

ECONOMIC VIABILITY OF SWEET CORN (*ZEA MAYS L. SACCHARATA*) CULTIVATION AS INFLUENCED BY INTEGRATED NUTRIENT MANAGEMENT

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Abstract: A field experiment entitled “Economic viability of Sweet corn (*Zea mays L. saccharata*) cultivation as influenced by integrated nutrient management” was conducted during the *kharif* season of 2019-20 at Research farm of Ambikapur. The experiment constituted of nine treatment combinations consisting three levels of organic manures (0 t, 3 t vermicompost and 5 t FYM) and three levels of inorganic fertilizers (50%, 75% and 100% RDF, where RDF is 120:60:40 kg ha⁻¹ N, P₂O₅ and K₂O) and replicated thrice. Growth and yield attributes, husked, dehusked cob and fodder yield were influenced significantly due to organic and inorganic sources of nutrients. Maximum cob yield and fodder yield were recorded with 3 t ha⁻¹ vermicompost followed by 5 t ha⁻¹ FYM, both were proved significantly superior to control. However 100% RDF recorded higher value of such parameters, which was significantly fair over 75% RDF and 50% RDF. Application of 5 t FYM ha⁻¹ and 100% recommended dose of nutrients was economically viable as these produced significantly more net return.

Keywords: Sweet corn, Vermicompost, Integrated nutrient management

INTRODUCTION

Maize (*Zea mays L.*) is one of the important cereal crops occupying a prominent position in global agriculture and one of the most important staple food crops of the world and ranks next to wheat and rice. Maize has been an important cereal because of its great production potential and adaptability to wide range of environmental conditions. Maize occupies an important place in Indian economy also known as the “Queen of Cereals”. Recently specialty corns such as sweet corn, baby corn and popcorn have emerged as alternative food sources, especially for affluent society. Maize growers are shifting towards specialty corn production due to higher returns and also opening opportunities for employment generation in peri-urban areas. Sweet corn (*Zea mays L. saccharata*) used as a human food in soft dough stage with succulent grain. The sugar (20% on dry basis at green ear stage) and starch make the major component of the endosperm, which results in sweetish taste of the kernel before they attain the maturity. The cobs are picked up at green stage (with 70% moisture) for canning and table purpose. The higher content of water soluble polysaccharide in the kernel adds texture and quality in addition to sweetness (Venkatesh *et al.*, 2003). Most of the sweet corn is grown for the processing sector ending up on the super market shelves as products which include canned kernels, frozen kernels and frozen cobs. Being a short duration crop (65 – 70 days), it easily fits in an rainfed cropping system and in addition to sweet corn it provides green, soft, succulent, nutritious, palatable nutritious fodder to cattle (Sahoo and Mahapatra, 2007).

Rice - rice was dominant cropping system in the Northern hills of Chhattisgarh, which is now shifting towards mono cropping of rice or maize due to climate change. With growing concern about the human health, soil quality and environmental safety, need has been felt to rethink over the prevailing agricultural practices, especially the nutrient management. Thus, organic source of nutrient supply has distinct advantages of sustainability of crop production and judicious combination of organic and inorganic fertilizers helps to sustain 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* (Rao *et al.*, 2002).

Sweet corn is new introduction particularly as short duration crop; so, efforts are required to standardize and economize its cultivation for maximum productivity along with sustainability and soil health. Although the agronomic requirements like plant geometry and fertility levels (Sahoo and Mahapatra, 2007) and weed control methods (Arvadiya *et al.*, 2012) for sweet corn has been worked out for irrigated conditions but work on intensive cultivation of sweet corn at different nutrient management systems having both inorganic and organic sources has not been done for rainfed conditions. 100 % NPK + FYM resulted 66 per cent increase in soil organic carbon content over initial value. Similar effects were recorded on cation exchange capacity and available nutrients (Bharti and Sharma, 2017). Application of 180-75-60 kg N P K ha⁻¹ + vermicompost at 20, 35 and 50 DAS found parity with 180-75-60 kg N P K ha⁻¹ + vermicompost but exhibited their superiority at the highest levels of fertilization over

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the same levels under chemical sources in enhancing green cob yield (Keerthi *et al.*, 2013).

MATERIALS AND METHODS

The field experiment was carried out during *Kharif* season of 2019-20 at the Research farm, RMD College of Agriculture & Research Station, Ambikapursituated at 23°18' N latitude and 83°15' longitude and at altitude of 611 meter above mean sea level which represents the northern hills agro-climatic zone of Chhattisgarh. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.7), medium in organic carbon (0.56), available nitrogen (234 kg ha⁻¹), available phosphorus (8.4 kg ha⁻¹) and available potassium (268 kg ha⁻¹). The experiment was carried out in factorial randomized block design (FRBD) with 3 replications. The treatments contained of ninetreatment combinations. The treatment comprised of two factors having three levels each, *ie.* organics (0t, 3t ha⁻¹ vermicompost and 5t ha⁻¹ FYM) and inorganics (50%, 75% and 100% RDF, RDF = 120: 60:40 kg N, P₂O₅, K₂O ha⁻¹). Sowingwas done manually in 1st week of July and 'Sugar 10' sweet corn cultivar was used as test crop. Well decomposed farmyard manure and vermicompost were applied as per treatments. Complete manures were applied at the time of last field preparation. Inorganic fertilizers were applied through iffco (12:32:16), urea and MOP. One third nitrogen, full dose of P₂O₅ and K₂O were applied as basal at the time of sowing whereas remaining nitrogen was top dressed in two equal splits at knee high stage (30 DAS) and tasseling stage (45 DAS) equally in all treatments. Sweet corn was sown at spacing of 60 cm with plant to plant spacing and 15 cm to maintain the plant population of 111,111 plants ha⁻¹ using 8 kg seeds ha⁻¹. Atrazine @ 1kg ai ha⁻¹ was applied as pre emergence herbicide using knapsack sprayer fitted with flat fan nozzle using in 500liters water ha⁻¹. Five plants were selected randomly in each net plot to record growth parameters such as plant height, leaf area index and dry matter accumulation at 30, 60 DAS and at harvest. The days taken for 50% tasseling and 50% silking were calculated by taking the difference of date of sowing and date of 50% plants had tasseling and silking respectively. five cobs were randomly selected from each net plot for determination of yield attributes viz., cob length, cob girth, no. of grain rows per cob, no. of grains per row and individual cob weight. Cobs from the net plot area were harvested at milky stage and weighed, without removing husk for husked cob yield. After recording the weight of green cobs with husk, the husk was removed and the weight of cobs without husk was determined for dehusked cob yield. The cost of cultivation of different treatments was worked out separately. Labour and requirement of mechanical power for different operations such as land

preparation, planting and harvesting was calculated as per local market rate. The cost of FYM and vermicompost were ₹ 600 and 5000 per ton respectively. The sweet green cobs were sold @ of ₹10 per kg cob yield with husk. Benefit cost (B:C) ratio was calculated by dividing cost of cultivation by net return. All data obtained in the was statistically analyzed using *F*- test, the procedure given by Gomez & Gomez (1984), critical difference (CD) values at *P*= 0.05 were used to determine the significance of differences between means.

RESULTS AND DISCUSSION

Growth Parameters

A significant improvement in growth parameters such as plant height, number of leaves plant⁻¹, leaf area, index and drymatter accumulation was observed with application of vermicompost and FYM (Table 1). Cropdid not show significant differences in days to reach 50% tasseling and 50% silking due tovariation in organic manures. Plant height increased significantly with the application ofvermicompost@ 3 t ha⁻¹(251.3 cm)remained statistically similar to FYM @ 5t ha⁻¹ (248.7cm) than that of no organic manure. The application of 100%RDF resulted in significantly more plant height (262.5cm). Moreover, application of50% RDF exhibited significantly the lowest plant height(233 cm).More plant height under high application of FYM and fertilizers might be due to more cell division and elongation favoured by high metabolic activity as a consequence of adequate availability of nutrients. Pal and Bhatnagar (2012) also found enhancement in plant height of maize with increase in nutrient dose. Maximum leaf area index per plant (4.59) was obtained with vermicompost @ 3 t ha⁻¹ that was statistically same with FYM @ 5t ha⁻¹ but significantly higher than control. Among nutrient levels, 100% NPK was significantly higher to 50 and 75 % NPK by 39.81 and 21.68 %. Application of vermicompost resulted in synthesis of phytohormones, vitamins and chlorophyll and helped the crop to intercept more solar radiation reflected on higher leaf area index in maize. This result is in close accordance with finding of Baharvand *et al.*, (2014) and Kouret *et al.*, (2017). Similarly crop grown with vermicompost @ 3 t ha⁻¹ being at par with FYM @ 5t ha⁻¹ exhibited significantly more dry matter accumulation per plant (77.25g) than that of without organic manure. Crop fertilized with 100 % NPK accumulated significantly more dry matter (79.90g) than rest of the treatments. Application of 50 % NPK resulted into significantly lowest dry matter per plant. High dry matter accumulation in vermicompost and FYM treated plots might be attributed due to the continuous steady release of nutrients which might have enabled the leaf area duration to extend, thus favouring the plants to increase the photosynthetic rate which in turn, could

have led to higher accumulation of dry matter. These results were in the agreement with the findings of Grazia *et al.*, (2003) and Kumar *et al.*, (2007).

Yield attributes

Cob length, cob girth, number of grains row⁻¹ and number of grains cob⁻¹ varied significantly due to organic nutrients and nutrient levels (Table 1). Significantly higher cob length (18.70cm) and cob girth (15.95 cm) was obtained in vermicompost @ 3 t ha⁻¹ as compared to no application of organic manure, however it remained at par with FYM @ 5t ha⁻¹. Application of vermicompost @ 3 t ha⁻¹ being at par with FYM @ 5t ha⁻¹ also resulted insignificantly more number of kernel rows cob⁻¹ (14.76) and higher number of kernels row⁻¹ (36.69) than 0. The improvement in the values of yield attributes was noted with each successive increase in the dose of nutrient dose where 100 % NPK produced significantly more cob length (11.8cm) than

50 and 75% NPK. Maximum cob girth (16.26cm), number of kernel rows cob⁻¹ (15.59) and number of kernels row⁻¹ (37.84) were observed in 100 % NPK which was significantly superior to 50 % NPK and 75 % NPK. Better availability of nutrients under high nutrient levels improved the plant growth in terms of leaf area and dry matter accumulation which in turn might help in increasing cob length and cob girth. These findings are in close conformity with the results obtained by Sinha (2012). The number of kernels row⁻¹ depends on cob length therefore, treatments having significantly more cob length had more number of kernels cob⁻¹. Since, number of kernels cob⁻¹ is product of number of kernel rows cob⁻¹ and number of kernels row⁻¹, hence variation in number of kernels cob⁻¹ may be ascribed to significant differences in number of kernels row⁻¹. Similar observations were also obtained by Kumar *et al.* (2007).

Table 1. Growth and yield attributes as influenced by different organic sources and inorganic nutrient levels.

Treatments		Growth attributes (60 DAS)			Yield attributes			
		Plant height (cm)	Leaf area index	Total dry matter plant ⁻¹ (g)	Cob length (cm)	Cob girth (cm)	No. of kernels row cob ⁻¹	No. of kernels row ⁻¹
Organic manure (t ha⁻¹)								
O ₁	0 t ha ⁻¹ (Without organic manure)	242.2	3.80	73.55	17.94	15.40	13.62	34.73
O ₂	3 t ha ⁻¹ Vermicompost	251.3	4.59	77.25	18.70	15.95	14.76	36.69
O ₃	5 t ha ⁻¹ FYM	248.7	4.36	76.68	18.41	15.80	14.61	35.93
Sem±		1.22	0.17	0.42	0.10	0.06	0.13	0.32
CD (P=0.05)		3.66	0.51	1.27	0.31	0.18	0.39	0.96
Inorganic nutrient level (% recommended dose of NPK)								
F ₁	50%	233	3.22	71.41	17.25	15.10	12.87	33.64
F ₂	75%	246.8	4.19	76.17	18.40	15.79	14.53	35.87
F ₃	100%	262.5	5.35	79.90	19.40	16.26	15.59	37.84
Sem±		1.22	0.17	0.42	0.10	0.06	0.13	0.32
CD (P=0.05)		3.66	0.51	1.27	0.31	0.18	0.39	0.96

Yield

A significant increase in cob yield was noted with organic manures. Crop fertilized with vermicompost @ 3 t ha⁻¹ being at par FYM @ 5t ha⁻¹ resulted in significantly more husked (16876.3kg ha⁻¹), dehusked cob yield (12034.2kg ha⁻¹) and fodder yield (20540.6 kg ha⁻¹) than that of grown without organic manure (Table 2). The increase in husked cob yields in vermicompost @ 3 t ha⁻¹ and FYM @ 5t ha⁻¹ over no use of organic manure was to the tune of 14.58 and 9.34 %, respectively whereas for the same treatments the increase in dehusked cob yield and fodder yield

was 19.89, 13.53 % and 11.9, 8.98% respectively. Raising the nutrient level from 50 to 100 % also caused significant increase in husked, dehusked cob yield and fodder yield. crop nourished with 100% NPK produced significantly more husked, dehusked cob yield and green fodder yield (18734.7, 13361.5 and 22502.2 kg ha⁻¹, respectively) than that of 50 and 75 % NPK. Fresh cob yield is the manifestation of growth characters. Significant increase in cob yield of sweet corn can be traced back to the significant increase in the yield components like cob length, cob girth, number of

kernel rows cob⁻¹ and number of kernels row⁻¹ which had direct influence. These findings are in accordance with Sahoo and Mahapatra(2007).

Economics

Significant differences in economic parameters were observed due to organic treatments (Table 2). Cost of cultivation on sweet corn was very high due to high price of seed i.e. ₹4500 per kg and purchase of FYM and vermicompost from outside. Crop grown with vermicompost had maximum (₹ 73593.10 ha⁻¹) cost of cultivation. Among nutrient levels, 50 % NPK and 100% NPK exhibited the lowest and the highest cost of cultivation (₹ 63063.38 and ₹ 66111.42 ha⁻¹, respectively). The maximum gross return (₹ 179033.2 ha⁻¹) was obtained under application of vermicompost @ 3 t ha⁻¹ that was significantly superior to 0t but at par with application of FYM @ 5t ha⁻¹. The maximum gross return was obtained under 100% NPK (₹ 198597.8 ha⁻¹) that was significantly higher than 50 and 75 % NPK. Since gross return was obtained from cob yield and fodder yield hence, variation in these resulted in significant differences in gross return under different treatments. The maximum net return of ₹ 107359.1 ha⁻¹ was obtained under FYM @ 5t ha⁻¹ which was at par with vermicompost @ 3 t ha⁻¹ but was significantly higher than 0 t. The maximum net return (₹132486.4 ha⁻¹) was obtained under 100% NPK that was significantly superior to 50 and 75 % NPK. An increase of 25.23

and 43.52% was noticed in 75 and 100% NPK, respectively over 50 % NPK. The variations in net return were due to differences in cost of cultivation and gross return in respective treatments. Non-significant difference in benefit: cost ratio was observed due to different organic manures. However, the maximum B:C ratio (1.74) was obtained under 5 t FYM ha⁻¹. Among nutrient levels, the maximum B:C ratio (2.01) was noted under 100% NPK that was significantly superior to 50% NPK and 75% NPK. Benefit cost ratio in different treatments varied owing to difference in net return and cost of cultivation. Nutrient management treatments showed significant direct yield advantage over without organic manure and minimum fertilizer treatment in maximizing net return as well as B:C ratio. This was because of more net returns than the money spent in crop production under these treatments. These results are found to be in close conformity with findings of Mathukia *et al.*, (2014) and Nath *et al.*, (2009).

CONCLUSIONS

Results of the study indicated that the higher green cob yield and net profit of sweet corn in *kharif* season may be obtained by fertilizing it with 100 % recommended dose of nutrients (120kg N, 60 kg P₂O₅ and 40 kg K₂O ha⁻¹) along with 5 t FYM ha⁻¹.

Table 2. Yield and economics of sweet corn cultivation as influenced by different weed management practices.

Treatments		Yield (kg ha ⁻¹)			Economics	
		Husked Cob yield	Dehusked Cob yield	Green fodder yield	Net return (₹ha ⁻¹)	B:C ratio
Organic manure (t ha⁻¹)						
O ₁	0 t ha ⁻¹ (without organic manure)	14415.3	9640.2	18096.3	94608.4	1.61
O ₂	3 t ha ⁻¹ Vermicompost	16876.3	12034.2	20540.6	105440.2	1.43
O ₃	5 t ha ⁻¹ FYM	15901.2	11149.1	19880.7	107359.1	1.74
Sem±		346.1	265.3	281.8	3540.7	0.06
C.D. (P=0.05)		1038.1	795.5	845.0	10615.4	0.17
Inorganic nutrient levels (% recommended dose of NPK)						
F ₁	50%	12959.6	8803.4	16599.1	74832.5	1.20
F ₂	75%	15498.5	10658.5	19416.3	100088.8	1.56
F ₃	100%	18734.7	13361.5	22502.2	132486.3	2.01
Sem±		346.25	265.3	281.8	3540.6	0.06
CD (P=0.05)		1038.11	795.5	845.0	10615.4	0.17

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