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Effect of integrated nutrient management on production potential and economics in summer sweet corn (*Zea mays* L. var. *Saccharata*)

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Abstract

A field experiment was carried out in sandy loam soil at Experimental Farm, Bagusala, M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management during summer in 2018. The experiment was laid out in randomized complete block design with three replications and 8 treatments comprised of 100% recommended dose of fertilizer RFD (120-60-60 kg N-P₂O₅-K₂O/ha), 100% RFD + bio fertilizer consortia (*Azotobacter* + *Azospirillum* + phosphobacter) @15 kg/ha, 50% recommended N through farm yard manure(FYM) + 50% RFD + bio fertilizer consortia @15 kg/ha, 50% recommended N through vermicompost (VC)+ 50% RFD + bio fertilizer consortia@15kg/ha, 75% RFD +25% recommended N through FYM, 75% RFD + 25% recommended N through VC, 75% RFD + 25% recommended N through FYM + bio fertilizer consortia@15 kg/ha and 75% RFD + 25% recommended N through VC + biofertilizer consortia @15kg/ha. The soil was acidic in reaction (6.8) with available N, P₂O₅ and K₂O of 158.83, 10.82 and 147.67 kg/ha, respectively. The crop growth parameters like plant height, number of leaves/plant and leaf area index and yield attributes such as number of cobs/plant, cob length, cob girth and cob weight and green cob and forage yield were markedly influenced by integrated nutrient management treatments. Application of 75% RFD + 25% RDN (VC) + BFC @15 kg/ha recorded the highest crop growth, yield attributes and green cob (12.01 t/ha) and green fodder (16.52 t/ha) yield. It was followed by 100% RFD + biofertilizer consortia producing the green cob (11.67 t /ha) and forage green forage (16.17 t/ha). The conjugated application of 100% RFD (120-60-60 kg N, P₂O₅ and K₂O /ha) and biofertilizer consortia (*Azotobacter* + *Azospirillum*+ phosphobacter) @15 kg/ha registered the highest net return (Rs164206/ ha) and benefit cost ratio (1.92).

Keywords: Sweet corn, recommended dose of fertilizer, organic manure, biofertilizer consortia, production potential, economics

Introduction

In India, sweet corn is confined to meagre area by both farmers and private sectors to meet the demand of consumption at raw stage after roasting and industries. There is greater scope of growing sweet corn to improve the economic status of poor farmers. The major constraint for its popularization among Indian growers is non-availability of appropriate production technology. Nutrient management as key to production technology, contributes appreciably towards higher productivity of sweet corn. Sweet corn as an exhaustive crop removes a major portion of plant nutrients from soil after harvesting. The soil will be replenished with the nutrients to sustain crop production. The judicious use of nutrients in integrated manner and its management strategies has immense benefit to address the commercial yield and quality, the economics of crop production and protection of the environment. Application of recommended dose of NPK is found suitable in sweet corn (Sunitha and Maheswar Reddy, 2012) [8]. The use of organic manure alleviates the soil physical, chemical and biological properties and maintains soil health. The conjugated application on NPK fertilizer with organic manure through FYM or vermicompost resulted in beneficial effect in sweet corn (Mohammadi *et al.*, 2017 and Canatoy, 2018) [3, 1]. Biofertilizer consortia containing microbial inoculants of *Azotobacter*, *Azospirillum* and P solubilizing bacteria in combination with inorganic fertilizers and organic manures reduce the quantity of chemical fertilizers and sustain the crop production.

The favourable effect of NPK with organic manure (FYM and vermicompost) and biofertilizer has been observed in sweet corn by several workers (Harish *et al.*, 2012^[2], Shobana and Imyavaramban 2012^[2], Rasool *et al.*, 2015^[4], Singh *et al.* 2018^[6] and Rathod *et al.*, 2018)^[5]. Keeping the above facts in view, the present experiment was under taken to devise the location specific low cost nutrient management strategy in sweet corn.

Materials and Methods

A field experiment was carried out at Experimental Farm, Bagusala, M.S. Swaminathan School of Agriculture, Centirion University of Technology and Management, Paralakhemundi, Odisha during summer in 2018. The soil of experimental plot was sandy loam texture containing available N, P₂O₅ and K₂O of 158.83, 10.82 and 147.67 kg ha⁻¹, respectively. The trial was laid out in randomized complete block design with three replications and eight treatments in plot size of 5.0 m x 4.0 m. The details of nutrient management treatments were comprised of 100% recommended fertilizer dose RFD (120-60-60 kg N, P₂O₅ and K₂O/ha), 100% RFD + bio fertilizer consortia (*Azotobacter* + *Azospirillum*+ *posphobacter*) @15 kg/ha, 50% recommended dose of N (RDN) through farm yard manure (FYM)+50% RFD + bio fertilizer consortia (BFC) @15 kg/ha, 50% recommended N through vermi compost (VC) + 50% RFD + BFC@15kg/ha, 25% RDN through FYM+75% RFD, 25% RDN through VC+75% RFD, 25% RDN through FYM+75% RFD+BFC @15 kg/ha and 25% RDN through VC+75% RFD + BFC@15kg/ha. The sweet corn variety sugar-75 was sown on 10 th February, 2018 with spacing of 50 cm from row to row and 30 cm from seed to seed. At sowing, one third nitrogen, full P and half K were applied as basal as per the treatment specification. The organic manure like farm yard manure (FYM) and vermin compost (VC) and bio fertilizer consortia comprise of *Azotobacter* + *Azospirillum* + *Pospho bacteria*@15kg/ha were applied at sowing as per the treatments. In first top dressing, one third N and 25% K were applied at 30 days after sowing (DAS) at knee high stage. The final dressing of one third N and 25% K was done at tasselling stage. The sources of fertilizer for N, P and K were urea, single super phosphate and muriate of potash. All cultural operations were performed as per the recommended practice. The green cob was harvested by plucking for table purpose. After final plucking, the crop was harvested as green fodder purpose. The biometric observation on crop growth, yield attributes and yield were recorded at plucking of cob and harvesting for green forage.

Result and Discussion

Effect of INM treatments on crop growth

Data presented in Table 1 indicated the significant effect of nutrient management treatments on plant height and leaf area index. The nutrient management treatments failed to exhibit the significant effect on number of leaves at harvest. The tallest plants were recorded in 100% RFD+BFC (216.3cm) which was at par with all other treatments except 100% RFD and 50% RDN (FYM)+50% RFD+BFC. The number of leaves /plant was maximum in (75% RFD+25% RDN (VC)+BFC (13.37) closely followed by 75% RFD+25% RDN(FYM)+BFC (13.33) and 100% RFD+BFC (13.13). At harvest, maximum LAI (4.45) was recorded with 75% RFD+25% RDN (VC)+BFC @15 kg/ha followed by 75% RFD +25% RDN (FYM) + BFC (4.32) which were at par. The next treatment in order with respect to LAI as 100%

RFD+ BFC (4.05) that did not differ significantly from 75% RFD+25% RDN(FYM)+ BFC. Application of recommended NPK integrated with bio fertilizer either with or without organic manure increased the crop growth in terms of plant height, number of leaves/ plant and leaf area index (LAI). It is resulted in due to timely and quick release of nutrients and more availability of N, P and K. Thus, it was associated with increase in cell division and enlargement there by increased plant height, leaf number and LAI. Increase in crop growth in treated plots with inorganic fertilizers with organic manure (vermicompost and FYM) with bio fertilizers consortia improves the physiochemical and biological properties of soil resulting in greater availability and absorption of nutrients. Therefore, bio fertilizer and organic manure either alone or in combination increase the efficiency of fertilizer use. The present result is in agreement with findings of Rasool *et al.* (2015)^[4], Rathod *et al.* (2018)^[5] and Singh *et al.* (2018)^[6].

Effect of INM treatments on yield attributes.

The yield attributes of sweet corn like cob length, and cob weight were significantly affected by nutrient management treatments (Table.1). The nutrient management treatments failed to exhibit significant effect on number of cobs/plant and cob girth. Application of 75% RFD + 25% RDN (VC)+BFC recorded the maximum number of cobs/plant (1.27) followed by 75% RFD+25% RDN (FYM) + BFC. The highest cob length was observed with 75% RFD + 25% RDN (VC) + BFC (23.57 cm) followed by 50% RDN (VC)+50% RFD+BFC (23.22 cm) and 50% RDN (FYM)+50% RFD+BFC (23.20cm) which were at par with former treatment. The minimum cob length was recorded at 100% RFD @120-60-60 kg NPK/ha (21.27 cm). Nutrient management treatments failed to exhibit the significant effect on cob girth. The cob girth was maximum in 75% RFD + 25% RDN (VC) + BFC (17.80 cm) followed by 75% RFD + 25% RDN (FYM) +BFC and 75% RFD + 25% RDN (FYM) +BFC@15 kg/ha (17.77 cm). The highest cob weight was recorded with 75% RFD+25% RDN (VC) + BFC (365.33 g). It was statistically at par with all other treatments except 50% RDN@ 60 kg N/ha (FYM) + 50% RFD + BFC (302.33 g). Increase in yield attributes observed with integrated application of inorganic, organic and bio fertilizers is due to improvement in crop growth parameters resulted in better translocation, utilization and partitioning of photosynthates. Improvement in soil physico-chemical and biological properties with integrated use of nutrients resulted in better availability, absorption and utilization of nutrients there by enhanced yield attributes. This result is in close harmony with the findings of (Shobana and Imyavaramban, (2012)^[7], Rathod *et al.* (2018)^[5] and Singh *et al.* (2018)^[6].

Effect of INM treatments on yield

The perusal of data (Table 2) indicated that the green cob yield of sweet corn were significantly affected by nutrient management treatments. Application of 75% RFD+25% RDN(VC) + BFC produced the highest yield (12.01 t/ha). It remained at par with 100% RFD + BFC (11.67 t/ha) and 75% RFD+25% RDN@30kg N/ha (FYM)+BFC@15 kg/ha (11.28 t/ha), 75% RFD+25% RDN@30kgN/ha FYM)+BFC(11.03t/ha) and 100% RFD(120-60-60 kg NPK/ha). The integrated nutrient management treatments failed to exhibit significant effect on green forage yield 'Maximum green forage yield was recorded with 75% RFD+25% RDN@ 30kg N/ha (VC) +BFC@15 kg/ha (16.52 t/ha) followed by 75% RFD +25% RDN@ 30kg/ha through VC (16.17 t/ha) and 100%

RFD(120-60-60 kg NPK/ha) giving the stover yield of 16.10 /ha. The harvest index was maximum in 75% RFD + 25% RDN@ 30kg N/ha (VC) + BFC @15 kg/ha (42.19%) followed by 75% RFD + 25% RDN @30kg N/ha (FYM) + BFC @15 kg/ha (41.55%). The green cob and forage yield were enhanced due to remarkably increase in yield attributes and crop growth, respectively. The combined effect of inorganic nutrient, organic manure and bio fertilizers had synergistic effect in availability of applied nutrient in soluble form coupled with better utilization of it. SSS resulted in increased sink capacity through better nutrient uptake by crop. It corroborates with the findings of Harish *et al.* (2012) [2], Shobana and Imyavaramban (2012) [7] and Rathod *et al.* (2018) [5].

Effect of INM treatments on economics

The data depicted in Table 2. Showed that maximum gross return was recorded in 75% RFD+25% RDN@ 30kg N/ha

(VC) + BFC (Rs 256656/ ha) followed by 75% RFD + 25% RDN (FYM) + BFC (Rs241378/ha). This was due to increase in cob and green forage yield with those combinations which ultimately reflected the enhancement of gross return. However, 100% RFD + BFC registered the highest net return (Rs164206/ha) and benefit cost ratio (1.92) followed by 100% RFD giving the corresponding values of Rs151772/ ha and 1.81, respectively. This was possible as a result of appreciable cob and green fodder yield that were obtained with chemical fertilizers either alone and combined with biofertilizer consortia. The reason is that chemical fertilizer are cheaper in comparison to vermicompost and farm yard manure and required less quantity to supply recommended dose of nutrient. Virtually, the cost of cultivation is reduced with conjugated application of 100% RFD and bio fertilizer consortia that ultimately fetched maximum net return and benefit cost ratio. This result is in agreement with the findings of Rathod *et al.*, 2018 [5].

Table 1: Effect of nutrient management treatments on crop growth and yield attributes of sweet corn

Treatments	Plant height (cm)	No of leaves /plant	Leaf area index	Cobs/ plant	Cob length (cm)	Cob girth (cm)	Cob weight (g)
100% RFD	206.0	11.77	3.89	1.21	21.27	17.13	331.00
100% RFD+ BFC	216.3	13.13	4.05	1.23	22.30	17.20	344.33
50% RDN (FYM) + 50% RFD +	206.3	12.67	3.64	1.18	23.20	16.87	302.33
50% RDN (VC) + 50% RFD+	213.0	12.50	3.57	1.21	23.22	16.97	320.33
75% RFD +25% RDN (FYM)	211.3	12.53	3.73	1.22	22.23	17.50	360.00
75% RFD +25% RDN (VC)	215.0	13.10	3.93	1.24	22.42	17.00	363.00
75% RFD +25% RDN (FYM) + BFC	213.3	13.33	4.32	1.25	22.55	17.77	361.33
75% RFD+25% RDN (VC) + BFC	213.0	13.37	4.45	1.27	23.57	17.80	365.33
SEM ±	1.7	0.32	0.12	0.06	0.36	0.37	14.03
CD (P=0.05)	5.2	NS	0.37	NS	1.10	NS	42.62

RFD = Recommended fertilizer dose, BFC= Bio fertilizer consortia (*Azotobacter*+*Azospirillum*+ *Posphobacter*), RDN= Recommended dose of nitrogen, FYM= Farm yardmanure, VC= Vermi compost.

Table 2: Effect of nutrient management treatment on yield, harvest index and economics of sweet corn

Treatments	Cobs yield (t/ha)	Green Forage yield (t/ha)	Harvest index (%)	Gross return (Rs/ha)	Net Profit (Rs/ha)	Benefit: cost ratio
100% RFD	10.98	16.10	40.53	235712	151772	1.81
100% RFD+ BFC	11.67	16.17	41.94	249646	164206	1.92
50% RDN (FYM) + 50% RFD + BFC	9.54	14.27	40.09	205055	110973	1.18
50% RDN (VC) + 50% RFD +BFC	10.34	15.37	40.21	222237	107321	0.93
75% RFD +25% RDN (FYM)	10.25	15.55	39.73	220482	132222	1.50
75% RFD +25% RDN (VC)	11.03	16.03	40.68	236566	137889	1.40
75% RFD +25% RDN (FYM) + BFC	11.28	15.83	41.55	241378	151618	1.69
75% RFD+25% RDN (VC) + BFC	12.01	16.52	42.19	256656	156478	1.56
SEM ±	0.49	0.77	1.38			
CD (P=0.05)	1.48	2.33	4.18			

RFD = Recommended fertilizer dose, BFC= Bio fertilizer consortia (*Azotobacter*+*Azospirillum*+ *Posphobacter*), RDN= Recommended dose of nitrogen, FYM= Farm yardmanure, VC= Vermi compost

Conclusion

It is inferred that integration of 100% RFD (120-60-60 kg N, P₂O₅ and K₂O/ha) + biofertilizer consortia (*Azotobacter*+*Azospirillum*+ *posphobacter*) @15 kg/ha is recommended to increase the crop growth, yield attributes, yield and economics in sweet corn.

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