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Original Research Article

Effect of Integrated Nutrient Management on Productivity and Profitability of Sweet Corn (*Zea mays* L. *saccharata*)

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A B S T R A C T

A field experiment was conducted at Research Farm of IGKV, Raipur in *rabi* season of 2014. The integrated nutrient combination *i.e.* RDF + 10 t FYM ha^{-1} (T_2) resulted in highest plant height, stem girth, LAI, dry matter accumulation, CGR, cobs plant^{-1}, cob weight, grain rows cob^{-1}, grains row^{-1}, green cob yield (187.74 q ha^{-1}), grain yield (34.80 q ha^{-1}) and green fodder yield (328.72 q ha^{-1}). However, application of RDF + 5 t FYM ha^{-1} + 2% foliar spray of 18:18:18 N: P: K at 40 and 60 DAS (T_7) and RDF + 10 t Rice straw compost (*Trichoderma* based) ha^{-1} (T_4) were found statistically at par in term of grain yield of sweet corn with the application of RDF + 10 t FYM ha^{-1} (T_2). In terms of net returns, RDF + 10 t FYM ha^{-1} (T_2) continue to maintain its superiority (Rs. 152646.54). However, in term of B: C ratio, application of RDF + 5 t FYM ha^{-1} + 2% foliar spray of 18:18:18 N:P:K at 40 and 60 DAS (T_7) was found higher value (3.8). In order to the superiority 10 t ha^{-1} *Trichoderma* based rice straw could be the substitute of 10 t of FYM. Thus, it may be inferred that among the different integrated nutrient management practices, RDF + 10 t FYM ha^{-1} (T_2) resulted in maximum green cob yields and net profits.

Keywords

Sweet corn, Trichoderma and FYM

Introduction

Sweet corn (*Zea mays* L. *saccharata*) also known as sugar corn, is a hybridized variety of maize (*Zea mays* L.) specifically bred to increase the sugar content and provides green ears in 75 to 90 days after sowing. Sweet corn contains 5-6% sugar, 10-11% starch, 3% water soluble polysaccharides and 70% water, besides moderate levels of protein and vitamin (yellow varieties) and potassium (Oktem and Oktem, 2005). Sweet corn is gaining importance in the star hotels and urban areas for the preparation of vegetables, special soups, syrup, sweets, jams, cream, pastes and other delicious eatables. Besides, its fodder is highly succulent, palatable and digestible. Amongst various agricultural inputs, fertilizer is and will remain as a chief source in achieving the food production targets. For higher productivity, there is a need for the application of higher dose of fertilizers but the increased use of high analysis fertilizers and adaptation of high yielding cultivars demanding more secondary and micro nutrients for enhancing food grain production has resulted in their deficiencies and declined growth and productivity of crop due to continued removal of nutrients from soil. From the results of the long term fertilizer experiments conducted in different parts of the country, it has been well established that under high input production system, where crop productivity can not be further increased with incremental use of fertilizer alone, addition of organic sources could again increase the yield through increased soil productivity and fertilizer use efficiency. Farm yard manure application to the crops is being practiced for long period. Well decomposed FYM in addition to supplying plant nutrients acts as binding material and improves the soil physical properties. The use of foliar fertilizer is more economical and effective than the granulated form of fertilizer. Application of foliar fertilizer is an effective way of correcting soil nutrient deficiencies when plants are unable to absorb them directly from the soil (Liang and Silberbush, 2002). The use of both foliar and soil application of NPK have been found to increase grain yield in maize (Ghaffari *et al.*, 2011). However, study is needed to ascertain the response of inorganic, organic and foliar spray on the yield and quality of sweet corn. Due to their importance in agriculture production through natural mean, we achieve the aim of higher yield and which give sustainable production in agriculture for long term.

Materials and Methods

The soil of the experimental field was clay in texture (*Vertisols*), slightly alkaline in reaction (pH 7.6), low in organic carbon (0.37%) and available N (188 kg ha^{-1}), medium in available P (19 kg ha^{-1}) and high in available K (220 kg ha^{-1}). The experiment was laid out in RBD with thrice replications and conducted at Research Farm, IGKV, Raipur during *rabi* 2014. The experiment comprising twelve different organic and inorganic nutrient source combination *viz.*, RDF (120:60:40 kg N:P:K ha^{-1}) + 5 t FYM ha^{-1} (T_1), RDF + 10 t FYM ha^{-1} (T_2), RDF + 5 t Rice straw compost (*Trichoderma* based) ha^{-1} (T_3), RDF + 10 t Rice straw compost (*Trichoderma* based) ha^{-1} (T_4), RDF + 5 t FYM ha^{-1} + IBA 100 mgL^{-1} at 40 and 60 DAS (T_5), RDF + 5 t FYM ha^{-1} + 2% foliar spray of urea at 40 and 60 DAS (T_6), RDF + 5 t FYM ha^{-1} + 2% foliar spray of 18:18:18 N:P:K at 40 and 60 DAS (T_7), RDF + 5 t FYM ha^{-1} + 2% foliar spray of DAP at 40 and 60 DAS (T_8), RDF + 5 t FYM ha^{-1} + 15% foliar spray of sea weed sap (K sap) at 30, 45 and 60 DAS (T_9), RDF + 5 t FYM ha^{-1} + 15% foliar spray of sea weed sap (G sap) at 30, 45 and 60 DAS (T_{10}), RDF + 5 t FYM ha^{-1} + Biovita at 30, 45 and 60 DAS (T_{11}) and RDF + 5 t FYM ha^{-1} + Marino at 30, 45 and 60 DAS (T_{12}). The data were statistically analyzed applying the techniques of analysis of variance and the significance of different sources of variations were tested by error mean square of Fisher Snedecor's 'F' test at probability level 0.05 (Gomez and Gomez, 1984).

Results and Discussion

Effect on growth

The different integrated nutrient management practices (INMP) had significant influence on plant height, LAI and stem girth at harvest stage. The plot treated with RDF + 10 t FYM ha^{-1} (T_2) attained significantly maximum plant height (213.90 cm), LAI (3.23) and stem girth (9.73 cm) (Table 1). However, the application of RDF + 5 t FYM ha^{-1} + 2% foliar spray of 18:18:18 N:P:K at 40 and 60 DAS (T_7) was exhibited at par with application of RDF + 10 t FYM ha^{-1} (T_2). The favourable influence of growth parameters were noticed in RDF + 10 t FYM ha^{-1} (T_2), optimum amount of nutrient is most important factor for growth and development. FYM serve as a reservoir of macro, secondary and micro nutrients, many hormones, antibiotics and organic matter content etc. Organic matter content is the major natural source of microbial energy. Kumar and Sharma (1999) also reported that growth parameters increased significantly or tended to increase with increasing in dose of FYM. The results fall in the line with report of Luikham *et al.* (2003). Thus, the significantly maximum amounts of crop growth 3.89 g plant^{-1} day^{-1} was recorded under the RDF + 10 t FYM ha^{-1} (T_2). But, the treatments T_7, T_4, T_8, T_6, T_{10} and T_9 were found statically at par with T_2. The dry matter accumulation was greater due to increasing doses of nitrogen resulting in higher CGR value (Fig. 1, 2 & 3). Waghmare (1980) also observed that the relative crop growth rate and NAR increased with increase in these levels of N upto 120 kg N ha^{-1}.

The significantly maximum relative growth rate (0.012 g g^{-1} plant^{-1} day^{-1}) was recorded under the RDF + 5 t FYM ha^{-1} + 15% foliar spray of sea weed sap (G sap) at 30, 45 and 60 DAS (T_{10}). However, the treatments T_2, T_4, T_6, T_7, T_8 and T_9 were found at par with T_{10}. The highest amount of dry matter 355.3 g plant^{-1} was generated at harvest stage under RDF + 10 t FYM ha^{-1} (T_2) and statistically at par with the treatment of T_7 and T_4. Organic matter content is the major natural source of microbial activities. It also serves as an ion exchange material and chelating agent and nutrients which made available to the plants resulting more accumulation of dry matter. Kumar and Sharma (1999) also reported that dry matter accumulation and green fodder yield of maize either increased significantly or tended to increase with increasing dose of FYM. Similar results have also been reported by Luikham *et al.* (2003), Kumar and Puri (2001), Suri and Jha (1996). Khandaker and Islam (1988) also expressed same view.

Effect on yield attributes and yield

The number of cobs plant^{-1}, green cob weight (g), no. of grain rows cob^{-1} and Number of grains row^{-1} were significantly influenced by different integrated nutrient management practices (Table 2). Among different integrated nutrient management practices, significantly maximum number of cobs (1.73) was observed with the application of RDF + 10 t FYM ha^{-1} (T_2), which was found statistically at par with RDF + 10 t Rice straw compost (*Trichoderma* based) ha^{-1} (T_4), RDF + 5 t FYM ha^{-1} + 2% foliar spray of 18:18:18 N:P:K at 40 and 60 DAS (T_7), RDF + 5 t FYM ha^{-1} + 2% foliar spray of DAP at 40 and 60 DAS (T_8) and RDF + 5 t FYM ha^{-1} + 2% foliar spray of urea at 40 and 60 DAS (T_6). The green cob weight (g) was observed same pattern as no. of cobs plant^{-1} except T_8 and T_6 which was not found at par. The green cob length (cm) and girth of cob were found non significant difference among different treatments. Number of grain rows cob^{-1} and number of grains row^{-1} were significantly influenced by the different integrated nutrient management practices. The maximum number of grain rows cob^{-1} (18.47) and highest number of grains row^{-1} (44.33) were obtained under application of RDF + 10 t FYM ha^{-1} (T_2). However, application of RDF + 5 t FYM ha^{-1} + 2% foliar spray of 18:18:18 N:P:K at 40 and 60 DAS (T_7) and RDF + 10 t Rice straw compost (*Trichoderma* based) ha^{-1} (T_4) were found statistically at par with T_2. But in case of number of grains row^{-1} , RDF + 5 t FYM ha^{-1} + 2% foliar spray of DAP at 40 and 60 DAS (T_8), RDF + 5 t FYM ha^{-1} + 2% foliar spray of urea at 40 and 60 DAS (T_6) and RDF + 5 t FYM ha^{-1} + 15% foliar spray of sea weed sap (G sap) at 30, 45 and 60 DAS (T_{10}) were also produced comparable number of grains row^{-1} of maize.

Table.1 Yield attributes of sweet corn as influenced by different integrated nutrient management practices

Treatment	Plant height (cm) at Harvest	Leaf area index at harvest	Stem girth(cm) at harvest	No. of cobs plant $^{-1}$	Green cob weight (g)	Cob length (cm)	Cob girth (cm)	No. of grain rows cob $^{-1}$	Number of grains row $^{-1}$	Test weight (g)
T_1 - RDF + 5 t FYM ha $^{-1}$	181.87	2.41	7.99	1.13	321.33	23.13	20.43	15.13	38.27	123.86
T_2 - RDF + 10 t FYM ha $^{-1}$	213.90	3.23	9.73	1.73	394.67	24.47	21.39	18.47	44.33	120.24
T_3 - RDF + 5 t Rice straw compost (*Trichoderma* based) ha $^{-1}$	178.90	2.33	7.70	1.07	310.67	22.47	20.05	14.93	38.07	122.31
T_4 - RDF + 10 t Rice straw compost (*Trichoderma* based) ha $^{-1}$	197.67	2.76	9.18	1.67	363.00	24.05	21.24	16.73	42.53	115.43
T_5 - RDF + 5 t FYM ha $^{-1}$ + IBA 100 mg L $^{-1}$ at 40 and 60 DAS	184.93	2.47	8.13	1.20	325.67	23.33	20.54	15.40	38.67	119.86
T_6 - RDF + 5 t FYM ha $^{-1}$ + 2% foliar spray of urea at 40 and 60 DAS	193.93	2.70	8.71	1.53	349.33	23.89	21.16	16.00	41.27	114.12
T_7 - RDF + 5 t FYM ha $^{-1}$ + 2% foliar spray of 18:18:18 N:P:K at 40 and 60 DAS	203.37	2.99	9.35	1.67	368.67	24.26	21.31	17.33	43.87	115.28
T_8 - RDF + 5 t FYM ha $^{-1}$ + 2% foliar spray of DAP at 40 and 60 DAS	195.90	2.74	8.85	1.60	355.00	23.90	21.21	16.47	42.00	116.10
T_9 - RDF + 5 t FYM ha $^{-1}$ + 15% foliar spray of sea weed sap (K sap) at 30, 45 and 60 DAS	190.67	2.61	8.57	1.40	339.00	23.68	21.01	15.73	39.93	116.49
T_{10} - RDF + 5 t FYM ha $^{-1}$ + 15% foliar spray of sea weed sap (G sap) at 30, 45 and 60 DAS	192.90	2.66	8.61	1.47	343.33	23.79	21.13	15.87	40.67	118.91
T_{11} - RDF + 5 t FYM ha $^{-1}$ + Biovita at 30, 45 and 60 DAS	185.87	2.52	8.28	1.27	334.00	23.59	20.87	15.60	38.80	119.27
T_{12} - RDF + 5 t FYM ha $^{-1}$ + Marino at 30, 45 and 60 DAS	187.07	2.56	8.38	1.33	338.67	23.65	20.96	15.73	39.60	117.17
SEm±	5.84	0.14	0.29	0.08	11.86	0.85	0.54	0.66	1.41	6.66
CD (P=0.05)	17.13	0.42	0.85	0.23	34.79	NS	NS	1.95	4.15	NS

Table.2 Yield and economics of sweet corn as influenced by different integrated nutrient management practices

Treatment	Green cob yield (q ha^{-1})	Grain yield (q ha^{-1})	Green fodder yield (q ha^{-1})	Harvest index (HI)	Cost of cultivation (Rs ha^{-1}	Net return (Rs ha^{-1})	B:C ratio
T_1 - RDF + 5 t FYM ha^{-1}	135.6	26.6	259.5	34.3	37971.5	104086.0	2.7
T_2 - RDF + 10 t FYM ha^{-1}	187.7	34.8	328.7	36.3	43311.5	152646.5	3.5
T_3 - RDF + 5 t Rice straw compost (*Trichoderma* based) ha^{-1}	130.2	24.2	253.7	33.9	37971.5	98570.0	2.6
T_4 - RDF + 10 t Rice straw compost (*Trichoderma* based) ha^{-1}	171.2	31.2	307.7	35.7	43311.5	135561.3	3.1
T_5 - RDF + 5 t FYM ha^{-1} + IBA 100 mg L^{-1} at 40 and 60 DAS	139.7	27.3	262.4	34.8	39851.5	106447.5	2.7
T_6 - RDF + 5 t FYM ha^{-1} + 2% foliar spray of urea at 40 and 60 DAS	160.9	29.2	291.4	35.6	38787.8	129357.7	3.3
T_7 - RDF + 5 t FYM ha^{-1} + 2% foliar spray of 18:18:18 N:P:K at 40 and 60 DAS	179.2	32.4	315.5	36.2	38897.2	148231.0	3.8
T_8 - RDF + 5 t FYM ha^{-1} + 2% foliar spray of DAP at 40 and 60 DAS	165.3	29.8	294.0	36.0	39285.1	133384.4	3.4
T_9 - RDF + 5 t FYM ha^{-1} + 15% foliar spray of sea weed sap (K sap) at 30, 45 and 60 DAS	151.3	28.3	279.4	35.1	47091.5	111143.5	2.4
T_{10} - RDF + 5 t FYM ha^{-1} + 15% foliar spray of sea weed sap (G sap) at 30, 45 and 60 DAS	156.1	28.6	287.0	35.2	47091.5	116153.5	2.5
T_{11} - RDF + 5 t FYM ha^{-1} + Biovita at 30, 45 and 60 DAS	142.7	27.7	266.8	34.9	40611.5	108758.5	2.7
T_{12} - RDF + 5 t FYM ha^{-1} + Marino at 30, 45 and 60 DAS	147.8	28.1	271.7	35.2	40719.5	113822.3	2.8
SEm±	6.36	1.61	11.41	0.48			
CD (P=0.05)	18.65	4.72	33.46	1.41			

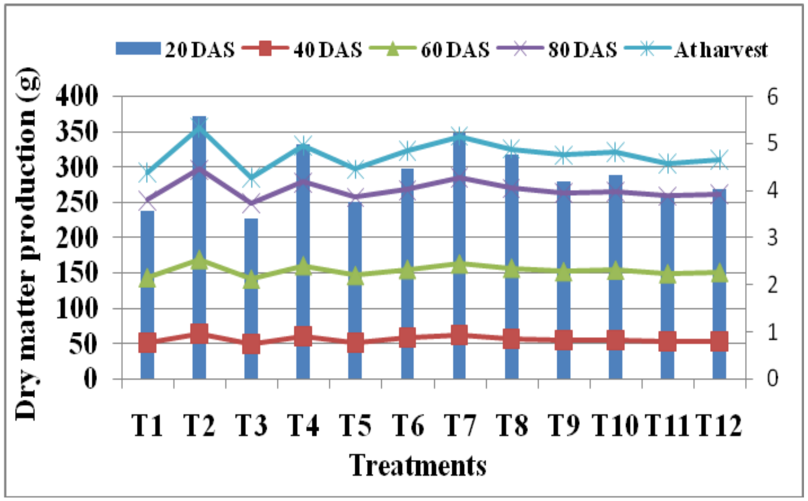

Figure.1 Effect of different INMP on dry matter production (g) of sweet corn

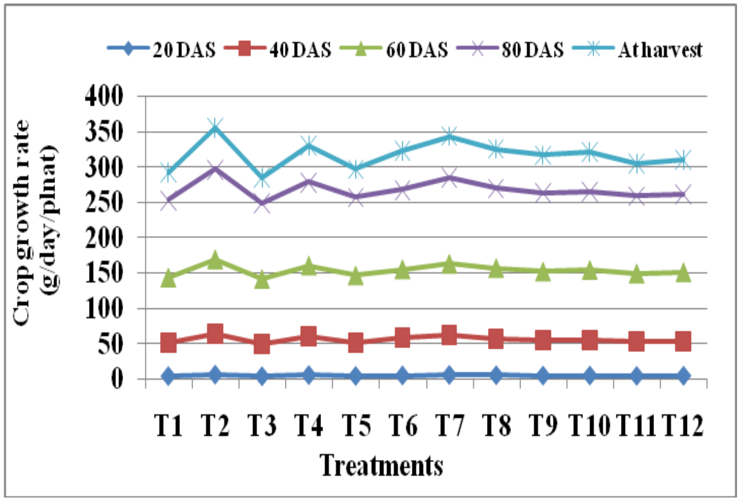

Figure.2 Effect of different INMP on Crop growth rate (g/day/plant) of sweet corn

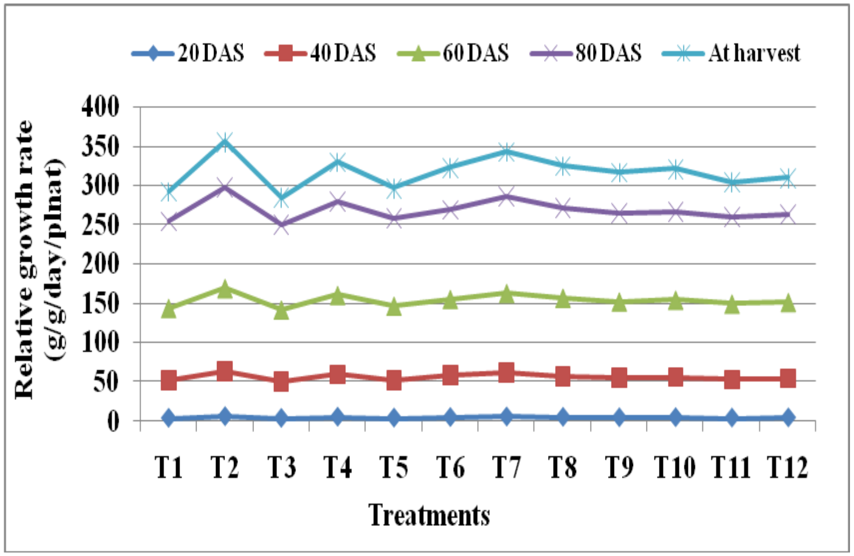

Figure.3 Effect of different INMP on Relative growth rate (g/g/day/plant) of sweet corn

The test weight was not significantly influenced by the different integrated nutrient management practices. Significantly higher green cob yield (187.7 q ha^{-1}) and grain yield (34.8 q ha^{-1}) were obtained with RDF + 10 t FYM ha^{-1} (T_2). Application of RDF + 5 t FYM ha^{-1} + 2% foliar spray of 18:18:18 N:P:K at 40 and 60 DAS (T_7) was produced comparable green cob yield and grain yield of sweet corn with application of RDF + 10 t FYM ha^{-1} (T_2). However, in case of grain yield RDF + 10 t Rice straw compost (*Trichoderma* based) ha^{-1} (T_4) was also found comparable yield with RDF + 10 t FYM ha^{-1} (T_2), the same pattern was found with green fodder yield. Considerable variation in green herbage yield with RDF + 10 t FYM ha^{-1} (T_2) might be attributed due to the improvement in overall growth and development of plants by application of proper nutrition and FYM finally led to higher green fodder yield. This enabled the plant to draw more nutrients from soil for proper growth and development. The harvest index values in sweet corn influenced significantly due to different integrated nutrient management practices. The maximum value of harvest index (36.3%) was achieved in RDF + 10 t FYM ha^{-1} (T_2) which was found at par with RDF + 5 t FYM ha^{-1} + 2% foliar spray of 18:18:18 N:P:K at 40 and 60 DAS (T_7), RDF + 5 t FYM ha^{-1} + 2% foliar spray of DAP at 40 and 60 DAS (T_8) and RDF + 10 t Rice straw compost (*Trichoderma* based) ha^{-1} (T_4).The results fall in the report of Srinivasan, 1992, Mishra *et al.*, 1994 and Ramamurthy and Shivashankar (1996).

Effect on economics

Data related with economics was computed and embodied in Table 2. The cost of cultivation of sweet corn varied from Rs. 37,971.5 to Rs. 47091.5 ha^{-1} owing to the use different integrated nutrient management practices. The application of RDF + 10 t FYM ha^{-1} (T_2) gave maximum net return (Rs. 152,646.5). This was followed by treatment RDF + 5 t FYM ha^{-1} + 2% foliar spray of 18:18:18 N:P:K at 40 and 60 DAS (T_7) and RDF + 5 t Rice straw compost (*Trichoderma* based) ha^{-1} (T_3). The highest B:C ratio was recorded under treatment RDF + 5 t FYM ha^{-1} + 2% foliar spray of 18:18:18 N:P:K at 40 and 60 DAS (T_7) followed by RDF + 10 t FYM ha^{-1} (T_2) and RDF + 10 t Rice straw compost (*Trichoderma* based) ha^{-1} (T_4).

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