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RESEARCH ARTICLE :

Studies on growth parameters and nutrient uptake of sweet corn in relation to different crop geomtery and nutrient management under Chhattisgarh plain ecosystem

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SUMMARY : The results revealed that all the growth parameters and yield attributes *viz.*, higher plant height (119.12 cm), dry matter accumulation (58.25 g plant^{-1}), SPAD value (43.67), cob length (17.26 cm), cob girth (16.76 cm), green cob weight (255.46 g cob^{-1}) and number of grains cob^{-1} (397.72 cob^{-1}) were improved in wider crop geometry of 60 cm x 30 cm (G_3). However, narrow plant spacing (45 cm x 20 cm) proved superior in terms of number of cobs ha^{-1} (62016 cobs ha^{-1}), green stover (186.37q ha^{-1}), green cob yield (98.03 q ha^{-1}) and harvest index (33.68 %).

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KEY WORDS :
Growth parameters, Nutrient uptake, Sweet corn, Relation Different crop geomtery

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BACKGROUND AND OBJECTIVES

Green cobs of maize (*Zea mays*), baked in fire or steam boiled, form a favourite dish of the urbanites. But the hybrids and composite varieties presently available in the market are neither sweet nor have succulency. Sweet corn (*Zea mays* L.) however, having higher sugar content in green cobs (14-20%), is more delicious. Since there is limited scope to increase the area under sweet corn cultivation because of competition from other cereals and cash crops, the only alternative is through enhancement of productivity by various management factors. Presently greater emphasis is being given on cultivation of sweet corn to augment the income of farming community dwelling in the outskirts of big cities and metropolis.The lack of knowledge about the use and economic importance of sweet corn and non-availability of appropriate production technology are the major constraints for its popularization among Indian sweet corn growers. The net income from sweet corn is quite higher as compared to grain maize. Keeping in view the production potential of maize in the state and high economic returns from sweet corn, there is immense scope of growing maize as sweet corn to improve economic status of poor maize growers. In addition, it has potential to generate employment opportunities in the rural areas. There is need to crop geometry and nutrient management practices to be optimized to improve the production potential and income of sweet corn. As the information on planting geometry and optimum nutrient requirement for sweet corn is very meagre for Chhattisgarh conditions, the present experiment was initiated to fill this gap.

RESOURCES AND METHODS

Field experiment was conducted during *Rabi* season of 2013-14 at Research-cum- Instructional Farm of IGKV, Raipur (Chhattisgarh). The soil of experimental field was 'Vertisols' which was low in organic carbon (0.48%), available N (208.5 kg ha^{-1}) and available phosphorus (17.23 kg ha^{-1}) whereas, it was high in available potassium (348 kg ha^{-1}) with neutral soil reaction (pH 6.8). The experiment was laid out in split plot design with 3 replications. The treatments comprised of three planting geometry *viz.*, 45 cm x 20 cm, 45 cm x 30 cm and 60 cm x 30 cm and six levels of nutrient management practices; control (0:0:0 kg N:P:K ha^{-1}), 50 per cent RDF, 100 per cent RDF 100:60:40 kg N:P:K ha^{-1}, 50 per cent RDF + vermicompost @ 3 tonnes ha^{-1}, 100 per cent RDF+ vermicompost @3 tonnes ha^{-1} and 150 per cent RDF. Sweet corn variety Sugar-75 was taken as test variety. One-third quantity of urea and full doses of phosphorus (SSP), potassium (MoP) and vermicompost were applied as basal at the time of sowing and remaining nitrogen was top-dressed in two equal splits at 30 and 50 DAS.

In sweet corn, tasseling and silking stages are the critical for irrigation. Four irrigations were provided at different growth phases namelt; seedling stage (6-leaf stage), knee-high stage, tasseling, 50 per cent silking and dough stages. The experimental plots were kept free from weeds throughout the crop growth periods through weeding and intercultural operations. Earthing-up operation was done at 30 DAS to provide the support and anchorage to the growing plants.

OBSERVATIONS AND ANALYSIS

Plant height and all the growth parameters of sweet corn varied significantly due to different planting densities (Table 1). Taller plants of sweet corn were found with

Table 1: Growth parameters of sweet corn as influenced by crop geometry and nutrient management

Treatments	Plant population (m^{-2}) (20 DAS)	Plant height (cm)				SPAD value				Dry matter accumulation (g plant^{-1})			
		20 DAS	40 DAS	60 DAS	90 DAS	60 DAS	harvest	60 DAS	harvest	20 DAS	40 DAS	60 DAS	harvest
Main plot: Crop geometry													
G_1:45 cm x 20 cm	8.86	20.02	42.07	74.85	98.27	11.59	22.27	29.00	27.07	6.09	20.45	52.96	70.15
G_2:45 cm x 30 cm	6.16	22.17	44.61	81.40	110.01	11.73	24.17	31.36	28.93	6.44	23.98	56.43	82.33
G_3:60 cm x 30 cm	4.92	28.11	47.57	83.85	119.12	12.26	25.35	33.20	32.67	7.44	25.72	58.29	94.87
S.E.±	0.18	0.68	0.71	0.501	0.94	0.36	0.56	0.40	0.99	0.26	0.32	0.69	1.42
C.D. (P=0.05)	0.71	2.66	2.80	1.97	3.69	NS	2.20	1.57	3.88	1.04	1.26	2.69	5.57
Sub plot: Nutrient management													
N_1:Control	6.43	18.54	35.20	73.26	94.41	10.80	20.94	26.96	25.28	5.44	18.55	48.32	53.29
N_2:50% RDF	6.54	22.52	41.19	77.06	97.57	11.47	21.18	28.31	27.56	5.61	20.03	52.05	64.33
N_3:100% RDF(100:60:40 kg NPK ha^{-1})	6.94	23.51	43.42	77.80	103.29	11.67	23.03	30.47	28.16	6.03	22.37	55.30	67.61
N_4:50% RDF+ Vermicompost(@3 tonnes ha^{-1})	6.99	23.23	46.44	80.84	110.17	11.81	24.20	32.37	30.01	6.79	24.02	57.02	75.58
N_5:100% RDF+ Vermicompost (@3 tonnes ha^{-1})	6.32	25.95	49.15	82.48	122.08	12.23	25.59	34.01	32.09	7.03	26.24	60.53	114.01
N_6:150% RDF	6.66	26.87	53.09	88.74	127.30	13.19	28.63	35.00	34.27	9.05	29.08	62.14	119.92
S.E.±	0.33	1.27	0.95	1.39	1.19	0.475	0.478	0.55	1.50	0.27	0.54	0.57	1.79
C.D. (P=0.05)	NS	3.68	2.75	4.04	3.45	1.371	1.379	1.58	4.34	0.78	1.56	1.63	5.17

NS= Non-significant

successive increase in crop geometry from 45 cm x 20 cm, 45 cm x 30 cm to 60 cm x 30 cm, respectively. Each successive increase in nutrient level from control to 150% RDF gave taller plants of sweet corn with increasing values of other growth parameters of sweet corn, *viz.*, Plant population (m^{-2}), Plant height (cm), SPAD value and Dry matter accumulation(g $plant^{-1}$) (Table 1). Similar findings were noticed by Muniswamy *et al.* (2007) also reported that plant height, leaf area and stem girth of maize increased linearly with the increase in spacing from 60 cm x 10 cm to 60 cm x 20 cm. This clearly indicated that plants at lower density fully exploited the natural resources efficiently, besides responding to externally applied inputs and expressed the same liberally compared to plants at highest plant density where the competition was stiff (Bhatt, 2012).

The increased levels of nutrients might have resulted in easy and greater availability of nutrients to the crop plants, which consequently improved the plant height and other growth parameters of corn. These findings are in close conformity with those of Bindhani *et al.* (2007) and Sahoo and Mahapatra (2007). At narrow crop geomtery, greater competition for different resources reduced the values of different parameters, which consequently decreased the yield. The results are in close conformity with those of Sahoo and Mahapatra (2007). The different nutrient management practices influenced the SPAD value significantly throughout all the growth stages. Maximum SPAD value (45.27) was recorded in 150 per cent RDF while the least value (36.28) was noticed in (N_1) Control at all the stages of observations. (Pandey *et al*., 2000 and Rambo *et al*., 2010) also reported that increasing Nutrient application increased N content and chlorophyll content in corn. Hence, the value of relative chlorophyll content (SPAD) reûected N availability for corn.

Further, availabilityof sunshine and CO_2 under wider spacing of 60 cm x 30cm might have resulted in higher photosynthetic productivity than 45 cm x 20 cm and 45 cm x 30 cm spacings. Highest amount of dry matter was accumulated by the plants raised under wider row spacing of 60 cm x 30 cm at all the stages. The minimum amount of dry matter was recorded in the plants raised with narrow spacing *i.e.* 45 cm x 20 cm. This may be due to availability of sunshine and CO_2 under wider spacing than the narrow crop geometry resulted in higher photosynthetic production and higher dry matter production. Kunjir *et al.* (2009) also reported similar results. This was evident from significantly more dry matter accumulation under wider spacing of 60 cm x 20cm followed by 45 cm x 30 and 45 x 20cm spacing in the order of significance. Therefore, the higher availability of source under wider spacing recorded significantly higher values ofthe sink in terms of plant population

Table 2 : Nutrient uptake of sweet corn as influenced by crop geometry and nutrient management

Treatments	Nutrient uptake (kg ha^{-1})					
	N uptake		P uptake		K uptake	
	20 DAS	harvest	20 DAS	harvest	20 DAS	harvest
Main plot: Crop geometry						
G_1:45 cm x 20 cm	8.41	93.44	1.14	12.06	8.13	72.34
G_2:45 cm x 30 cm	6.10	72.02	0.79	9.29	6.10	55.76
G_3:60 cm x 30 cm	5.69	70.33	0.73	9.07	5.69	54.45
S.E.±	0.09	2.95	0.03	0.38	0.09	2.28
C.D. (P=0.05)	0.38	11.59	0.13	1.50	0.38	8.98
Sub plot: nutrient management						
N_1:Control	5.13	47.83	0.70	6.17	5.35	37.03
N_2:50% RDF	5.52	58.95	0.71	7.61	5.74	45.64
N_3:100%RDF(100:60:40 kg $NPKha^{-1}$)	6.28	64.02	0.81	8.26	6.28	49.56
N_4:50%RDF+Vermicompost (@ 3 $tonnesha^{-1}$)	6.77	69.85	1.01	9.01	6.77	54.08
N_5:100%RDF+Vermicompost (@ 3 tonnes ha^{-1})	6.51	113.19	0.88	14.61	6.84	87.63
N_6:150% RDF	9.20	117.75	1.20	15.19	8.65	91.16
S.E. ±	0.45	4.28	0.06	0.55	0.43	3.33
C.D. (P=0.05)	1.31	12.41	0.17	1.60	1.25	9.61

(m^{-2}), Plant height (cm), SPAD value and dry matter accumulation (g $plant^{-1}$) 60 x 20 and 45 x 20 cm spacings. Similar results were reported by Thakur *et al.* (2000) and Raja (2001).

The growth parameters *viz.*, plant height, SPAD values and dry matter accumulation perplant increased significantly with 150% RDF(Table 2).The crop geometry of 45 cm x 20 cm resulted into significantly highest nitrogen uptake over other plant geometry at both stages. There was significantly higher nitrogen uptake (8.41 and 93.44 kg ha^{-1}) with 45 cm x 20 cm, while the minimum nutrient uptake (5.69 and 70.33 kg ha^{-1}) was recorded in the wider crop geometry of 60 cm x 30 cm, respectively. Similar findings were obtained by Shivay *et al.* (1999). The beneficial effects of the higher levels of nutrients to sweet corn in terms of dry matter accumulation ultimately reflected in increasing the yield contributing characters and yield. Similar findings were obtained by Raja (2001). Better corn and grain development was due to increased availability of nutrient and greater production of photosynthates and their efficient translocation for development of reproductive parts. Similar results were reported by Sahoo and Mahapatra (2004); Kar *et al*. (2006); Bhatt (2012) and Singh *et al*. (2013).

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