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Influence of integrated plant nutrient supply on growth, productivity and quality of baby corn (*Zea mays*) in Indo-Gangetic plains

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ABSTRACT

A field experiment was conducted during 2004 and 2005 on sandy clay-loam soil of university research farm, Kalyani, on baby corn (*Zea mays* L.). Combined application of organic sources of nutrients, viz. neem seed powder @ 1.5 tonnes/ha or *karanj*-cake L. @ 1.25 tonnes/ha, farmyard manure @ 7.5 tonnes/ha, commercial formulation of pelleted form of organic manures @ 0.75 tonnes/ha and organic manure rich with humus @ 1.8 tonnes/ha along with 75% recommended dose of NPK fertilizer (RDF), were effective in increasing the standard corn yield by 6.20%–40.53% over the control (100% RDF). The biomax (pelleted form of organic manure) proved most effective in increasing the dehusked corn yield (30.32%) and standard yield (40.53%) over the control. Application of organics along with chemical fertilizer improved the yield attributes, quality parameter of protein content of corn over the control. Judicious application of organic manure along with inorganic fertilizer improved fertility status of the soil (N, P, K and organic C). The maximum net return, benefit : cost ratio and removal of nutrient by baby corn (67.68, 13.88 and 90.02 kg/ha of N, P and K respectively) was obtained when the crop management was done with 75% RDF + pelleted form of organic manure.

Key words : Baby corn, Integrated plant nutrient supply system, Growth, Yield, Protein, Uptake, Fertility and Economics

For diversification and value-addition of maize as well as the growth of the food-processing industry, growing maize for vegetable purpose 'baby corn' is comtemplated. A baby corn is dehusked maize ear, harvested within 2–3 days of silking, i.e. prior to fertilization. For obtaining maximum yield, baby corn requires 200 kg N/ha (Thakur, 2000). However, phosphorus and potassium requirements remain at 60–70 kg P and 40–50 kg K/ha. As the product is freshly consumed, the quality of the corn is considered to be the most important. It is well established that the improvement of quality (viz. protein content) and productivity in cereals could be made possible with combined application of organic manure and balanced chemical fertilizer. Hence present investigation was carried out to find out a suitable integrated plant nutrient supply system in baby corn.

MATERIALS AND METHODS

A field experiment was conducted on integrated plant nutrient supply system in baby corn during 2004 and 2005 at the university research farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal (23.5°N, 89°E, and 9.15 m above mean sea level). The soil was sandy clay loam, having pH 7.2 (soil: solution ratio 1: 2.5), organic carbon 0.58%, total Kjeldahl N 0.058%, 15.95 kg/ha available P, and 130.79 kg/ha available K.

The treatments comprised 8 integrated plants nutrient application system, viz. T_1, 100% recommended dose of fertilizer (RDF) (control); T_2, 75% RDF; T_3, 75% of RDF + rest of nitrogen by addition of pelleted form of organic manure [through 0.75 tonne/ha Biomax commercial formulation (cf)] T_4, 75% of the RDF + rest of the nitrogen by addition of organic manure rich with humus (through 1.8 tonnes/ha biomass c.f.); T_5, 75% of the RDF + rest of nitrogen by addition of *karanj* (*Pongamia pinnata*) cake (through 1.25 tonnes/ha Enmite c.f.); T_6, 75% of the RDF + rest of nitrogen by addition of neem seed powder (through 1.5 tonnes/ha Neematex); T_7, 75% of the RDF + rest of nitrogen by addition of FYM (7.5 tonnes/ha); T_8, 75% of the RDF + incorporation of crop residues @ 7.14 tonnes/ha after harvesting of previous crop. The experiment was laid out in randomized block design with 3 replications. The commercial formulation of pelleted form of organic manure (Biomax), manure rich with humus (Biomas), *karanj* cake (Enmite) and neem seed powder (Neematex) contain 5: 2: 1, 2 : 4 : 1, 3 : 2 : 1.25, and 2.5 : 1 : 1 per cent N : P_2O_5 : K_2O respectively. However, the nutrient content in farmyard manure and crop residues

were 0.5 : 0.2 : 0.5 and 0.525 : 0.198: 0.190 per cent N : P_2O_5 : K_2O respectively.

The recommended dose of fertilizer (RDF) for baby corn is 150, 60 and 40 kg N, P_2O_5 and K_2O/ha respectively (Thakur, 2000). The baby corn was sown in rows of 40 cm apart using 40 kg/ha seed rate in last week of June during both the years. The manures along with whole of potassium, phosphorus and one-third nitrogen were applied at the time of sowing. Remaining nitrogen was applied in 2 equal splits, at knee high stage (25-30 days after sowing) and second at pre-teaseling stage (45-50 DAS). Crop was thinned 7 days after emergence and final plant population was maintained at 1,25,000 plants/ha by keeping plant distance 20 cm. The earthing up was done 25 days after sowing. Young baby cobs were carefully handpicked within 2–3 days of silk emergence from the leaf sheath and 7–8 pickings were done. Thereafter freshly harvested green cobs were dehusked and baby corn yield was recorded. Ten baby corns, representing the bulk yield from each replication, were chosen at random for recording the weight of baby corn. After measuring the plant height 65 days after sowing, the crop was harvested and green fodder yield was measured. Standard yield of baby corn referred to those corn which were straight, having 7–10 cm length and 1–1.5 cm diameter, mostly preferred for industrial purpose (Mondal *et al.* 2006). For nutrient uptake, composites samples (plant and cob) for all replications were used for analysis. Results were pooled over 2 years. The soil was analysed at the initial stage and after the second year of baby corn harvest to monitor the change in nutrient status from initial values. Economic return was calculated on present market price of yield and inputs.

RESULTS AND DISCUSSION

Growth attributes and yield components

Plant height varied significantly due to the different treatments (Table 1). The tallest plant was recorded with the application of pelleted form of organic matter (Biomax) along with 75% RDF (T_3). Better response was also observed in treatments receiving neem seed powder (T_6) and FYM (T_7) along with 75% RDF compared to 100% RDF (T_1). The increase in plant height was attributed to availability of energy sources for prolonged time from integrated sources of nutrient. On the other hand, lowest plant height was recorded in treatment T_2, i.e. reduced rate of the RDF (i.e. 75% RDF) application. The highest percentage of barrenness (13.2%) was recorded under 75% RDF, which resulted in the production of the lowest number of baby corn/plant (1.98). The results confirm the findings of Pandey *et al.* (2000).

The highest fresh weight of individual green cob and baby corn weight was recorded with the application of pelleted form of organic manure along with 75% of the RDF. Significant increase in baby corn/plant, weight of green cob and baby corn were also found owing to increase in supply of nutrient in more synchroize way at the treatments receiving integrated supply of nutrient from organic manure along with inorganic fertilizer. Among the different organic sources, pelleted form of organic manure performed better because of continuous availability plant nutrients and less nutrient losses. All yield attributes were also recorded significantly higher under 100% RDF compared with 75% RDF.

Productivity

Significantly highest yield of baby corn (i.e. with husk,

Table 1. Growth and yield attributes of baby corn as influenced by integrated plant nutrient supply system (pooled data of 2 years)

Treatment	Plant height (cm)	Green cob weight (g)	Baby corn weight (g)	Barrenness (%)	Baby corn/ plant	Yield (tonnes/ha)				Protein content (g/100 g edible portion)
						With husk	Without	Standard yield	Green fodder	
T_1: 100% RDF	219.5	19.20	4.8	11.70	2.10	5.46	1.24	1.09	33.7	1.88
T_2: 75% RDF	212.7	17.55	4.5	13.20	1.98	4.83	1.10	0.98	30.9	1.82
T_3: 75% RDF + pelleted form of organic manure (Biomax)	235.6	25.44	5.3	7.60	2.34	8.01	1.61	1.54	38.8	1.95
T_4: 75% RDF + organic manure rich with humus (Biomas)	225.0	22.13	4.8	9.80	2.20	6.53	1.35	1.24	35.0	1.91
T_5: 75% RDF + *karanj* cake (Enmite)	224.1	22.83	4.9	9.50	2.21	6.76	1.38	1.28	35.4	1.92
T_6: 75% RDF + neem seed powder (Neematex)	230.7	24.17	5.1	8.12	2.25	7.51	1.50	1.40	37.6	1.93
T_7: 75% RDF + farm yard manure	232.1	23.97	5.1	8.03	2.27	7.45	1.49	1.38	37.0	1.93
T_8: 75% RDF + crop residue	220.4	21.94	4.8	10.20	2.12	6.08	1.29	1.16	34.0	1.91
CD (P=0.05)	6.4	1.30	0.1	1.20	0.06	0.33	0.10	0.09	0.8	0.03

without husk and standard yield) was recorded in the treatment receiving pelleted form of organic matter (Biomax) along with 75% of the RDF (T_3) compared with the control (100% RDF). This indicates that baby corn responds well to integrated nutrient management, specially pelleted form of organic manure which might be owing to the favourable soil condition and synchronize release of plant nutrients throughout the crop-growth period. Higher baby corn yields were also recorded under treatments receiving 75% of the RDF along with either neem seed powder (T_6) or FYM (T_7) compared with the yield obtained under the control treatment (100% REF), which was also at par with each other (T_6) and (T_7). The 100% RDF resulted in higher baby corn yield than 75% RDF. Kataraki *et al.* (2004) also reported similar findings in respect of yield increase because of combined organic and inorganic sources in maize. Green fodder yield also showed the same trend. Maximum conversion percentage of standard baby corn yield from without husk yield was 95.4 under treatment receiving 75% RDF + pelleted form of organic matter. The lowest conversion of 87.0% was obtained with treatment receiving reduced rate of RDF (i.e. 75% RDF).

Protein content

The protein content of baby corn differed significantly with different fertilizer treatments (Table 1). The highest protein (1.95 g/100 g edible portion) was recorded under treatment T_3 where baby corn was fertilized with 75% RDF along with pelleted form of organic manure (Biomax). The lowest content of protein was observed from the treatment receiving reduced rate of inorganic fertilizer only (75% RDF). Hemlatha *et al.* (2001) reported improvement in quality of cereals owing to integrated nutrient management.

Nutrient uptake

Significantly difference for N, P and K uptake (Table 2) by the crop was recorded with different nutrient management treatments. The uptake of N, P and K by baby corn increased when 25% of RDF was substituted by organic manure. The maximum uptake of N, P and K/ha by the crop was recorded under the treatment receiving 75% RDF + pelleted form of organic manure. The lowest uptake of nutrient by the crop was obtained when the crop was fertilized with 75% RDF.

Soil fertility

After completion of 2 crops in successive year, soil was analysed to study the effect of integrated nutrient supply system on fertility status (Table 2). An increase of 26 kg N/ha was recorded with the addition of 75% RDF +

Table 2. Effect of integrated plant nutrient supply system, nitrogen, phosphorus and potassium uptake by plant, soil-fertility status after 2 years of cropping and economic analysis of baby corn (pooled data of 2 years)

Treatment	Nutrient uptake (kg/ha)			Soil-fertility status (kg/ha)				Net returns (Rs/ha)	Benefit : cost ratio
	N	P	K	N	P_2O_5	K_2O	Org. C (%)		
T_1: 100% RDF	50.04	9.40	74.18	1262 (-37)	14.00 (-1.95)	128.41 (-2.38)	0.52	43,310	2.60
T_2: 75% RDF	42.91	7.45	64.89	1233 (-66)	12.10 (-3.86	123.20 (-3.86)	0.46	38,166	2.46
T_3: 75% RDF + pelleted manure (Biomax)	67.28	13.88	90.02	1326 (+27)	17.92 (+1.97)	133.04 (+2.25)	0.62	58,226	3.23
T_4: 75% RDF + organic manure (Biomas)	61.00	9.97	76.80	1304 (+5)	18.40 (+5.45)	134.00 (+3.21)	0.59	46,100	2.50
T_5: 75% RDF + *karanj* cake (Enmite)	61.80	10.29	77.35	1306 (+7)	17.40 (+1.45)	133.96 (+3.17)	0.60	47,015	2.50
T_6: 75% RDF + neem seed powder (Neematex)	65.20	12.20	84.43	1312 (+13)	17.07 (+1.12)	133.81 (3.02)	0.60	48,984	2.64
T_7: 75% RDF + farmyard manure	64.70	11.74	82.10	1308 (+9)	17.13 (+1.18)	134.72 (+7.93)	0.63	53,896	3.19
T_8: 75% RDF + crop residues	60.56	9.80	76.00	1301 (+2)	16.46 (+0.51)	132.88 (+2.09)	0.65	44,653	2.58
CD (P=0.05)	2.40	1.26	4.42	18.50	1.20	4.56			

+and – indicate the increase or decrease of soil-nutrient content over initial value

pelleted form of organic manure. Maximum increase in available P (34.17%) was recorded with the treatment receiving 75% RDF + organic manure rich with humus. However, the increase in available K was maximum (5.72%) under the treatment receiving 75% RDF + FYM. Organic C content after the harvesting of crop in second year was improved due to application of any sources of organic manure (crop residues or pelleted form of organic manure or *karanj* cake or neem seed powder or organic manure rich with humus) along with 75% RDF. The highest value for organic C was obtained under the treatment receiving 75% RDF + crop residue. The application of pelleted form of organic manure along with 75% RDF recorded the highest increase in N (2.07%), moderate increase in P (12.35%) and K (1.72%) over the initial value. Kataraki *et al.* (2004) also reported the same pattern of soil-fertility status in maize under irrigated condition.

Economics

The mean values of 2 years revealed that net returns and benefit : cost ratio of baby corn increased with application of 75% RDF along with each of pelleted form of organic manure (T_3), neem seed powder (T_6) and FYM (T_7) over 100% RDF. Additional cost of this organic manure was compensated by the additional yield of baby corn and 25% substitution of RDF. The maximum net returns and benefit : cost ratio were found under 75% RDF + pelleted form of organic manure, which was very much similar to the treatment receiving 75% RDF + FYM.

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