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Influence of Integrated Nutrient Management on Yield, Uptake, Soil Fertility Status and Economics of Baby Corn (*Zea mays* L.)

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Abstract A field experiment was conducted for two consecutive *kharif* seasons of 2012 and 2013, to study the effect of integrated nutrient management on baby corn. Application of 75% RDF + vermicompost @ 2.5 t/ha + mixed bio-fertilizers recorded the highest yield of baby corn (1.50 t/ha) along with maximum N, P, K uptake. However, the post harvest soil fertility status was improved with 75% RDF + FYM @ 5 t/ha + mixed bio-fertilizers. Application of 40 kg S/ha + 5 kg Zn/ha + 2.5 kg B/ha has resulted in significant increase in yield of baby corn (1.54 t/ha), N, P, K uptake and improved soil fertility status. The highest net return (Rs 77921/ha) and B : C ratio of 3.07 were registered in 75% RDF + vermicompost @ 2.5 t/ha + mixed bio-fertilizers. Application of 40 kg S/ha + 5 kg Zn/ha + 2.5 kg B/ha resulted in highest net return (Rs 81217/ha) with B : C ratio of 3.13.

Keywords Integrated nutrient management, Baby corn, NPK uptake, Economics, Yield.

Introduction

Baby corn (*Zea mays* L.) cultivation is a recent development in India. It was Thailand in the 1970's that first seriously started cultivating this crop for export. Later other countries like Guatemala, Zambia, Zimbabawe and South Africa started cultivation. Today Thailand and China are the world leaders in baby corn production. Baby corn cultivation is a recent development in India. It is becoming popular among the city elite and the processing industry [1]. This crop has been developed into a multi dollar business in foreign countries (Thailand, Taiwan, Singapore, Malaysia, USA, Canada and Germany) because of its potential as a value added product for export and a good food substitute. It is a small young corn ear harvested at the stage of silk emergence. Young cob corn has been used by Chinese as vegetable for generations and this practice has spread to other Asian countries. It is used as ingredient in most food prepa-

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rations. Application of chemical fertilizer may assist in obtaining maximum production of baby corn but keeping in mind that chemical fertilizer may lead to hazardous effect on environmental quality, besides increasing production cost due to its expensiveness. As such, the judicious use of nutrients from different organic and inorganic sources on baby corn will maintain sustainability in food production for generations without affecting the environmental health [2]. However, integrated nutrient management (INM) is a judicious amalgamation of fertilizers or manures from different sources in order to maintain the environmental sustainability. The adoption of INM practices on the field will reduce the production cost thereby increasing the economics of the farmers. Hence, present investigation was carried out to find out a suitable integrated nitrogen management in baby corn.

Materials and Methods

The field experiment was conducted at Agronomy Main Research farm of Orissa University of Agriculture and Technology, Bhubaneswar, Odisha during *kharif*, 2012 and 2013. The soil was sandy loam in texture, acidic in reaction, and low in organic carbon, available N, K, S, Zn, B and medium in available P. The experiment was carried out adopting factorial randomized block design with three replications and twenty treatments combination consisting of four fertility levels and five secondary and micronutrient levels. The fertility levels were (120 kg N, 60 kg P_2O_5 and 60 kg K_2O/ha), 75% RDF + farm yard manure (FYM) @ 5 t/ha + mixed bio-fertilizers (*Azotobacter* in combination with *Azospirillum* and PSM), 75% RDF + vermicompost @ 2.5 t/ha + mixed bio-fertilizers and 75% RDF + green manuring with sunhemp + mixed biofertilizers. The five levels of secondary and micronutrients were no nutrient, 5 kg Zn/ha, 40 kg S/ha, 40 kg S/ha + 5 kg Zn/ha and 40 kg S/ha + 5 kg Zn/ha + 2.5 kg B/ha. The plant geometry was maintained at 40 cm × 20 cm spacing in each experimental plot. The baby corn variety VL baby corn-1 was the test variety. Well decomposed FYM, vermicompost was applied at the time of land preparation. Sunhemp was grown as a green manure crop before baby corn crop. Full dose of phosphorus, potassium, sulfur, zinc, boron and half of nitrogen was applied as basal dose while remaining nitrogen was applied in two equal split applications at knee high stage and pre-tasseling stage. The source of N, P, K, Zn, S and B were urea, diammonium phosphate, muriate of potash, maha zinc, granular sulfur, and borax, respectively. The baby corn was sown on 10th July, 2012 and 13th July, 2013. The crop was raised with all cultural operations as per the recommended package of practices. The biometric observations on crop growth parameters were taken from ten randomly selected plants. The baby corn yield and green fodder yield were recorded from each plot.

Results and Discussion

Yield

Perusal of data (Table 1) revealed that integrated use of 75% RDF + organic manure in the form of vermicompost @ 2.5 t/ha mixed with bio fertilizers (*Azotobacter, Azospirillum* and PSB) increased the yield of baby corn (1.50 t/ha). It was in agreement with the findings of Rasool et al. [3]. The favorable effect of integrated nutrient supply resulted in enhancement of baby corn yield. Baby corn yield was boosted with use of INM due to its favorable effect in increase in crop growth. The combined effect of inorganic nutrient, organic manure (vermicompost) mixed with bio fertilizers had synergistic effect in availability of nutrient in soluble form throughout the growing period. However, enhancement of yield might be due to the effective utilization of applied nutrients which increased sink capacity and higher nutrient uptake by crop. The combined application of 40 kg S/ha + 5 kg Zn/ha + 2.5 kg B/ha recorded the highest baby corn yield (1.54 t/ha). The increased yield attributes due to sulfur and zinc nutrition resulted in chlorophyll formation which had positive effect on photosynthesis, translocation of metabolites and growth regulating substances, oxidation and metabolic activities, there by augmented the yield attributes and yield through promotion of crop growth. The favorable effect of applied S, Zn and B had positive influence on physiological and metabolic process of plant which ultimately augmented baby corn yield. This result was in pipeline with earlier work done by Kumar and Bhora [4].

Table 1. Influence of integrated nutrient management on yield, nutrient uptake, soil fertility status and economics of baby corn (pooled data of two years).

Treatments	Yield (t/ha)	Uptake (kg/ha) N	P	K	Organic carbon (%)	Soil fertility status (kg/ha) N	P_2O_5	K_2O	Net return	Benefit: cost ratio
Fertility levels										
F_1–RDF (120:60:60 N:P_2O_5:K_2O) (kg/ha)	1.44	84.40	13.22	85.54	0.48	144.15	20.44	118.24	76259	3.14
F_2–75% RDF + 5 t FYM/ha+Azs+Azb+PSB	1.48	85.29	13.50	87.72	0.53	153.6	23.72	137.21	77331	3.11
F_3–75% RDF + 2.5 t VC/ha+Azs+Azb+PSB	1.50	87.73	14.35	89.89	0.52	151.9	22.83	135.76	77921	3.07
F_4–75% RDF + GM (Sunhemp)+Azs+Azb+PSB	1.32	77.87	12.26	82.00	0.52	148.3	22.60	132.27	68781	2.94
SEm±	0.02	0.85	0.17	0.73	0.004	0.39	0.70	1.19	1432	0.04
CD (p=0.05)	0.07	2.53	0.50	2.16	0.01	1.16	2.0	3.51	4238	0.12
Secondary and Micronutrient levels										
M_0 (No nutrient)	1.24	74.55	11.87	80.19	0.49	144.81	21.14	128.31	64860	2.88
M_1–5 kg Zn/ha	1.42	80.03	12.92	85.62	0.50	147.12	21.72	130.01	76309	3.15
M_2–40 kg S/ha	1.43	84.78	13.19	85.69	0.51	150.0	22.26	131.03	74015	3.04
M_3–40 kg S/ha+5 kg Zn/ha	1.52	88.86	14.06	89.36	0.52	152.0	22.98	132.65	78965	3.11
M_4–40 kg S/ha+5 kg Zn/ha + 2.5 kg B/ha	1.54	90.90	14.62	96.57	0.53	153.50	23.93	133.78	81217	3.13
SEm±	0.03	0.96	0.19	0.82	0.005	0.43	0.78	1.33	1601	0.04
CD (p=0.05)	0.08	2.83	0.56	2.42	0.02	1.29	NS	3.92	4738	0.14
Interaction (F×M)										
SEm±	0.05	1.91	0.38	1.63	0.06	0.62	1.10	1.87	3202	0.09
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Nutrient uptake

Integrated nutrient application of 75% RDF with organic manure like vermicompost @ 2.5 t/ha mixed with bio fertilizers recorded the highest nutrient uptake of N (87.73 kg/ha), P (14.35 kg/ha), K (89.89 kg/ha). It was followed by combined use of 75% RDF + 5 t FYM/ha + mixed bio fertilizers. This was possible due to increase in biological yield and nutrient content which enhanced the nutrient uptake. The better nutrient uptake might be due to built up of vigorous growth and photosynthetic rate as a result of combined application of organic and inorganic sources of nutrients along with bio fertilizers. Similar favorable effect of INM in increasing the nutrient uptake in baby corn was reported by Thavaprakash et al. [5].

During two years of experimentation (2012 and 2013), combined application of S @ 40 kg/ha + Zn @ 5 kg/ha + B @ 2.5 kg/ha resulted in the highest uptake of N (90.90 kg/ha), P (14.62 kg/ha), K (90.57 kg/ha). The second best result was obtained in conjugated use of 40 kg S/ha + 5 kg Zn/ha. Increase in nutrient uptake may be due to better nutrition resulting in increase in growth and yield. The positive response of micronutrient application in increasing the nutrient removal by baby corn was reported by Ashoka et al. [6].

Soil fertility status

The use of different integrated nutrient management practices in baby corn-green gram sequence remark-

ably improved the soil fertility. Conjunctive use of 75% RDF + 5 t FYM/ha + mixed bio fertilizers increased the soil organic carbon (0.53%), N (153.6 kg/ha), P (23.72 kg/ha), K (137.21 kg/ha). It was closely followed by 75% RDF + 2.5 t vermicompost/ha + mixed bio fertilizers in enhancing the soil fertility after two years of experimentation. Increase in organic carbon was possible due to use of organic manure like vermicompost or FYM as they slowly build up of organic carbon and N status of soil. The addition of organic manure or green manuring with sunhemp resulted in formation of humic acid that stimulated the activity of micro organism thus increased the organic content. It was in agreement with the findings of Bajpai et al. [7]. The continuous use of organic manure with mixed bio fertilizers had beneficial effect in maintenance and build up of available nutrient in soil. It corroborated with the findings of Prasad et al. [8]. Application of organic source of nutrient helped slowly in building up of N, P, K, S, Zn and B of soil as organic matter served as the store house of nutrients. The judicious application of secondary nutrient S @ 40 kg/ha with combination of micronutrient of Zn @ 5 kg/ha and B @ 2.5 kg/ha tended to build up soil fertility with respect to soil organic carbon (0.53%), N (153.5 kg/ha), P (23.93 kg/ha), K (133.78 kg/ha).

Economics

Objective is to obtain highest return from the efficient and integrated use of inorganic nutrients, manures and bio fertilizers. The highest nets return of Rs 77921/ha was obtained with conjunctive use of 75% RDF + 2.5 t vermicompost + mixed bio fertilizers. It was closely followed by 75% RDF + FYM @ 5 t/ha + mixed bio fertilizers. The B : C ratio was highest in RDF followed by 75% RDF + FYM @ 5 t/ha + mixed biofertilizers. Increase in baby corn with appreciable cost of cultivation registered the better return. Similar line of result was reported earlier by different workers Dadarwal et al. [9]. Application of 40 kg S/ha in combination with 5 kg Zn/ha + 2.5 kg B/ha registered the highest net return (Rs 81217/ha) and B : C ratio (3.13). The next best result was obtained with combination of 40 kg S/ha + 5 kg Zn/ha. The enhancement in economics of baby corn with integrated use of RDF + vermicompost and micronutrient was reported earlier by Ashoka et al. [6], Kumar and Bhora [4] also obtained the favorable effect of S + Zn in increasing the economics of baby corn.

Conclusion

The integrated application of 75% RDF + organic manure as vermicompost @ 2.5 t/ha + mixed bio-fertilizers (*Azotobacter* + *Azospirillum* + PSB) recorded the highest yield of baby corn (1.50 t/ha) along with maximum N (87.73 kg/ha), P (14.35 kg/ha), K (89.89 kg/ha) uptake. The post harvest soil fertility status was improved with 75% RDF + FYM @ 5 t/ha + mixed biofertilizers. Application of 40 kg S/ha + 5 kg Zn/ha + 2.5 kg B/ha has resulted in significant increase in yield of baby corn (1.54 t/ha), N (90.90 kg/ha), P (14.62 kg/ha), K (90.57 kg/ha) uptake and improved soil fertility status. The highest net return (Rs 77921/ha) and B:C ratio of 3.07 were registered in 75% RDF + vermicompost @ 2.5 t/ha + mixed bio-fertilizers. Application of 40 kg S/ha + 5 kg Zn/ha + 2.5 kg B/ha resulted in highest net return (Rs 81217/ha) with B:C ratio of 3.13.

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