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Effect of Plant Density and Nitrogen Management on Uptake of Major Nutrients in Sweet Corn (*Zea mays* var *saccharata*)

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A B S T R A C T

A field experiment was conducted during *kharif*, 2018 at Agricultural College Farm, Mahanandi to assess "Effect of plant density and nitrogen management on yield and quality of sweet corn (*Zea mays* var *Saccharata*)". Among the plant densities tried, plant density at (D_1) 60 cm X 15 cm recorded that highest uptake of N, P_2O_5 and K_2O by the crop at all the growth stages. Among the nitrogen levels tried, application of (T_5) 125 % RDN + FYM @ 10 t ha^{-1} at 25, 50 DAS and at harvest recorded the highest uptake of N, P_2O_5 and K_2O which was however, found parity with (T_4) 100% RDN + FYM @ 10 t ha^{-1}. Plant density and nitrogen management treatments exhibited their superiority at the highest levels of plant density and nitrogen management over the other levels under chemical sources in enhancing green cob yield. The lowest cob yield was associated with non-supply of fertilizers.

Introduction

Sweet corn (*Zea mays* var. *saccharata*) also known as sugar corn is a variety of maize with high sugar content. Maize is grown under diversified environment unmatched by any another crop as the expansion of maize to new areas and environment still continues. Maize is achieving popularity among the farmers in India due to its flexible characteristics of suitability and adaptability to various agro-climates. Maize is the most productive coarse cereal crop species in utilizing radiant energy and has the highest capacity to produce carbohydrates per day as compared to other cereals. The crop is less susceptible to environmental threats and cost of cultivation per kg of grain is less compared to other cereals, which lead to drawing the attention of the farmers of Andhra Pradesh and India. Majority of the maize cultivated in the country is flint corn. However in recent years sweet corn is also gaining importance due to consumer preference in table purpose

maize. Maintenance of plant density is the most important factor to get higher cob yields. Plant density is one of the very important cultural practices which decide grain yield as well as other agronomic attributes of this crop (Songoai, 2001).In addition to optimum plant population, Nitrogen management also play crucial role in enhancement of crop productivity. Nitrogen plays major role in various physiological activities of maize. It extends the leaf area effectively, delaying senescence and essential for initiation of ear and kernel.

Since *kharif* sweet corn is achieving importance due to its productivity and stable market price, there is need to establish a relationship between nitrogen levels and plant density. The knowledge on response of highly productive sweet corn hybrids to other levels of nitrogen than the present level of recommendations is meager. By considering these points an experiment was proposed to research on "Effect of Plant density and Nitrogen management on uptake of major nutrients in Sweet corn (*Zea mays* var. *saccharata*)".

Materials and Methods

A field experiment entitled "Effect of plant density and nitrogen management on yield and quality of sweet corn (*Zea mays* var *Saccharata*)" was conducted at Agricultural College Farm, Mahanandi during *kharif*, 2018. The experiment was carried out in randomized block design with factorial concept and the each treatment was replicated thrice. The treatments consisted of combination of three plant densities (D_1 : 60 cm X 15 cm, D_2 : 60 cm X 20 cm, and D_3 : 60 cm X 25 cm) and five nitrogen management levels (T_1: control, T_2: 100% RDN, T_3: 75 % RDN + FYM @ 10 t ha^{-1} , T_4: 100% RDN + FYM @ 10 t ha^{-1} and T_5 : 125% RDN + FYM @ 10 t ha^{-1}) in Factor – I and Factor – II respectively. The soil was sandy loam and it was slightly alkaline in reaction with a pH of 8.08; EC of 0.25 dSm^{-1}, low in organic carbon (0.49%) and available nitrogen (166 kg ha^{-1}), medium in available phosphorus (46.6 kg ha^{-1}) and high in potassium (675.3 kg ha^{-1}). A popular sweet corn hybrid in this region, sugar-75, released by a private company M/s Syngenta India Limited, Baner, Pune, Maharashtra, was used for the study. The fertilizers such as urea, single super phosphate and muriate of potash were supply of NPK and the entire quantity of phosphorous as basal and potassium and nitrogen were applied in three equal splits at 10, 30 and 50 DAS and other agronomical operations were carried out as per recommendation.

At each stage five plants from the border rows were picked and kept separately for recording plot wise yields and expressed in kg ha^{-1}. At harvest, the stover form net plot was thoroughly sun dried and drymatter yield was expressed as kg ha^{-1}. After recording the yields from the net plots, the cobs were collected from five tagged plants. These cobs are made into small pieces, dried under shade for five days and then were oven dried at 60^0c to a constant weight. After recording their weights, the stover and cob samples were ground in Willley mill and were analyzed for the concentration of major nutrients as per the procedures outlined by Tandon (1993). The uptakes of major nutrients were estimated by using the formula:

Uptake of N, P and K (kg ha^{-1}) =

$$\frac{\text{Nutrient concentration (\%)} \times \text{Drymatter yield (kg ha}^{-1}\text{)}}{100}$$

The data obtained from experiment were subjected to statistical analysis as per the procedures outlined by Panse and Sukhtame (1967).

Results and Discussion

Nitrogen uptake (kg ha^{-1}) was significantly superior at higher planting density 60 cm X 15 cm (13.03, 139.71 and 237.37 N kg ha^{-1} at 25, 50 DAS and harvest, respectively) compared to that of lower plant densities at all the stages of crop growth, which might be due to production of significantly the maximum stover yield at higher planting density of 60 cm X 15 cm. Nitrogen uptake (kg ha^{-1}) of sweet corn increased significantly with each increase in the level of nitrogen up to with 125% RDN + FYM @ 10 t ha^{-1} at all the stages of crop growth. The highest nitrogen uptake (kg ha^{-1}) was recorded with the application of 125% RDN + FYM @ 10 t ha^{-1} (11.05, 143.092 and 271.05 N kg ha^{-1} at 25, 50 DAS and harvest, respectively). The increased uptake of nitrogen by the crop due to increasing rates of nitrogen might be due to increased green cob and stover yields. These results of increasing trend of uptake over the remaining levels with incremental addition of nitrogen were consistent with findings of Ummed Singh *et al.*, (2012).

Significantly the highest phosphorous content at 25, 50 DAS and at harvest (in stover and cob) was recorded with the planting density of 60 cm X 15 cm which was superior over 60 cm X 20 cm and 60 cm X 25 cm. Significantly, the highest phosphorus uptake kg ha^{-1} of sweet corn was recorded at 125% RDN + FYM @ 10 t ha^{-1} and the lowest phosphorus uptake was registered in control. This higher uptake of P might be due to synergistic effect of N and P leading to higher yield and uptake of phosphorus. These results are in line with the findings of Sahoo and Mahapatra (2007), Ananthi *et al.*, (2010) (Table 1–3).

Table.1 Effect of plant density and nitrogen management on uptake of major nutrients (kg ha^{-1}) at 25 DAS in sweet corn (*Zea mays* var *saccharata*)

Treatments	Drymatter (kg ha^{-1}) At 25 DAS	Uptake (kg ha^{-1})		
		N	P	K
Plant density levels (D)				
D_1 : 60 cm X 15 cm	482.3	13.0	1.8	17.1
D_2: 60 cm X 20 cm	334.7	8.4	1.3	11.2
D_3 : 60 cm X 25 cm	296.5	7.9	1.2	10.4
SEm±	11.5	0.1	0.1	0.2
CD (p=0.05)	33.3	0.1	0.1	0.8
Nitrogen levels (T)				
T_1: control	280.8	8.5	0.9	10.3
T_2: 100% RDN	329.7	10.8	1.4	14.2
T_3: 75 % RDN + FYM @ 10 t ha^{-1}	351.1	9.1	1.5	12.4
T_4: 100% RDN + FYM @ 10 t ha^{-1}	416.7	9.3	1.5	13.0
T_5: 125% RDN + FYM @ 10 t ha^{-1}	477.5	11.0	1.8	14.6
SEm±	14.8	0.1	0.1	0.3
CD (p=0.05)	43.0	0.2	0.1	1.0
Interaction D X T				
SEm±	25.7	0.1	0.1	0.6
CD (p=0.05)	NS	0.4	0.3	1.8

Table.2 Effect of plant density and nitrogen management on uptake of major nutrients (kg ha^{-1}) at 50 DAS in sweet corn (*Zea mays* var *saccharata*)

Treatments	Drymatter (kg ha^{-1}) At 50 DAS	Uptake (kg ha^{-1})		
		N	P	K
Plant density levels (D)				
D_1 : 60 cm X 15 cm	6650.3	139.7	22.2	159.4
D_2: 60 cm X 20 cm	5016.5	106.9	13.6	117.7
D_3 : 60 cm X 25 cm	4358.7	99.0	8.8	104.9
SEm±	149.8	1.3	2.5	3.8
CD (p=0.05)	434.1	3.8	7.3	11.2
Nitrogen levels (T)				
T_1: control	4217.9	66.5	7.1	87.6
T_2: 100% RDN	5548.7	111.	10.7	134.1
T_3: 75 % RDN + FYM @ 10 t ha^{-1}	5339.6	129.4	13.6	126.5
T_4: 100% RDN + FYM @ 10 t ha^{-1}	5784.4	124.9	14.9	138.9
T_5: 125% RDN + FYM @ 10 t ha^{-1}	5826.7	143.9	28.1	149.7
SEm±	193.4	1.6	3.2	4.9
CD (p=0.05)	560.5	4.9	9.4	14.4
Interaction D X T				
SEm±	335.8	2.9	5.6	8.6
CD (p=0.05)	NS	8.0	NS	25.0

Table.3 Effect of plant density and nitrogen management on uptake of major nutrients (kg ha^{-1}) at harvest in sweet corn (*Zea mays* var *saccharata*)

Treatments	Yield (kg ha^{-1}) at harvest		Uptake (kg ha^{-1})					
			N		P		K	
	Stover	Cob	Stover	Cob	Stover	Cob	Stover	Cob
Plant density levels (D)								
D_1 : 60 cm X 15 cm	5207	11042	70.8	166.5	7.4	27.4	94.5	106.8
D_2: 60 cm X 20 cm	4255	9680	53.6	166.1	5.1	26.7	73.0	91.2
D_3 : 60 cm X 25 cm	3999	11286	46.8	158.4	4.5	25.3	61.4	102.5
SEm±	96.1	333.4	0.5	1.6	0.6	1.8	1.3	1.3
CD (p=0.05)	279.9	966.3	1.5	4.8	1.7	NS	3.8	3.8
Nitrogen levels (T)								
T_1: control	3455	7249	38.1	78.6	3.1	13.1	55.3	67.2
T_2: 100% RDN	4077	9908	57.5	164.2	4.1	25.9	81.6	107.6
T_3: 75 % RDN + FYM @ 10 t ha^{-1}	4475	10734	63.0	175.0	6.7	27.0	83.2	101.8
T_4: 100% RDN + FYM @ 10 t ha^{-1}	4929	12083	60.8	195.6	6.4	30.3	76.9	109.8
T_5: 125% RDN + FYM @ 10 t ha^{-1}	5499	13372	66.1	204.9	7.4	36.0	84.7	114.5
SEm±	124.7	430.5	0.6	2.1	0.8	1.3	1.7	1.7
CD (p=0.05)	361.4	1247.5	1.9	6.2	2.3	4.0	4.9	5.0
Interaction (D X T)								
SEm±	216.04	7455.6	1.1	3.7	1.3	2.3	2.9	3.0
CD (p=0.05)	NS	NS	3.3	10.8	NS	6.9	8.6	8.7

Significantly the highest potassium uptake in sweet corn was recorded with the plant density of 60 cm X 15 cm at all the growth stages The increased potassium uptake at higher densities might be due to more number of plants exploiting the nutrients from larger volume of the rhizosphere. With the each increment of nitrogen level the potassium uptake also increases in sweet corn at all the growth stages upto 125% RDN + FYM @ 10 t ha^{-1} This might be due to favorable effect of nitrogen on the uptake of potassium as well as increased green cob and stover yield. Significantly the highest potassium uptake was at a planting density of 60 cm X 15 cm and with the application of 125% RDN + FYM @ 10 t ha^{-1} at all the growth stages. Similar findings were reported by Ananthi *et al.,* (2010) and Ummed Singh *et al.,* (2012).

It is concluded, among all the combinations, significantly highest yield parameters amd major nutrient uptake sweet corn were obtained with application of 125% RDN + FYM @ 10 t ha^{-1} at a planting density of 60 cm X 15 cm (1,11,111 plants ha^{-1}) but it was on par with 100% RDN + FYM @ 10 t ha^{-1} at a planting density of 60 cm X 15 cm (1,11,111 plants ha^{-1}). Hence the application of 100% RDN + FYM @ 10 t ha^{-1} at a planting density of 60 cm X 15 cm (1,11,111 plants ha^{-1}) for sweet corn may be recommended. However the results will have to be confirmed by conducting extensive field trails in farmer's fields on long term basis.

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