

Effect of Integrated Nutrient Management(INM) on Growth and Yield of Baby Corn (*Zea mays* L.)

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Received 20 October 2017; Accepted 24 November 2017; Published on 12 December 2017

Abstract The experiment on Integrated nutrient management in baby corn and its residual effect in green gram in rainfed ecosystem of Odisha was carried out during *kharif* and *rabi* seasons of 2012 and 2013. The experiment was laid out in factorial randomized block design with three replications of each twenty treatment combinations consisting of four fertility levels and five secondary and micronutrient levels. The fertility levels were RDF (120 kg N, 60 kg P₂O₅ and 60 kg K₂O/ha), 75% RDF + FYM @ 5.0 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 bio fertilizers. 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. Integrated nutrient management exhibited significant effect on growth, yield attributes and yield of baby corn. Application of 75% RDF + vermicompost @ 2.5 t/ha + mixed bio-fertilizers recorded the highest plant height, number of leaves/plant, LAI, dry matter accumulation of baby corn at harvest along with yield baby corn (1.50 t/ha) and green forage (26.03 t/ha). Application of 40 kg S/ha + 5 kg Zn/ha + 2.5 kg B/ha has resulted in significant increase in yield components such as number of cobs/plant, length and girth of baby corn, baby corn weight along with yield of baby corn (1.54 t/ha) and green forage (26.17 t/ha).

Keywords Nutrient management, Baby corn, Organic manures, Sulfur, Zinc.

Introduction

Maize (*Zea mays* L) is the third most important cereal crop next to rice and wheat and has the highest production potential among the cereals. For diversification and value addition of maize as well as growth of food processing industries, recent development is of growing maize as baby corn. It is a small young corn harvested at the stage of silk emergence. Baby corn has been used by Chinese as vegetable for genera-

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tions and this practice has spread to other Asian countries. It is used as ingredient in most food preparations. It has nutritive value similar to that of non-legume vegetable such as cauliflower, tomato, cucumber and cabbage. This vegetable has a great potential for cooking purposes and for processing as a canned product. Canned corn export to Thailand, Japan and Europe is increasing and has a good future. Generally, maize farmers strive by improving yields and cutting costs of production, for instance, through shortening cultural risks by harvesting for either green corn or baby corn. Young cob corn has a short growth thus a farmer can grow four or more crop cycles per year. It has a wide range of adaptation and does not need intensive cultivation. Considering these factors, baby corn has good potentials. Baby corn production, being a recent development has proved an enormously successful venture in countries like Thailand and Taiwan. Attention is now being paid to explore its potential in India, for earning foreign exchange besides higher economic returns to the farmers. The agronomic requirement of baby corn is similar to grain maize except for a suitable variety, plant population density, higher doses of nitrogen and most importantly early harvesting. Yield and quality of baby corn are affected by cultural management applied to the maize plants especially fertilizer application. The different levels of nutrition of maize plants greatly affected the yield and quality. The recent energy crisis and hike in prices of the inorganic fertilizers necessitate the use of organic manures and bio-fertilizers in crop production. In this context an attempt was made to augment baby corn cultivation practice by incorporation of FYM, vermicompost and sunhemp as green manure along with sulfur, zinc and boron into the normal fertilizer input requirement. This study aims to evaluate the impact of integrated nutrient management on growth and yield of baby corn cultivation.

Materials and Methods

The present study was carried out during *kharif*, 2012 at Agronomy Main Research farm of Orissa University of Agriculture and Technology, Bhubaneswar, Odisha. The soil of the experimental block was sandy loam in texture, acidic in reaction, low in organic carbon, available N, K, S, Zn, B and medium in available

P. The experiment was laid out in factorial randomized block design with three replications of each twenty treatment combinations consisting of four fertility levels and five secondary and micronutrient levels. The fertility levels were RDF (120 kg N, 60 kg P₂O₅ and 60 kg K₂O/ha), 75% RDF + FYM @ 5.0 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 bio fertilizers. 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 VI 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 and K, Zn S and B were Urea, Diammonium phosphate, Muriate of potash, Zinc EDTA, Elemental sulfur, and Borax respectively. All the cultural operations were performed as per the package of practices of maize. Observations on morphological traits were recorded for ten randomly selected plants while baby corn yield and green fodder yield were recorded on plot basis.

Results and Discussion

Application of inorganic fertilizer in conjunction with organic manure (vermicompost and farm yard manure) and mixed bio fertilizers (*Azotobacter*, *Azospirillum* and PSB) influenced the crop growth. Highest plant height (174.2 cm) and number of leaves/plant (9.26) were recorded with 75% RDF + 2.5 t vermicompost mixed with bio fertilizers (*Azotobacter* + *Azospirillum* + Phosphorus solubilizing bacteria) (Table 1). Similar favorable effect of 75% RDF + vermicompost mixed with bio fertilizers (*Azotobacter* + *Azospirillum* + PSB) in increasing the plant height of baby corn was noticed by Dadarwal et al. [1]. The highest LAI, dry matter production was in same trend as that of plant

Table 1. Effect of integrated nutrient management on growth, yield attributes and yields of baby corn. RDF- Recommended dose of fertilizer, FYM- Farm yard manure, VC- Vermicompost, GM- Green manuring, Azs- *Azospirillum*, Azb- *Azotobacter*, PSB- Phosphorus solubilizing bacteria.

Treatments	Plant ht. (cm.)	No. of leaves	LAI	Dry matter (g/m ²)	No. of cobs/plant	Length of baby corn	Girth of baby corn	Wt. of baby corn	Yield (t/ha)	Green forage yield (t/ha)
Fertility levels										
F ₁ -RDF (120:60:60 N ₁ :P ₂ O ₅ :K ₂ O kg/ha)	173.1	9.17	4.00	657.63	2.76	9.17	4.84	8.23	1.44	25.59
F ₂ - 75% RDF + 5 t FYM/ha + Azs + Azb + PSB	171.6	9.24	4.07	689.20	2.79	9.24	4.89	8.27	1.48	25.65
F ₃ - 75% RDF + 2.5 t VC/ha + Azs + Azb + PSB	174.2	9.26	4.11	718.97	2.82	9.28	4.99	8.45	1.50	26.03
F ₄ - 75% RDF + GM (Sunhemp) + Azs + Azb + PSB	160.2	8.74	3.82	633.10	2.66	8.76	4.61	7.99	1.32	24.66
SEm ±	2.3	0.07	0.02	5.13	0.03	0.07	0.06	0.07	0.02	0.30
CD (p=0.05)	6.8	0.20	0.06	15.17	0.08	0.22	0.18	0.21	0.07	0.88
Secondary and micronutrient levels										
M ₀ (No nutrient)	166.2	8.72	3.89	636.85	2.50	8.68	4.63	7.82	1.24	24.65
M ₁ - 5 kg Zn/ha	169.3	9.06	3.97	677.61	2.79	9.17	4.88	8.18	1.42	25.64
M ₂ - 40 kg S/ha	166.1	8.94	3.90	669.81	2.73	9.16	4.77	8.15	1.43	25.13
M ₃ - 40 kg S/ha+5 kg Zn/ha	174.0	9.33	4.02	690.25	2.88	9.23	4.87	8.51	1.52	25.83
M ₄ - 40 kg S/ha+5 kg Zn/ha+ 2.5 kg B/ha	173.3	9.48	4.21	699.11	2.88	9.32	5.01	8.53	1.54	26.17
SEm ±	2.6	0.08	0.02	5.73	0.03	0.08	0.07	0.08	0.03	0.33
CD (p=0.05)	NS	0.22	0.07	16.96	0.09	0.24	0.20	0.23	0.08	0.99
Interaction (F × M)										
SEm ±	5.2	0.15	0.05	11.46	0.06	0.16	0.13	0.16	0.05	6.71
CD (p=0.05)	NS	NS	0.14	NS	NS	NS	NS	NS	NS	NS

height and number of leaves/plant. The LAI (4.11) and dry matter production (718.97 g/m²) were observed with 75% RDF + 2.5 t vermicompost/ha mixed with bio fertilizers. The higher plant height and large number of leaves/plant favored higher canopy development under integrated nutrient management. It might have increased the light interception, absorption and utilization of solar radiation thus enhancing photosynthesis which was reflected in LAI and dry matter production. The reason for superior crop growth is due to synergistic effect of integration of inorganic fertilizers, organic manure and bio fertilizers that resulted in increased availability and absorption of nutrients through production of growth promoting substances and solubilization of nutrient by combined use of vermicompost mixed with bio fertilizers (*Azotobacter*, *Azospirillum* and PSB). It is in conformity with findings of several research workers

like Thavaprakash and Velayudham [2] and Rasool et al. [3]. The integration of green manuring (sun hemp) with inorganic and bio fertilizers had no significant effect on crop growth which might be due to slow release of nutrients by decomposition of green manure biomass in short duration crop cycle of baby corn.

Application of secondary nutrient as sulfur combined with micronutrients (zinc and boron) increased the plant height and number of leaves/plant. The highest plant height was recorded with combined use of 40 kg S/ha + 5 kg Zn/ha (174 cm) but highest number of leaves/plant (9.48) was recorded with 40 kg S/ha + 5 kg Zn/ha + 2.5 kg B/ha. Crop growth in terms of LAI and dry matter/m² was in similar trend as that of number of leaves/plant. The highest LAI and dry matter accumulation in 40 kg S/ha + 5 kg Zn/ha + 2.5 kg B/ha

were 4.21, 699.11 g/m² and 26.71 g/m²/day. Sulfur as a constituent of succinyl coenzyme helps in chlorophyll formation which enhances meristematic activities promoting apical growth, plant height, leaf area and bio mass production. The profound increase in growth parameters was due to presence of zinc in auxin metabolism that leads to higher hormonal activity and growth performance. Zinc was also involved in synthesis of tryptophan needed for production of growth hormones like auxin and indole acetic acid which promotes enzyme activation and cell membrane integrity as reported by Havlin et al. [4]. The boron had role in plant cell wall structure integrity and transport of water and nutrient and organic compounds, new growth and cell wall stability. Application of sulfur, zinc and boron exerted the positive influence on all growth parameters of baby corn because soil of the experimental site was below the critical level. Application of sulfur with micronutrient Zn and B in deficient soil improved their availability and also uptake of other nutrients, there by promoted growth and development. Similar favorable effect of Zinc and sulfur + Zinc was noticed in baby corn by Kumar and Bohra [5].

The combined application of 75% RDF + organic manure as vermicompost @ 2.5 t/ha mixed with bio fertilizers remarkably augmented the yield attributes like number of cobs/plant (2.82), length of baby corn (9.28 cm), girth of baby corn (4.99 cm) and baby corn weight (8.45 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. Moreover, 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.

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) and green forage (26.03 t/ha). The favorable effect of integrated nutrient supply in improving the yield components of baby corn resulted in enhancement of baby corn yield. Green cob yield was boosted with use of INM

due to its favorable effect in increasing 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 thus increased sink capacity and higher nutrient uptake by crop.

The yield attributes of baby corn such as number of cobs/plant (2.88), length of baby corn (9.32 cm), girth of baby corn (5.01 cm) and baby corn weight (8.53 g) were highest with application of 40 kg S/ha + 5 kg Zn/ha + 2.5 kg B/ha followed by 40 kg S/ha + 5 kg Zn/ha. 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) and green fodder yield of 26.17 t/ha. It was followed by application of S @ 40 kg/ha + Zn @ 2.5 kg/ha having the baby corn yield of 1.52 t/ha and green forage yield of 25.83 t/ha. The improvement in yield attributes due to application of sulfur and micronutrient like Zn and B might be due to its favorable effect in increasing crop growth and better utilization and partitioning of food material which ultimately reflected in baby corn and green forage yield. This result was in pipeline with earlier work done by Kumar and Bhora [5].

Conclusion

The integrated application of 75% RDF + organic manure as vermicompost @ 2.5 t/ha + mixed bio-fertilizers (*Azotobacter* + *Azospirillum* + PSB) remarkably increased the crop growth, yield components and yield of baby corn (1.50 t/ha) and green forage (26.03 t/ha) yield in maize. It remained at par with integration of 75% RDF + FYM @ 5 t/ha + mixed bio-fertilizer with respect to growth, yield attributes, baby corn yield (1.48 t/ha) and green forage yield (25.65 t/ha). The combined use of sulfur @ 40 kg/ha with micro nutrients, zinc @ 5.0 kg/ha + boron @ 2.5 kg/ha significantly influenced the crop growth, yield components and yield of baby corn (1.54 t/ha) and baby corn green forage yield (26.17 t/ha).

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