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RESEARCH PAPER

Effect of Spatial Nutrient Dose on the Growth and Yield of Finger Millet Varieties in Coastal Part of West Bengal

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ABSTRACT

The field experiment was carried out at Instructional Farm, The Neotia University, West Bengal to study the effect of spatial nutrient dose on the growth and yield of Finger millet varieties in Coastal part of West Bengal during *kharif* (rainy) season of 2024. The soil of the experimental field was fine in texture and clayey in nature, having 349 kg ha^{-1} available N, 26.80 kg ha^{-1} available P, 455 kg ha^{-1} exchangeable K. The experiment was laid out in a split plot design with 3 replications having three finger millet varieties, *viz.*, V_1: Sri Chaitanya (VR-847), V_2: VL Mandua 352 and V_3: Indravathi, respectively considered as main-plot, while, four nutrient dose *viz.* N_0: Control (no nutrient application), N_1: 20:10:10 kg N-P_2O_5-K_2O ha^{-1}, N_2- 40:20:20 kg N-P_2O_5-K_2O ha^{-1} and N_3- 60:30:30 kg N-P_2O_5-K_2O ha^{-1}, respectively were considered as sub-plot treatment of the experiment. The results showed that highest grain yield (11.98 q ha^{-1}) and straw yield (30.19 q ha^{-1}) were recorded by V_2 *i.e.*, VL Mandua 352 and V_3 *i.e.*, Indravathi, respectively. Application of 60:30:30 kg N-P_2O_5-K_2O ha^{-1} *i.e.* recorded highest values of most of the growth attributes, yield attributes and grain yield (16.36 q ha^{-1}) of finger millet.

HIGHLIGHTS

- The nutrient dose of 60:30:30 kg N-P_2O_5-K_2O ha^{-1} registered the highest grain and straw yield of finger millet as noted in growth and yield attributes.
- Finger millet varieties did not show any significant difference in grain and straw yields; however, marginally higher grain and straw yield were recorded by VL Mandua 352 and Indravathi respectively.

Keywords: Finger millet, plant height, dry matter accumulation, crop growth rate, yield attributes, productivity

The world's population is expected to increase to 9.7 billion in 2050, while the food demand is expected to rise in India up to ~ 400 million t at that time (IARI, 2013; UN, 2019; van Dijk *et al*. 2021). The consequences of the declining and polluting land and water resources imposed a huge burden to agriculture (Bhadra *et al*. 2022; Gaikwad *et al*. 2022; Sairam *et al*. 2023; Santosh *et al*. 2024). Further, the climate change is causing natural vagaries with several abiotic and biotic stresses (Brahmachari *et al*. 2019; Hossain *et al*. 2021; Mwadalu *et al*. 2022). Under these contexts, it is difficult to achieve the crop production potential (Maitra, 2020). The time warrants for the adoption of climate-resilient agricultural technologies and cultivation of climate-smart crops such as millets for the food and nutritional security (Maitra *et al*. 2000; Mangaraj

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et al. 2025). Finger millet is ideally suited crops to cultivate in dry and semi-arid regions due to its drought tolerance ability. The crop's resilience in challenging environments and its capacity to withstand climate change make it an important resource for ensuring food security (Ceasar *et al.* 2018; Hatakeyama *et al.* 2017). Finger millet not only tolerates abiotic and biotic stress, but also withstand significant amounts of salinity and resist water logging and emit low carbon during crop growth.

Millets are the oldest small grained cereals belonging to *Poacea* family (Dayal and Kushwaha, 2023; Maitra *et al.* 2023). They are commonly known as "Nutri-cereals" because of their high nutritional value (Banerjee and Maitra, 2020; Yadav *et al.* 2024). Among small millets, like finger millet (*Eleusine coracana* L.) is the most widespread crop. Although finger millet is a native of Ethiopia, it is widely grown throughout East Africa and Southeast Asia, where it is regarded as a staple grain that provides dietary energy and nutrients to a significant portion of the population especially to smallholders (Samanta *et al.* 2022; Mukesh *et al.* 2024).

Nutritionally, in comparison to other cereals and millets, finger millet is abundant in vital nutrients. Finger Millet is rich in essential amino acids (Tryptophan, Cysteine, Isoleucine, Leucine, Methionine, Phenylalanine), vitamins (Niacin, B6, Folic acid), minerals (Calcium, Iron, Potassium, Phosphorus, Magnesium, Zinc), and Vitamin B making it as a valuable crop in underdeveloped countries to reduce malnutrition (Dida and Kebero, 2023). Finger millet comprises 72-79.5% carbohydrates, 5.6-9.70% protein, 1-2% fat, 1.7-4.13% ash, and 15-22% dietary fiber. It is rich in calcium (344 mg 100 g^{-1}), magnesium (408 mg 100 g^{-1}), and iron (5.42 mg 100 g^{-1}) (Sahoo *et al.* 2023: Gaikwad *et al.* 2023).

There are improved varieties of finger millet which can produce satisfactory yield under proper agronomic management (Roy *et al.* 2001; Mukesh *et al.* 2024; Ray *et al.* 2024). Research on a variety of finger millet germplasm showed that protein levels are directly influenced by nitrogen content, with notable variation seen amongst accessions. (Backiyalakshmi *et al.* 2023). Finger millet responds well to nitrogen (N), phosphorus (P) and potassium fertilizer (K). The application of N fertilizer at the time of planting promotes improved crop emergence, especially in N-deficient soil (Rurinda *et al.* 2014). Based on the above facts, the current study was conducted to assess the performance of varied nutrient levels on growth and productivity of finger millet varieties.

MATERIALS AND METHODS

The field experiment was carried out at Instructional Farm, The Neotia University, West Bengal in the *kharif* (rainy) season of 2024. The farm is geographically located at the south of the tropic of cancer, 22.261297 N latitude and 88.198288 E longitudes, at an elevation of above 7.10 m mean sea level (MSL). The soil of the experimental field was fine in texture and clayey in nature, having 349 kg ha^{-1} available N, 26.80 kg ha^{-1} available P, 455 kg ha^{-1} exchangeable K. The experiment was laid out in a split plot design with 3 replications having three finger millet varieties *viz*., V_1: Sri Chaitanya (VR-847), V_2: VL Mandua 352 and V_3: Indravathi, respectively considered as main-plot, while, four nutrient dose *viz*., N_0: Control (no nutrient application), N_1- 20:10:10 kg N-P_2O_5-K_2O ha^{-1}, N_2: 40:20:20 kg N-P_2O_5-K_2O ha^{-1} and N_3: 60:30:30 kg N-P_2O_5-K_2O ha^{-1} were considered as sub-plot treatment of the experiment.

The fertilizers used in finger millet cultivation were urea as a source of N, single super phosphate (SSP) as source of P_2O_5, muriate of potash as a source of K_2O. Half dose of N_2 and full dose of P_2O_5 and K_2O were applied as basal during the time of land preparation/ after transplanting and remaining half dose of N_2 was applied as top dressing. One hand weeding at 15 DAT was done. The observations were recorded form 10 randomly selected plants. The data were subjected to statistical analysis using analysis of variance method (Gomez and Gomez, 1984) and the significance of different sources of variations were tested by error mean square using Fisher and Snedecor's 'F" test at a probability level of 0.05.

RESULTS AND DISCUSSION

Varieties significantly influenced the plant height (cm.), dry matter accumulation (g m^{-2}), Leaf Area Index (LAI) and crop growth rate (g m^{-2} day^{-1}) of finger millet. Among the varieties, V_2 - VL Mandua 352 recorded highest values of plant height at all the dates of observation, while finger millet variety

Indravathi *i.e.* V_3 recorded highest values of dry matter accumulation (g m^{-2}), Leaf Area Index (LAI) and crop growth rate (g m^{-2} day^{-1}) of finger millet (Table 1). Among the nutrient doses, N_3 *i.e.*, 60:30:30 kg $N\text{-}P_2O_5\text{-}K_2O$ ha^{-1} recorded highest values of plant height and dry matter accumulation (g m^{-2}) of finger millet whereas, the LAI was maximum under N_2: 40:20:20 kg $N\text{-}P_2O_5\text{-}K_2O$ ha^{-1} and highest CGR was recorded by N_1: 20:10:10 kg $N\text{-}P_2O_5\text{-}K_2O$ ha^{-1}. The interaction between varieties and nutrient levels did not show any significant effect on the plant height (cm.) but showed significant effect on dry matter accumulation (g m^{-2}), LAI and crop growth rate (g m^{-2} day^{-1}) of finger millet.

The reason for maximum plant height of finger millet under treatment N_3 *i.e.* 60:30:30 kg $N\text{-}P_2O_5\text{-}K_2O$ ha^{-1} might be due to increased availability of nutrients in the soil which could have triggered cell elongation and multiplication resulting in the higher growth rate of shoots. The results obtained from the experiment were in agreement with the findings of Giribabu *et al*. 2010; Patil *et al*. 2015. The applied nutrients by their effect on the metabolism of the cell, promoted the meristematic activity of the crop and its better uptake would have resulted in increased dry matter accumulation as reported by Maitra *et al*. (2020).

Varieties also influenced the yield attributing characters and yield of finger millet. Highest no. of grain ear^{-1} (2288.5) and grain weight ear^{-1} (3.88 g) were recorded by V_3 *i.e.*, Indravathi. Highest grain yield (11.98 q ha^{-1}) and straw yield (30.19 q ha^{-1}) were recorded by V_2 *i.e.*, VL Mandua 352 and V_3 *i.e.* Indravathi, respectively. The highest ear length (5.14 cm.) and 1000 grain weight (9.35) were recorded by V_1 *i.e.*, Sri Chaitanya (VR-847) and V_2 *i.e.*, VL Mandua 352, respectively.

The interaction between varieties and nutrient levels did not show any significant effect on the ear length (cm.) but showed significant effect on no. of grain ear^{-1}, grain weight ear^{-1} (g), 1000 grain weight, grain yield (q ha^{-1}) and straw yield (q ha^{-1}) of finger millet.

Application of higher dose of N can increase the grain yield and straw yield of finger millet in coastal part of West Bengal (Ghosh *et al*. 2024). The increase in the grain yields due to increasing NPK fertilizer rates was mainly due to the role of optimum P in energy provision for seed formation and grain filling. Increase in grain yield was due to optimum phosphorus, molybdenum, calcium and magnesium

Table 1: Effect of different varieties and nutrient levels on the crop growth rate (g m^{-2} day^{-1}) of finger millet

Treatments	Plant height at harvest (cm.)	Dry matter accumulation at harvest (g m^{-2})	Leaf Area Index		Crop growth rate (g m^{-2} day^{-1})		
			30 DAT	60 DAT	0-30 DAT	30-60 DAT	60 DAT-harvest
(a) Varieties							
V_1	81.13	426.50	0.012	1.027	1.51	2.90	9.80
V_2	81.91	357.91	0.005	1.021	1.03	1.82	9.06
V_3	80.05	438.12	0.011	1.151	1.05	2.49	11.04
S. Em. (±)	2.57	14.15	0.0004	0.0423	0.051	0.121	0.467
C. D. (*p=0.05*)	NS	39.30	0.0012	NS	0.143	0.338	NS
C.V.	—	12.03	16.68	—	14.99	17.51	—
(b) Nutrient levels							
N_0	72.91	342.50	0.005	0.784	1.10	1.59	8.71
N_1	80.02	454.44	0.009	1.141	1.13	2.38	11.61
N_2	83.83	409.77	0.012	1.193	1.20	3.21	9.22
N_3	87.17	423.33	0.010	1.148	1.34	2.44	10.33
S. Em. (±)	3.08	22.55	0.0005	0.0566	0.056	0.135	0.727
C. D. (*p=0.05*)	6.48	47.38	0.0012	0.1189	0.118	0.284	NS
C.V.	11.43	16.60	18.37	15.92	14.08	16.90	—

V_1 – Sri Chaitanya (VR-847); V_2 – VL Mandua 352; V_3 – Indravathi; N_0 - Control; N_1 – 20:10:10 kg $N\text{-}P_2O_5\text{-}K_2O$ ha^{-1}; N_2 - 40:20:20 kg $N\text{-}P_2O_5\text{-}K_2O$ ha^{-1}; N_3 - 60:30:30 kg $N\text{-}P_2O_5\text{-}K_2O$ ha^{-1}.

Table 2: Effect of different varieties and nutrient levels on the yield attributes and yield of finger millet

Treatments	Ear length (cm)	No. of grain ear^{-1}	grain weight ear^{-1} (g)	1000 grain weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
(a) Varieties						
V_1	5.14	2068.9	3.34	6.17	10.35	28.30
V_2	4.82	2109.5	2.78	9.35	11.98	26.23
V_3	4.95	2288.5	3.88	8.25	11.55	30.19
S. Em. (±)	0.169	56.92	0.201	0.331	0.416	1.198
C. D. (*p=0.05*)	NS	NS	0.55	0.919	NS	NS
C.V.	—	—	20.85	14.47	—	—
(b) Nutrient levels						
N_0	4.75	1706.3	2.84	6.26	5.84	15.87
N_1	5.24	2143.0	3.09	8.34	10.05	28.54
N_2	5.02	2368.8	3.37	8.15	12.92	32.56
N_3	4.86	2404.4	4.05	8.94	16.36	35.97
S. Em. (±)	0.233	57.99	0.189	0.317	0.621	1.027
C. D. (*p=0.05*)	NS	121.8	0.397	0.666	1.306	2.158
C.V.	—	8.07	16.87	12.01	16.51	10.91

For the treatment details Table 1 may be referred.

that were necessary for photosynthesis, nitrogen assimilation and metabolism. The results are in agreement with Reddy and Reddy (1985), Patil *et al*. (2015); Chakraborty *et al*. (2002) and Syama *et al*. 2023.

CONCLUSION

The study revealed that nutrient doses impacted on the growth and productivity of finger millet in the coastal part of West Bengal. Finger millet varieties did not show any significant difference in grain and straw yields; however, marginally higher grain and straw yield were recorded by VL Mandua 352 and Indravathi respectively. The nutrient dose of 60:30:30 kg N-P_2O_5-K_2O ha^{-1} registered the highest grain and straw yield of finger millet as noted in growth and yield attributes.

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