Mysore J. Agric. Sci., 55 (4) : 262-267 (2021)

Quality, Yield and Economics of Baby Corn as Influenced by Organic Nutrient Management

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ABSTRACT

After the green revolution, the application of chemical fertilizers increased in order to get maximum yield from crop plants, but it resulted in significant negative impact on the environment as well as human and animal health. New practices and methods are very much necessary to increase the yield while maintaining or preserving the environmental health. In this view, a field experiment was conducted at University of Agricultural Sciences, Bangalore, during *kharif,* 2016 on 'quality and economics of baby corn as influenced by organic nutrient management'. The experiment was laid out in a RCBD with seven treatments replicated thrice. Application of FYM at 50 kg N eq. ha^{-1} + vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS recorded significantly higher quality parameters like total soluble solids (11.13 ºBrix), moisture (87.23%) crude protein (13.05%) and crude fibre (5.46%). The same treatment also recorded significantly higher baby corn yield (18.05 t ha^{-1}).

Keywords : Organic baby corn, Quality, Panchagavya, Vermiwash

BABY corn is an excellent source of sugars, dietary fibre, vitamin-C, beta-carotene, niacin, in addition to calcium and potassium. Baby corn is not genetically dwarf maize as the name implies but it's the immature ear of normally grown maize. Unlike mature maize whose ear are too hard but the whole of baby corn ear are consumed by human being as a source of vegetable. One hundred grams of baby corn are found to be rich in 89.1 per cent moisture, 1.9 g protein, 0.2 g fat, 0.06 g ash, 8.2 mg carbohydrate, 28 mg calcium, 86 mg phosphorus and 11 mg ascorbic acid (Thavaprakash *et al*., 2005).

Although the application of chemical fertilizers helps in getting maximum yield but their hazardous effect on environment as well as high cost production cost. The judicious use of fertilizers from different source on crop will maintain the environmental sustainability for generations (Ranjan *et al.,* 2013; Dadarwal *et al*., 2009 and Kumar *et al*., 2014). Adoption of organic nutrient management will cut down the cost of cultivation thereby increasing the economic stability of farmers by fetching better price in the market. Besides nutritive advantage, it is also free from residual effect of pesticides as it is harvested within a week of tassel emergence and the young cob is wrapped up tightly with husk and well protected from insects and pests (Kumar *et al.,* 2014).

MATERIAL AND METHODS

A field experiment was conducted at the Zonal Agricultural Research Station, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka during *kharif* 2016. The soil of the experimental site was sandy clay loam. The experiment was laid out in a randomized complete block design (RCBD) with seven treatments replicated thrice.

Treatments

T_1 : Vermicompost at 75 kg N eq. ha^{-1} + EBDLM at 75 kg N eq. ha^{-1}

T_2 : FYM at 75 kg N eq. ha^{-1} + Vermicompost at 75 kg N eq. ha^{-1}

T_3 : FYM at 50 kg N eq. ha^{-1} + Vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1}

T_4 : Vermicompost at 75 kg N eq. ha^{-1} + EBDLM at 75 kg N eq. ha^{-1} + Panchagavya (3%) at 15 and 45 DAS + Vermiwash (3%) at 30 DAS

T_5 : FYM at 75 kg N eq. ha^{-1} + Vermicompost at 75 kg N eq. ha^{-1} + Panchagavya (3%) at 15 and 45 DAS + Vermiwash (3%) at 30 DAS

T_6 : FYM at 50 kg N eq. ha^{-1} + Vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + Panchagavya (3%) at 15 and 45 DAS + Vermiwash (3%) at 30 DAS

T_7 : FYM at 10t ha^{-1} + 150:75:40 kg NPK ha^{-1}

Note : FYM : Farmyard manure; EBDLM: Enriched biodigested liquid manure; DAS : Days after sowing, eq: Equivalent

Methods adopted for analyzing the nutritional quality of baby corn are given in Table 1.

TABLE 1

Methods adopted for analyzing the nutritional quality of baby corn

Particulars	Methodology	Reference
Crude protein content (%)	Modified Micro - Kjeldahl method (Protein content = % N x 6.25)	Piper (1966)
Crude fibre content (%)	Volumetric method	Piper (1966)
Total soluble solids (°Brix) method	Hand refractometer	Shobha *et al.* (2010)
Moisture (%)	Hot air oven method	Ranganna (1986)

Sensory Evaluation

Consumer acceptability of any food depends on its organoleptic appeal, storage quality and also nutritional qualities. Hence, baby corn was evaluated for these quality attributes using nine point descriptive scale by a panel of nine semi-trained judges from the Department of Food and Nutrition, Department of Agronomy, GKVK, Bengaluru. The parameters of evaluation were colour, appearance, texture, consistency, taste, aroma and overall acceptability.

Shelf Life of Baby Corn

The cobs were harvested at three day after silking (optimum stage of harvesting) and kept at room temperature to test the shelf life of baby corn. The physiological loss in weight and spoilage were recorded at 72 hours interval for one week as per the procedure outlined by Sudha Vani and Ravi Kumar (2014).

Economic Analysis

Cost of Cultivation (Rs.ha^{-1}) : While computing the cost of cultivation, different variable cost items were considered. The cost of cultivation includes cost on land preparation, seed, organic manures, chemical fertilizers, plant protection chemicals and labour charges at prevailing market prices during 2016. The prices of different organic manures used in the experiment were *viz*., FYM (Rs.800 t^{-1}), enriched biodigested liquid (Rs.0.36 l^{-1}) and vermicompost (Rs.3270 t^{-1}).

Returns (Rs.ha^{-1}) : Gross returns, net returns and B:C ratio were calculated using the following formulae:

$$\text{Gross returns} = \begin{matrix}(\text{Baby corn yield } ha^{-1} \times \text{Market price}) \\ + (\text{Stover yield } ha^{-1} \times \text{Market price})\end{matrix}$$

$$\text{Net returns} = \text{Gross returns - Cost of cultivation}$$

$$\text{Benefit cost ratio} = \frac{\text{Gross returns (Rs. } ha^{-1})}{\text{Cost of cultivation (Rs. } ha^{-1})}$$

RESULTS AND DISCUSSION

Nutritional Quality Parameters of Baby Corn

The data pertaining to total soluble solids, moisture, crude protein and crude fibre contents in baby corn as influenced by different organic manures are presented in Fig. 1.

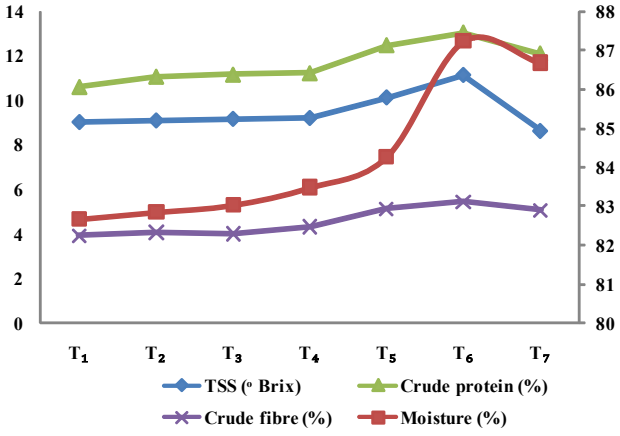

Fig. 1 : Total soluble solids, moisture, crude protein and crude fibre of baby corn as influenced by organic sources of nutrients

Total Soluble Solids (ºBrix)

The maximum total soluble solids was accumulated in treatment receiving FYM at 50 kg N eq. ha^{-1} + vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS (11.13 ºBrix) and it was statistically on par with FYM at 75 kg N eq. ha^{-1} + vermicompost at 75 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS (10.13 ºBrix). Whereas, the application of FYM at 10 t ha^{-1} along with 150:75:40 kg NPK ha^{-1} recorded significantly lower total soluble solids of 8.63 ºBrix.

Moisture (%)

The maximum per cent of moisture in baby corn (87.23%) was obtained with FYM at 50 kg N eq. ha^{-1} + vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS and it was statistically on par with the treatment receiving recommended dose of fertilizers (150:75:40 kg NPK ha^{-1}) along with FYM at 10 t ha^{-1} and FYM at 75 kg N eq. ha^{-1} + vermicompost at 75 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS (86.67 and 84.27%, respectively).

Crude Protein

Application of FYM at 50 kg N eq. ha^{-1} + vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS recorded significantly higher crude protein content (13.05%) as compared to other treatments and which was statistically on par with FYM at 75 kg N eq. ha^{-1} + vermicompost at 75 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS and recommended dose of fertilizers (150:75:40 kg NPK ha^{-1}) along with FYM at 10 t ha^{-1} (12.49 and 12.12%, respectively).

Crude Fibre

There was a significant increase in crude fibre content of baby corn with the application of FYM at 50 kg N eq. ha^{-1} + vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS (5.46%) as compared to vermicompost at 75 kg N eq. ha^{-1} + EBDLM at 75 kg N eq. ha^{-1} (3.97%). However, it was found on par with FYM at 75 kg N eq. ha^{-1} + vermicompost at 75 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS and recommended dose of fertilizers (150:75:40 kg NPK ha^{-1}) along with FYM at 10 t ha^{-1} (5.14 and 5.09%, respectively).

Sensory Attributes of Baby Corn

The cooked baby corn was evaluated for appearance, texture, colour, aroma, taste and acceptance on scale ranging from 1 to 9 (Fig. 2).

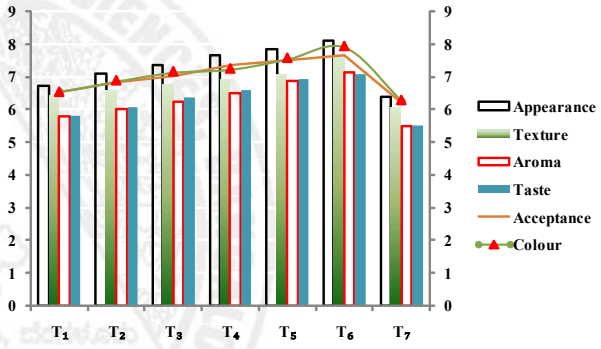

Fig. 2: Sensory evaluation of baby corn as influenced by different organic nutrient management

Inferior sensory attributes *viz.,* appearance, texture, colour, aroma, taste and acceptance were recorded with RDF (150:75:40 kg N: P_2O_5: K_2O ha$_{-1}$) + 10 t FYM ha^{-1}. Whereas, the superior sensory attributes were observed with FYM at 50 kg N eq. ha^{-1} + vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS and FYM at 75 kg N eq. ha^{-1} + vermicompost at 75 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS.

Shelf Life of Baby Corn

Physiological Weight Loss of Baby Corn (without Husk: g cob^{-1})

The data on physiological weight loss of baby corn at 3, 6 and 9 days after storage (without husk) as

influenced by the organic nutrient sources are furnished in Table 2.

The maximum weight loss was recorded with RDF (150:75:40 kg N: P_2O5: K_2O ha^{-1}) + 10 t FYM ha^{-1} (3.58, 2.81 and 4.73 g cob^{-1} at 3, 6 and 9 days after storage, respectively). Whereas, the lowest weight loss was recorded with application of FYM at 50 kg N eq. ha^{-1} + vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray at 30 DAS (2.06, 1.69 and 2.69 g cob^{-1}, respectively).

TABLE 2

Physiological weight loss and spoilage of baby corn (without husk) as influenced by organic sources of nutrients

Treatments	Physiological weight loss of baby corn without husk (g cob^{-1})				Spoilage of baby corn (without husk) (Days)
	0 DAS	3 DAS	6 DAS	9 DAS	
T_1	0	2.91	2.39	4.23	7
T_2	0	2.75	2.07	3.93	7
T_3	0	2.64	2.40	3.66	7
T_4	0	2.51	2.07	3.19	7
T_5	0	2.26	1.91	2.90	7
T_6	0	2.06	1.69	2.69	7
T_7	0	3.58	2.81	4.73	6
S.Em. ±	-	0.10	0.09	0.14	-
C.D. (p = 0.05)	-	0.31	0.26	0.42	-

Spoilage of Baby Corn (without husk)

The data pertaining to spoilage of baby corn without husk was not influenced by different organic sources of nutrients (Table 2).

Yield of Baby Corn (t ha^{-1})

The data on yield of baby corn with and without husk as influenced by different treatments are furnished in Table 3.

Baby corn yield with and without husk was maximum with RDF (150:75:40 kg N:P_2O_5:K_2O ha^{-1}) + 10 t FYM ha^{-1} (18.76 and 3.12 t ha^{-1}, respectively) and was statistically on par with the application of FYM at 50 kg N eq. ha^{-1} + vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS (18.05 and 2.86 t ha^{-1}, respectively). These results are in accordance with the findings of Kanu Murmu *et al.* (2013) in sweet corn, Latha (2013) in groundnut-onion based cropping system, Pradeep Gopakkali and Sharanappa (2014) in onion.

TABLE 3

Yield of baby corn (with husk and without husk) and green fodder yield as influenced by organic sources of nutrients

Treatments	Yield (t ha^{-1})	
	With husk	Without husk
T_1	14.12	2.15
T_2	14.53	2.48
T_3	14.92	2.37
T_4	15.66	2.45
T_5	16.80	2.52
T_6	18.05	2.86
T_7	18.76	3.12
S.Em.±	0.73	0.11
C.D. (p = 0.05)	2.25	0.33

Economics

The data on cost of cultivation, gross returns, net returns and benefit: cost ratio in baby corn as influenced by different organic sources of nutrients are given in Table 4.

Cost of cultivation (Rs.ha^{-1})

The lowest cost of cultivation of Rs.45,398 ha^{-1} was observed with FYM at 10 t ha^{-1} + 150:75:40 kg NPK ha^{-1}. However, FYM at 75 kg N eq. ha^{-1} + Vermicompost at 75 kg N eq. ha^{-1} + Panchagavya (3%) at 15 and 45 DAS + Vermiwash (3%) at 30 DAS recorded the highest cost of cultivation (Rs.68,244 ha^{-1}) followed by FYM at 75 kg N eq. ha^{-1} + Vermicompost at 75 kg N eq. ha^{-1} (Rs.66,919 ha^{-1}).

TABLE 4

Economics of baby corn as influenced by the organic nutrient management

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C
T_1	60896	221299	160403	3.63
T_2	66919	220794	153875	3.29
T_3	60224	229029	168805	3.80
T_4	62221	236993	174772	3.80
T_5	68244	266966	198722	3.91
T_6	61549	279811	218262	4.54
T_7	45398	262507	217109	5.78

Gross Returns (Rs.ha^{-1})

The highest gross returns of Rs.2,79,811 ha^{-1} was realized with FYM at 50 kg N eq. ha^{-1} + Vermi compost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + Panchagavya (3%) at 15 and 45 DAS + Vermiwash (3%) at 30 DAS followed by FYM at 75 kg N eq. ha^{-1} + Vermicompost at 75 kg N eq. ha^{-1} + Panchagavya (3%) at 15 and 45 DAS + Vermiwash (3%) at 30 DAS (Rs.2,66,966 ha^{-1}). FYM at 75 kg N eq. ha^{-1} + EBDLM at 75 kg N eq. ha^{-1} recorded the lowest gross returns of Rs.2,20,794 ha^{-1}.

Net Returns (Rs.ha^{-1})

Application of FYM at 75 kg N eq. ha^{-1} + vermicompost at 75 kg N eq. ha^{-1} recorded the lowest net returns of Rs.1,53,875 ha^{-1}. Whereas, the highest net returns of Rs.2,18,262 ha^{-1} was realized with FYM at 50 kg N eq. ha^{-1} + vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray at 30 DAS followed by FYM 10 t ha^{-1} + 150:75:40 kg NPK ha^{-1} (Rs.2,17,109 ha^{-1}).

The treatments receiving organic sources of nutrients showed improvement in the quality parameters *viz*., total soluble solids, moisture, crude protein and crude fibre. Application of FYM at 50 kg N eq. ha^{-1} + vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS recorded significantly higher total soluble solids, moisture content, crude protein and crude fiber content (Fig. 1). The results were in conformity with Supradip Saha *et al*. (2007), Hossain *et al*. (2012) and Pawar *et al*. (2012). Higher protein content in this treatment is mainly attributed to adequate supply of nutrients through EBDLM and plant growth regulatory substances through panchagavya which might have improved the quality characters of baby corn. Application of EBDLM, panchagavya and vermi wash, which may be the possible reason for the enhanced supply of plant hormones like indole acetic acid, cytokinins and gibberellins for improving the quality of baby corn.

The improvement in the quality *viz*., total soluble solids, crude protein and other biochemical quality parameters may be the reasons for improvement in sensory attributes of baby corn.

The loss in weight with storage is due to loss in moisture from the produce and other physiological processes taking place when stored under fresh condition. The increase in osmotic potential as a consequence of increase in TSS, crude protein and fibre might have prevented loss of moisture and retained the freshness of baby corn under organic nutrient sources and growth additives.

Significantly higher baby corn yield (with and without husk) is attributed to significantly more number of baby corn per plant, husked cob length, dehusked cob length, husked and dehusked cob girth, husked and dehusked cob fresh weight, husked and dehusked cob dry weight. Similar improvement in yield components of baby corn due to organic sources of nutrients was revealed by Waghmode (2010).

The economics of crop production in terms of net returns and B:C ratio have greater impact on practical utility and acceptance of any technology. Application of FYM at 50 kg N eq. ha^{-1} + vermicompost at 50 kg N eq. ha^{-1} + EBDLM at 50 kg N eq. ha^{-1} + panchagavya spray (3%) at 15 and 45 DAS + vermiwash spray (3%) at 30 DAS recorded the highest

gross returns, net returns and B:C ratio (Table 3). The results were in conformity with Pradeep Gopakkali and Sharanappa (2014) and Shashidhar (2014).

Organically grown baby corn is competitive in the market as the consumers prefer freshness, good appearance and taste which is a reflection of biochemical qualities of the products. Keeping consumers demand in view, organic products are likely to fetch 25 to 30 per cent premium price. This will compensate the yield loss under organic production of maize and higher cost of cultivation and provide more net returns and B:C. The benefits of organic crops are much higher than conventional production.

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(*Received :* July 2021 *Accepted :* November 2021)