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EFFECT OF CROP GEOMETRY AND NUTRIENT MANAGEMENT ON YIELD PERFORMANCE OF SWEET CORN (*ZEA MAYS* L. SACCHARATA) UNDER CHHATTISGARH PLAIN ECOSYSTEM

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ABSTRACT

A detailed study was undertaken during *rabi* season of 2013-14 at Raipur to test the performance of sweet corn cultivar Sugar-75 under the influence of different planting geometry and nutrient levels. The values of growth and yield attributes were significantly higher under broader spacing of 60 cm x 30 cm with significantly higher plant height (119.12 cm), dry matter accumulation, 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}). However, closer plant spacing (45 cm x 20 cm) proved superior in terms of number of cobs ha^{-1} (62016), green stover (186.37q ha^{-1}), green cob yield (98.03 q ha^{-1}) and harvest index (33.68 %). The application of 150 per cent RDF (150:90:60 kg N:P: K ha^{-1}) recorded maximum green cob yield (98.03 q ha^{-1}). Hence, crop geometry of 45 cm x 20 cm with nutrient level of 150 per cent RDF should be adopted to obtain the maximum green cob yield of sweet corn under Chhattisgarh plain ecosystem.

INTRODUCTION

Chhattisgarh is regarded as the "rice bowl of India" due to its more acreage under rice besides the staple food of the majority of the people. The uncertainty of rice in upland, especially in low rainfall areas leads the farmers to go for other alternative crops which provide more remunerative returns. Under such circumstances, scope to grow sweet corn seems to be the better choice for upland farmers. In order to popularize its cultivation among the farming community, it is essential to standardize its agro-techniques for harvesting its potential yields. The green cobs are being consumed as roasted or boiled. Starch is the most predominant carbohydrates component of sweet corn. Sweet corn has the highest edible quality in milk stage. In sweet corn the best nutritional quality depends on moisture (72.7%) and total solids (22.3%) comprising of carbohydrate (81%), protein (13%) and lipids (3.5%). In India, maize is grown over an area of 7.27 million ha with an annual production of 15.86 million tonnes and with an average productivity of 2181 kg ha^{-1} (Anonymous, 2011). Due to its increasing demand, there is an increasing tendency for commercial production of sweet corn (Kumar *et al.*, 2007). In Chhattisgarh, maize is grown in an area of 102.70 thousand ha with an annual production of 185.80 thousand million tonnes and with an average productivity of 1809 kg ha^{-1} (Anonymous, 2010). The net income from sweet corn is quite higher as compared to grain maize. In view of the production potential of maize in the Chhattisgarh 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. It is an established fact that higher grain yield depends on optimum plant density and adequate nutrient management. The plant growth involves various environmental and agronomical factors, such as water, temperature, light, nutrients *etc.* (Liu *et al.*,2004, Yadav,2008 and Yuan *et al.*,2003). At higher plant populations, resource availability must be adequate to help the plants in maintaining uniform growth, development, and grain yield of adjacent plants in a maize canopy (Rao *et al.*, 2014). Sweet corn is an exhaustive crop and it is harvested at milky stage and requires fertile soils for optimum production. The productivity of maize largely depends on its nutrient requirement and management particularly that of nitrogen, phosphorus and potassium (Kumar *et al.*, 2007).The use of vermicompost helps in maintaining soil fertility since the mineral elements contained in it get changed to available forms that could be readily taken up by plants such as nitrates, exchangeable phosphorous, soluble potassium, calcium, manganese *etc.* Keeping these points in view, an investigation was carried out with an objective to know the combined effects of nutrient management practices and crop geometry on the growth and cob yield of sweet corn.

MATERIALS 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.

RESULTS AND DISCUSSION

YIELD ATTRIBUTES

Wider planting geometry of 60 cm x 30 cm did show significantly higher values of yield contributing parameters *viz*. weight of cobs (227.3 and 165.6 g, respectively with and without husk), cob length (17.2 cm), cob girth (15.7 cm) and number of grains per cob (444.5). These values showed decreasing trend with the closer crop geometries (table 1). It indicated that, wider crop geometry did help in producing heavier, longer and thicker cobs with significantly more number of grains per cob. Nutrient levels also showed significant differences in yield attributes of sweet corn. Results indicate that, with the increasing levels of nutrients, the yield attributes did also increase correspondingly. These results are in close conformity to that reported by Raja (2011). Application of 150% RDF did produce heavier (233.7 and 179.5 g, respectively with and without husk), longer (17.2 cm) and thicker (16.7 cm) cobs with more number of grains per cob (475.2). These values of yield attributes were followed by nutrient level of 100% RDF, however, control *i.e.* no NPK produced the cobs with the least values of yield attributes.

YIELD

Closer crop geometry of 45 cm x 20 cm produced significantly more number of cobs ha^{-1}(62016.4). It produced comparatively higher green cob (98 q), green stover (186.3) and biological yields (284.3 q) per ha as compared to other crop geometries of 45 cm x 30 cm and 60 cm x 30 cm. It indicates that, yield did decrease with the wider crop geometries, despite having superior yield attributes. At higher planting densities, there might have been greater competition for different resources which reduced the values of different yield attributes. The results are in close conformity with those of Sahoo and Mahapatra (2007). The increasing planting density contributed significantly towards the green stover yield of sweet corn. Linear increase in green fodder yield with increasing planting densities was also noticed by Widdicombe and Thelen (2002).

Better availability of sunshine and CO_2 under crop geometry of 60 cm x 30 cm might have resulted in higher photosynthetic productivity than 45 cm x 30 cm and 45 cm x 20 cm geometries. More availability of nutrients at higher levels might have resulted in better growth in terms of plant height and dry weight per plant, which consequently expressed in different yield attributes like green cob weight. Sahoo and Mahapatra (2007) also found the higher values of yield attributes with increased nutrient levels. Similar results were also reported by Thakur *et al*. (2000).

There was significant impact of nutrient levels on yields of sweet corn. Nutrient level of 150% RDF produced more number of cobs (58641.9 ha^{-1}), green cob yield (100.9 q ha^{-1}), green stover yield (196.9 q ha^{-1}), and biological yield (297.8 q ha^{-1}) over other nutrient levels. These yield were followed by 100% RDF + vermicompost @3 t ha^{-1}, however, the minimum yields were obtained with control. Increasing levels of nutrient management practices at the same or different crop geometry enhanced the yield of green cob significantly from control to 150 per cent RDF. These results are in accordance with Thakur *et al*.(2015) and Khidrapure *et al*. (2015).

Nutrient uptake

The significant variation in nutrient uptake by the sweet corn was observed due to nutrient management practices (table 2). Nutrient uptake by sweet corn was improved significantly with

Table 1: Effect of planting geometry and nutrient management on yield attributes and yield of sweet corn

Treatment	No. of cobs (ha^{-1})	Weight of cobs (g)		Cob length (cm)	Cob girth (cm)	No. of grains cob^{-1}	Green cob yield (q ha^{-1})	Green stover yield(q ha^{-1})	Biological yield (q ha^{-1})	Harvest index(%)
		With husk	Without husk							
Crop geometry										
45 cm x 20 cm	62016.4	169	116.9	16.1	12.6	397.7	98	186.3	284.3	33.6
45 cm x 30 cm	53395	187.2	131.5	16.4	14.2	410.9	84.9	181.8	266.8	31.7
60 cm x 30 cm	45061.7	227.3	165.6	17.2	15.7	444.5	67.8	158.4	226.3	29.7
SEm±	2802.1	4.4	1.9	0.2	0.3	4.3	3.2	2.7	4.2	0.9
CD (P=0.05)	11002.4	17.4	7.5	0.8	1.1	17.2	12.6	10.7	16.6	3.5
Nutrient management										
Control	46510.2	151.3	102.2	15.5	10.9	351.4	49.1	135.8	185	25.9
50% RDF	50617.2	185.4	124.2	16.7	12.8	384.8	80.5	170.2	250.8	32.1
100%RDF (100:60:40 kg NPK ha^{-1})	53086.4	185.4	134.5	16.1	13.9	402.2	85.7	181	266.7	32.1
50%RDF + Vermicompost (@3 tonnes ha^{-1})	55946.5	197.1	132.4	16.7	14.8	432.9	90.4	183.2	273.6	33
100%RDF + Vermicompost(@3 tonnes ha^{-1})	56255.1	215	155.1	17	15.9	459.6	94.9	186	281	33.7
150% RDF	58641.9	233.7	17.2	17.2	16.7	475.2	100.9	196.9	297.8	33.4
SEm±	1978.96	5.5	3.9 0.3		0.3	6.4	3.3	6.1	6.8	1.3
CD (P=0.05)	5715.66	16	11.3	1.06	1.01	18.7	9.6	17.6	19.7	3.8

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

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

higher levels of nutrient. Total uptake of nitrogen (9.20 and 117.75 kg ha^{-1}), phosphorus (1.20 and 15.19 kg ha^{-1}) and potassium (8.65 and 91.16 kg ha^{-1}) were higher under 150 per cent RDF both at initial (20 DAS) and harvesting stages. The minimum uptake of nitrogen (5.13 and 47.83 kg ha^{-1}), phosphorus (0.70 and 6.17kg ha^{-1}) and potassium (5.35 and 37.03 kg ha^{-1}) were noted with control treatment. The results are in close conformity with that reported by Bhatt (2012)

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