and Sahoo and Mahapatra (2007).

Interaction between plant geometry and fertilizer levels was found to be non-significant in respect of growth, yield attributes and yield throughout the results.

Economics

Sowing of the crop at 45 × 20 c gave maximum net returns of Rs. 77838 ha^{-1} with B:C ratio of 3.11, followed by spacing of 30 × 30 cm, which recorded net returns of Rs. 74924 ha^{-1} and B:C ratio of 3.03.

Fertilizing the crop with 150-75 kg N-P_2O_5 ha^{-1} accrued maximum net returns of Rs. 76869 ha^{-1}, closely followed by fertilizer dose of 120-60 kg N-P_2O_5 ha^{-1} by recording net returns of Rs. 76359 ha^{-1}. Application of 120-60 kg N-P_2O_5 ha^{-1} recorded highest B:C ratio of 2.89, followed by that of 150-75 kg N-P_2O_5 ha^{-1} with B:C ratio of 2.86. Sahoo and Mahapatra (2007) and Kumar (2009) also reported similar results.

It was concluded that higher yield and net returns from *rabi* sweet corn could be achieved by sowing the crop at 45 × 20 cm spacing and fertilizing with 120-60 kg N-P_2O_5 ha^{-1} under south Saurashtra agro-climatic conditions of Gujarat.

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