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Influence of Nitrogen and Phosphorus Levels on Yield Potential and Economics of sweet corn (*Zea mays* L. *saccharata*) varieties

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Abstract
Sweet corn cultivation can contribute in diversifying cropping pattern. Performance of sweet corn varieties was evaluated under different fertility levels. Treatment consisted four sweet corn varieties *viz.*, Bajaura sweet corn, Sugar 75, Win Orange and Priya and three levels of fertilizers (90-40, 120-50 and 130-60 kg N-P_2O_5 ha^{-1}). Highest values of yield attributing parameters, green cob (9.00 t ha^{-1}), green fodder yield (20.96 t ha^{-1}), net return (68189 ` ha^{-1} and B C ratio (2.19) were obtained with Sugar 75. For sweet corn, application of 120 kg N + 50 kg P ha^{-1} significantly improved yield attributing parameters, green cob (4.17 t ha^{-1}) and green fodder (6.25 t ha^{-1}) yield and proved economically profitable dose with highest net returns (54212 ` ha^{-1}) and BC ratio (2.05).

Keywords: Yield Potential, sweet corn, economically profitable

1. Introduction
Corn (*Zea mays* L.) is a versatile crop, which finds a place in the human food, animal feed, fodder and industrial raw material. Recently speciality corns such as baby corn and sweet corn have emerged as alternative food sources, especially for the affluent society. Sweet corn is used as a human food in the soft dough stage with succulent grain. The higher content of a water-soluble polysaccharide in the kernel adds texture and quality in addition to sweetness Sweet corn is gaining popularity both in rural and urban areas because of its high sugar and low starch content. It has a great market potential and high market value in India [1]. Generally, maize farmers strive by improving yields and cutting costs of production, for instance, through shortening cultural risks by harvesting for either green corn or baby corn. Young cob corn has a short growth thus a farmer can grow four or more crop cycles per year. It has a wide range of adaptation and does not need intensive cultivation. Considering these factors, young cob corn has good potentials [2]. Sweet corn production, being a recent development has proved an enormously successful venture in India. Attention is now being paid to explore its potential in India, for earning foreign exchange besides higher economic returns to the farmers. The agronomic requirement of sweet corn is similar to grain maize except for a suitable variety, plant population density, higher doses of nitrogen and most importantly early harvesting. Yield and quality of sweet corn are affected by cultural management applied to the maize plants especially fertilizer application. The different levels of nutrition of maize plants greatly affected the yield and quality. Farmers are growing these varieties with existing fertilizer recommendations made for composite and hybrids maize. The needs of a sweet corn crop for supplemental nutrients can vary greatly among fields, seasons and crop growing conditions. Hence, there is need to evaluate sweet corn varieties under optimum combination of nitrogen and phosphorus fertilization under prevailing agroclimatic conditions [3].

2. Materials and methods
The present study was conducted throughout summer season of 2015 at the College Farm, College of Agriculture, Junagadh Agricultural University, Junagadh to study the Response of sweet corn (*Zea mays* L. *saccharata*) varieties to fertility levels under South Saurashtra region of Gujarat. The soil of the experimental plot was clayey in texture and slightly alkaline in reaction with pH 7.9 and EC 0.38 dS m^{-1} and organic carbon 0.62%. The soil was low in available nitrogen (241.00 kg ha^{-1}) and available phosphorus (31.60 kg ha^{-1}) while medium in

available potash (245.36 kg ha^{-1}). The experiment was conducted in factorial randomized block design with total 12 treatment combination consisting of 4 varieties *viz*., Bajaura sweet corn (V_1), Sugar 75 (V_2), Win Orange (V_3) and Priya (V_4) and 3 levels of fertilizers (90-40, 120-50 and 130-60 kg N-P_2O_5 ha^{-1} as F_1, F_2 and F_3, respectively). These treatments were replicated four times in a Randomized Block Design with factorial concept.

The gross plot size was 5.0 m x 3.0 m and net plot sizes were 4.0 m x 1.8 m and 60 cm x 25 cm spacing was employed. 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 knee height stage of the crop. The statistical analysis of grain and stover yield was carried out through the procedure appropriate to the Factorial Randomized Block Design of the experiment as described by Panse and Sukhatme, 1967 [4]. The significance of difference was tested by 'F' test. Five per cent level of significance was used to test the significance of results. The critical differences were calculated when the differences among treatments were found significant in F' test. The gross realization in term of rupees per hectare was calculated on the basis of the yield of chickpea for each treatment using the prevailing market prices of produce. The cost of cultivation of the crop for each treatment was worked out by taking into consideration the cost of all the inputs used and operations followed starting from the preparatory tillage to harvesting. The net realization was worked out by deducting the total cost of cultivation from gross realization per hectare for each treatment and recorded accordingly. The benefit cost ratio (BCR) was calculated as follows

$$\mathrm{BCR} = \frac{\text{Gross realization}}{\text{Total cost of cultivation}}$$

3. Result and discussion

Green cob yield, green fodder yield and economics

Effect of varieties

Data presented in Table 1 reveal that sweet corn variety 'Sugar 75' exhibited significant superiority in yield potential (10.25 t ha^{-1}) over 'Win Orange' (8.21 t ha^{-1}), 'Bajaura sweet corn' (8.02 t ha^{-1}) and 'Priya' (7.43 t ha^{-1}). The comparison of later varieties indicated that 'Win Orange' was higher yielder as it recorded higher green cob yield over 'Bajaura sweet corn' and 'Priya', respectively. Further, 'Bajaura sweet corn' was also significantly higher over 'Priya'.

Data on green fodder yield of different varieties presented in Table 4.13 explicit almost similar trend as observed in green cob yield. Amongst varieties, 'Sugar75' (25.55 t ha^{-1}) was significantly higher over 'Win Orange' (22.91 t ha^{-1}), 'Bajaura sweet corn' (16.96 t ha^{-1}) and 'Priya' (16.12 t ha^{-1}) in producing green fodder yield. Further, 'Win Orange' produced significantly higher green fodder yield over 'Bajaura sweet corn' and 'Priya', respectively. At the same time 'Bajaura sweet corn' recorded significantly higher green fodder yield over 'Priya'.

The data revealed that maximum gross realization of ` 123419 ha-1 was realized with sweet corn variety 'Sugar-75' followed by 'Win orange' ` 102032 ha-1 and the lowest gross return was obtained from 'Priya' with ` 86347 ha-1. It is evident from the data that amongst varieties 'Sugar-75' was found efficient in realizing highest net returns (`67189 ha^{-1}) and B C ratio (2.19) which was higher over rest of the varieties. Further amongst rest of varieties 'Win orange' registered second highest net returns of ` 51469 with B C ratio of 2.03. 'Bajaura sweet corn' achieved lowest net returns (`42068 ha^{-1}) and B C ratio (1.90).

The significant increase in yield attributes in variety 'Sugar 75' over other varieties seems to be on account of overall improvement in growth as evinced from higher production of dry matter and greater availability of photosynthates as evinced from higher biomass accumulation along with availability of nutrient particularly N and P in variety 'Sugar 75' might have resulted in enhancing cob and fodder yield. Similar results were also reported by Suthar *et al.* [3] and Kumawat *et al.* [5].

Fertility levels

The data from Table 1 reveal that application of nitrogen and phosphorus in different proportions resulted in significant variation in the green cob yield of the sweet corn varieties. An application of 120 kg N + 50 kg P_2O_5 ha^{-1} significantly increased green cob yield over 90 kg N + 40 kg P_2O_5 ha^{-1}. Further increase in fertility levels could not produce significant increase in green cob yield of the test crop. The highest green cob yield (9.02 t ha^{-1}) was obtained under 130 kg N + 60 kg P_2O_5 ha^{-1}. From Table 1 it can be seen that an application of 120 kg N + 50 kg P_2O_5 ha^{-1} accounted for significant increase in green fodder yield (20.96 t ha^{-1}) over 90 kg N + 40 kg P_2O_5 ha^{-1} (19.99 t ha^{-1}). No significant increase in green fodder yield was observed with further enhancement of fertility level up to 130 kg N + 60 kg P^2O^5 ha^{-1} (20.96 t ha^{-1}).

It is evident from data (Table 1) that the application of 130 kg N + 60 kg P_2O_5 ha_{-1} recorded highest gross returns of ` 106626 $ha^{-1}$. The lowest gross returns of ` 96389 ha^{-1} was obtained with 90 kg N + 40 kg P_2O_5 ha^{-1}. The crop fertilized with fertility level 120 kg N + 50 kg P_2O_5 ha^{-1} recorded highest net returns (` 54212 $ha^{-1}$) and B C ratio (2.05) over its preceding level 90 kg N + 40 kg $P_2O_5$ $ha^{-1}$ with 45518 ` ha^{-1} net returns and 1.91 B C ratio and succeeding level 130 kg N + 60 kg P_2O_5 ha^{-1} with 53791 ` ha-1 net returns and 2.00 B C ratio, respectively (Table 1).

Significant increase in green cob yield due to application 120 kg N + 50 kg P_2O_5 ha^{-1} could be ascribed to the fact that green cob yield of crop is function of several yield components further affirms the role of yield attributing and growth parameters in improving green cob yield. This might also be attributed to better availability of nutrients in the soil under these treatments.The observed relationship corroborates with findings of Nath *et al.* [6], Choudhary *et al.* [7], Dhaka *et al.* [8] and Snehlta *et al.*, [9].

Interaction effects

A perusal of data (Table 2) indicated that highest BCR of ` 2.33 was obtained with treatment combination of V_2F_2 (Sugar coupled with 120 kg N + 50 kg P_2O_5 kg N:P:K ha^{-1}). The enhanced photosynthesis due to more N application might have resulted in higher yields of sweet corn. Present study clearly demonstrated that application of 120 kg N + 50 kg P_2O_5 ha^{-1} with variety 'Sugar 75' positively increased green cob yield, green fodder yield, and economics of sweet corn.

Table 1: Effect of fertilizer levels on yield and economics of sweet corn varieties

Treatments	Green cob yield (t ha^{-1})	Green fodder yield (t ha^{-1})	Gross realization (` ha^{-1})	Cost of production (` ha^{-1})	Net profit (` ha^{-1})	BCR
Varieties (V)						
Bajaura sweet corn	8.02	16.96	92625	50559	42068	1.90
Sugar 75	10.25	25.55	123419	56243	67189	2.19
Win Orange	8.21	22.91	102032	50559	51469	2.03
Priya	7.43	16.12	86347	50559	35785	1.76
S. Em. ±	0.14	0.19	-	-	-	-
C. D. (P = 0.05)	0.51	0.69	-	-	-	-
Fertility levels (F) ha^{-1}						
90 kg N + 40 kg P_2O_5	8.00	19.99	96389	50870	45518	1.91
120 kg N + 50 kg P_2O_5	9.00	20.96	106449	52238	54212	2.05
130 kg N + 60 kg P_2O_5	9.02	20.97	106626	52831	53791	2.00
S. Em. ±	0.12	0.17	-	-	-	-
C. D. (P = 0.05)	0.36	0.49	-	-	-	-

Table 2: Economics of sweet corn varieties under various treatment combinations of levels of fertilizers

Treatment combination	Yields (t ha^{-1})		Gross realization (` ha^{-1})		Cost of production (` ha^{-1})			Net realization (` ha^{-1})	BCR
	Green cob	Green fodder	Green cob	Green fodder	Fixed cost	Variable cost	Total		
V_1F_1	7.75	16.10	68229	20926	16755	33028	49783	39372	1.79
V_1F_2	8.59	17.62	75563	22902	16755	33896	50651	47813	1.94
V_1F_3	8.67	17.17	76296	22317	16755	34489	51244	47369	1.92
V_2F_1	8.61	24.74	75797	32158	16755	39378	54133	53822	1.99
V_2F_2	11.27	25.90	99176	33674	16755	40246	57001	75849	2.33
V_2F_3	10.89	26.02	95861	33822	16755	40839	57594	72089	2.25
V_3F_1	8.36	22.61	73568	29389	16755	33028	49783	53174	2.07
V_3F_2	8.68	23.03	76355	29935	16755	33896	50651	55638	2.10
V_3F_3	8.77	23.10	77205	30030	16755	34489	51244	55991	2.09
V_4F_1	7.27	15.52	64005	20172	16755	33028	49783	34394	1.69
V_4F_2	7.48	16.28	65824	21160	16755	33896	50651	36333	1.72
V_4F_3	7.76	16.58	68259	21554	16755	34489	51244	38569	1.75

Selling rate of produce (` $t^{-1}$) Green cobs : 8800 Green fodder : 1300 (A) Fixed cost (` ha^{-1}): 16755	(B) Variable costs			
	V_1	30000	F_1	3028.76
	V_2	36350	F_2	3896.95
	V_3	30000	F_3	4489.44
	V_4	30000		

V_1**:** Bajaura sweet corn, V_2**:** Sugar75, V_3**:** Win Orange and V_4**:** Priya and (90-40, 120-50 and 130-60 kg N-P_2O_5 ha^{-1} as F_1, F_2 and F_3, respectively).

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