



# Optimizing Nutrient Management for Finger Millet (*Eleusine coracana*) in Lateritic Soils of Odisha: Effects on Growth, Yield and Economics

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

Finger Millet is a nutritional powerhouse as it contains many essential nutrients including iron, protein, calcium, dietary fibre, and carbohydrates. Since it's a gluten-free cereal, it has received attention for its impressive value in nutrition thus serving as a potential tool in battling malnutrition. It is resistant to extreme weather conditions. Despite its rich nutrient content, recent studies show lesser intake of millets as a whole. Therefore, a field experiment has been conducted at the farmers' field of Bargarh district of Odisha in kharif, 2023 in Lateritic soil under the demonstration programme of Krishi Vigyan Kendra, Bargarh to assess the impact of nutrient management practices on the growth, yield, and economics of finger millet crop at Bargarh district of Odisha. The recommended dose (40:20:20) was applied through Farmer's practice (FP). Recommended practice (RP), application of lime @0.25 LR; lime is applied 15 days before flowering followed by N-P2O5-K2O (30:20:20 kg ha<sup>-1</sup>). Each treatment was replicated 10 times on randomized block design. Nutrient management practices at applied dose resulted in the increased yield along with the entire yield attributes of the crop. Also, the maximum net return and B:C was noted in RP when compared with FP. Finger millet thresher was proved to be effective as it increased the working capacity than the traditional practices. The cost of threshing was found to be low than the conventional practices for threshing of one quintal of finger millet.

*Keywords: Plant height; yield; economics; nutrient management; finger millet.*

## 1. INTRODUCTION

Finger millet, is an important food crop of the Asia and Africa semi-arid tropics and an integral part of dry-land farming systems. It is named from the form of the seed head, resembling human fingers (Kerr et al., 2014; Pokharia et al., 2014 and Goron et al., 2015). Locally, the crop is referred to as finger millet or marua (India); koddoo (Nepal); bulo (Uganda) and kurakkan (Sri Lanka) (National Research Council, 1996). It was domesticated 5000 years ago in the highlands of Ethiopia and Uganda, but reached India some 3000 years ago (National Research Council, 1996 and Dida et al., 2008). Currently, the crop ranks fourth worldwide in importance among millets after sorghum, pearl millet, and foxtail millet (Gupta et al., 2012). An important characteristic of finger millet is its adaptability to diverse agro-climatic conditions. It is well adapted to high altitudes and grows in the Himalayas at an elevation of up to 2400 m (NRC, 1996). Its adaptability to drought has been proven: it is drought-tolerant (Dass et al., 2013 and Hegde et al., 1986), resistant to diseases, especially many fungal and viral diseases (Kerr et al., 2014), effective in suppressing weed growth (Samarajeewa et al., 2006), and can grow on marginal lands with poor soil fertility. It can be established either by broadcasting the seeds or transplanting the seedlings in rows, where the yield is higher when transplanted in rows as compared to broadcasting (Hegde et al., 1986 and Tenywa et al., 1999). Though finger millet is valued by traditional farmers as a low fertilizer

input crop (NRC, 1996) under these conditions, it suffers from low yields (Rurinda et al., 2014; Sial et al., 2024). Most of the soils where finger millet is grown are deficient in macro and micronutrients primarily owing to continuous cropping, bad recycling of crop residues, and low rates of organic matter application which can limit yield potential (Rao et al., 2012). For improvement in productivity, integrated nutrient management is one of the important practices. This calls for balanced use of fertilizers and adoption of INM practices (Hema et al., 2022). INM aims at efficient and judicious use of the major sources of plant nutrients in an integrated approach so as to get maximum economic yield without any deleterious effect on physico-chemical and biological properties of the soil (Arbad et al., 2008). These are the major benefits that yield increased INM: water use efficiency, grain quality, economic return, and sustainability (Wu et al., 2015). Thus, the present study attempts to increase the yield of the finger millet crop by optimum nutrient management practice.

## 2. MATERIALS AND METHODS

The experiment was conducted in farmers field during *kharif*, 2023 by taking the finger millet crop of variety KMR-630 at village Sodha, Saplaha & Sarkanda of Bargarh district of Odisha under the field demonstration programme of KVK, Bargarh to study the influence of nutrient management practices on yield, growth and economics of Finger millet. The treatments were taken as Farmers' practice (FP) on application of

recommended dose (40 :20 :20) only and recommended practice (RP) on application of lime @ 0.25 LR (applied 15 days before flowering) along with N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O (30-20-20 kg ha<sup>-1</sup>). Each treatment replicated for 10 times with randomized block design. The soil is sandy loam in texture having pH 6.1. The fertility status of the soil was less in organic carbon (0.41%), low status of available nitrogen (239 kg ha<sup>-1</sup>), less of available phosphorous (11 kg ha<sup>-1</sup>) and medium in potassium (143 kg ha<sup>-1</sup>). Crop was fertilized as per respective treatments with lime application. Optimum plant protection measures were adopted and applied insecticide as per need of crops. The observations were taken up on growth (plant height), yield parameters and economics. Harvesting was done on the harvest stage. The yield of both grain and straw was recorded. To carry out this each respondent was tied of the digital heart rate monitor for taking of heart rate during the post-harvest operation. Energy expenditure during work was also calculated from average heart rate (AHR) by using regression equation by Varghese et al., 1994. The Energy Expenditure = 0.159 X HR (beats min<sup>-1</sup>) – 8.72. The working capacity of this machine over traditional practices was also measured in terms kg/hr.

### 3. RESULTS AND DISCUSSION

The effect of nutrient management practices significantly increased the plant height at various stages (60 DAS, 90 DAS & at harvest stage) of finger millet. At 60 DAS, the plant height of 36.81 cm and 35.28 cm was recorded in RP and FP respectively, (4.3 per cent increase over FP). Similar trend was observed in plant height particularly 90 DAS and during the harvest. The RP increased the plant height @ 4.3, 3.6 and 4.8% respectively, at 60 DAS, 90 DAS and at harvest stage over FP (Table 1).

More no. of fingers/head, no. of productive tillers and no. of ear head/ plant was observed in RP as compared to FP. The increase was 35, 6.5 and 42%, respectively (Table 2).

The 1000 grain weight (g) was 3.68 g and 3.26 g in RP and FP, respectively, which was 11.4% increase over FP. The grain yield of 24.7 q ha<sup>-1</sup> and 20.9 q ha<sup>-1</sup> was (15.4 per cent increase over FP) observed in RP and FP respectively. The increased straw yield of 9.4 percent was observed over FP. The lowest yield was recorded the FP whereas highest was seen in the RP (Table 2).

The economic analysis showed the significant increase in gross cost and gross return in RP as compared to FP. The RP significantly increased the net return and B:C ratio over the FP. The highest net return was seen in RP and lowest was seen in FP.

The performance of Finger millet thresher with its impact on ergonomical parameters has been represented in the Table 4.

The threshing & cleaning of finger millet after harvesting is considered as a tedious work. So KVK, Bargarh has promoted the use of OUAT developed finger millet thresher for processing of finger millet seeds to overcome the problem. This thresher was operated with 1 hp motor with threshing efficiency of 93.5% & cleaning efficiency of 92.4%. The performance of Finger millet thresher over manual method along with its impact on agronomical parameter was studied for its wider acceptability.

It was clearly depicted that finger millet thresher had proved efficient as it increased the working capacity (46.4 kg hr<sup>-1</sup>) than to the traditional practices (7.1 kg hr<sup>-1</sup>). The percentage change in average working heart rate was decreased to 23.5% with the use of finger millet thresher while the average energy expenditure was reduced to 42.5%. The variation in heart rate and energy expenditure for the thresher may be attributed to the design & configurations of the thresher. Similar agronomical observations were also made by Mohanty et al., 2009 & Khadatkar et al., 2018 for thresher. The cost of threshing was found to be Rs. 420/- less than traditional

**Table 1. Influence of nutrient management practices particularly on plant height (cm) at various stages of Finger millet**

Treatments	60 DAS	90 DAS	At harvest
FP	35.28	53.19	70.86
RP	36.81	55.12	74.28
SE(d)±	1.08	0.85	0.48
C.D. at 5%	1.53	0.24	1.06

**Table 2. Nutrient management practices effects on yield attributing parameters of finger millet**

Treatments	No. of fingers /head	No. of productive tillers /plant	Ear head/ plant no	1000 of grain weight (g)	Grain yield (q ha <sup>-1</sup> )	Straw yield (q ha <sup>-1</sup> )
FP	6.48	110.21	4.68	3.26	20.9	50.18
RP	10.12	117.83	8.10	3.68	24.7	55.36
SE(d)±	0.16	0.85	0.09	0.07	0.45	0.69
C.D. @ 5%	0.47	1.19	0.62	0.13	0.64	0.83

**Table 3. Nutrient management practices influence on economics of finger millet**

Treatments	Gross Cost (Rs. ha <sup>-1</sup> )	Gross return (Rs. ha <sup>-1</sup> )	Net return (Rs. ha <sup>-1</sup> )	B:C ratio
FP	25600	80381	54781	3.13
RP	28800	94996	66196	3.29

**Table 4. Performance of Finger millet thresher with its impact on agronomical parameters**

	Working capacity (kg hr <sup>-1</sup> )	Rate of Working Heart (beats min <sup>-1</sup> )	Rate on Energy Expenditure (KJ min <sup>-1</sup> )	Cost of threshing (Rs. Q <sup>-1</sup> )
Threshing by manual beating	7.1	123	10.83	660
Power operated manual thresher	46.4	94	6.22	240
SE(d)+	0.25	0.96	0.15	
C. D at 5%	0.81	3.09	0.49	

practices for threshing of one quintal of finger millet. Hence this finger millet thresher can be effectively used for increasing the working capacity along with reducing the time & degree of drudgery to a great extent than traditional practices.

#### 4. CONCLUSION

The nutrient management practices application increased all the yield attributing parameters of finger millet i.e. the plant height at different growth stages, no of fingers/head, no of productive tillers/head, no. of ear head/plant as compared to the farmers' practice. The 1000 of grain weight and highest showing of yield both grain and straw was recorded in RP. The highest showing of net return and ratio of B:C was observed in RP. Finger millet thresher had proved efficient as it increases the working capacity than the traditional practices. The cost of threshing was found to be Rs. 420/- less than traditional practices for threshing of one quintal of finger millet.

#### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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