



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(6): 1079-1081
Received: 21-03-2026
Accepted: 25-04-2026

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Effect of different fertility levels and organic sources on growth parameters of Finger Millet (*Eleusine coracana* L.)

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i6n.5828>

Abstract

A field experiment was conducted during *kharif*, 2025 at the Instructional Farm, Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur to study effect of different fertility levels and organic sources on growth parameters of finger millet (*Eleusine coracana* L.). The experiment was laid out in a split-plot design with four fertility levels, namely control, 50% RDF, 75% RDF and 100% RDF, and four organic sources, namely control, vermicompost @ 4 t ha⁻¹, FYM @ 10 t ha⁻¹ and ghanjeevamrit @ 1 t ha⁻¹, replicated three times. The recommended dose of fertilizer was 40:20:20 kg N:P₂O₅:K₂O ha⁻¹ and half nitrogen with full phosphorus and potassium were applied at sowing while the remaining nitrogen was top-dressed in splits. The experimental results showed that application of 100% RDF recorded significantly higher values of growth parameters viz., plant height (113.62 cm), dry matter accumulation (34.44 g plant⁻¹), leaf area index (4.55) and effective tillers plant⁻¹ (5.48) at harvest in finger millet which was superior to lower fertility levels. It also recorded higher crop growth rate and relative growth rate during different growth stages. Among the organic sources, application of vermicompost @ 4 t ha⁻¹ recorded significantly higher values of growth parameters and growth indices which was found superior over FYM, ghanjeevamrit and control. The results indicated that application of 100% RDF in combination with vermicompost @ 4 t ha⁻¹ had a positive effect on the growth and development of finger millet.

Keywords: Finger millet, fertility levels, organic sources, growth parameters

Introduction

Finger millet (*Eleusine coracana* L.) is an important small millet crop grown in India. This crop was classified as an annual grass and belongs to the Poaceae family. It is mainly grown for grain as human food and fodder for livestock and has the highest productivity among millets. Finger millet contains about 5-8% protein, 65-75% carbohydrates, 15-20% dietary fibre and 2.5-3.5% minerals (Chethan and Malleshi, 2007) [2]. Finger millet is exceptionally rich in calcium (344 mg 100 g⁻¹), iron (3.9 mg 100 g⁻¹), phosphorus (408 mg 100 g⁻¹), magnesium (137 mg 100 g⁻¹) and dietary fibre (11.5 g 100 g⁻¹). It also contains essential amino acids like methionine and isoleucine as well as vitamins such as niacin and riboflavin making it superior to many other cereals in nutritional value (Devi *et al.*, 2014) [3]. Finger millet is a popular small millet in India due to its high nutritional value and drought resistance. The crop is grown on approximately 11.89 lakh hectares with production of around 17.63 lakh tonnes with an average productivity of 1,483 kg ha⁻¹ (Government of India, 2023-24) [4].

Inorganic fertilizers have an important role in increasing the productivity of finger millet by providing critical nutrients in readily available form. Nitrogen and phosphorus are the most important nutrients for finger millet and impacting key growth characteristics such as plant height, number of tillers, panicle length and grain size. The use of recommended fertilizer doses has been shown to significantly increase grain and straw yield, nutrient uptake and harvest index (Bharathi *et al.*, 2017) [1]. Integrated Nutrient Management (INM) combines organic manures, inorganic fertilizers and bio-inputs to ensure balanced nutrient delivery and soil health. INM has been shown in finger millet to improve soil structure, microbial activity and nutrient-use efficiency resulting in increased growth, nutrient uptake and yield. Integrating FYM or vermicompost with appropriate fertilizer doses improves crop production and promotes sustainability under rainfed circumstances.

Materials and Methods

A field experiment was conducted at block E₁, Instructional Farm, Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur during *kharif*, 2025. The experimental soil was clay-loam in texture, slightly alkaline in reaction (pH 7.6), low in organic carbon and available nitrogen, medium in available phosphorus and high in available potassium. The experiment was laid out in a split-plot design with three replications, comprising four fertility levels in the main plot, viz. control, 50% RDF, 75% RDF and 100% RDF and four organic sources in the subplots, viz. control, vermicompost @ 4 t ha⁻¹, FYM @ 10 t ha⁻¹ and ghanjeevamrit @ 1 t ha⁻¹. The test crop was finger millet variety KMR 301, sown at a spacing of 30 cm × 10 cm with a seed rate of 8 kg ha⁻¹. The recommended dose of fertilizer was 40:20:20 kg N:P₂O₅:K₂O ha⁻¹ and half nitrogen with full phosphorus and potassium were applied at sowing through urea, DAP and MOP, while the remaining nitrogen was applied in two equal splits at 30 and 45 DAS. FYM @ 10 t ha⁻¹ and vermicompost @ 4 t ha⁻¹ were applied 15 days before sowing and incorporated into the soil whereas ghanjeevamrit was prepared from cow dung, jaggery, besan, cow urine and soil and applied as basal application. The crop was managed through thinning, pre-emergence atrazine, post-emergence metsulfuron-methyl and hand weeding at critical stages. Observations were recorded on plant height, dry matter accumulation, LAI, tillers, crop growth rate and relative growth rate using standard procedures and the data were analyzed by ANOVA as per split-plot design (Panse and Sukhantme, 1985) [7].

Results and Discussion

Fertility levels: During *kharif* 2025, fertility levels had a significant effect on all growth parameters of finger millet including plant height, dry matter accumulation, leaf area index, total number of tiller number, crop growth rate and relative growth rate. Application of 100% RDF recorded the tallest plants at 90 DAS and at harvest (Table 1) with 110.44 and 113.62 cm, respectively which was statistically at par with 75% RDF (100.94 and 103.77 cm) but higher than 50% RDF and control. This is due to nitrogen, being the primary building block of protoplasm, vitally promotes cell division at apical meristems and cell enlargement through enhanced synthesis of gibberellic acid (GA₃) and cytokinins. These phytohormones stimulate internodal elongation and leaf expansion resulting in taller plants with greater canopy coverage. Phosphorus plays crucial role in root development through enhanced ATP synthesis and energy transfer processes. Well-developed root system under higher phosphorus availability facilitates superior water and nutrient absorption from soil profile, particularly important under rainfed conditions. Potassium ions maintain cellular turgor through osmotic regulation and activate over 60 enzymes involved in photosynthesis, protein synthesis and starch formation. The synergistic NPK interaction creates optimal physiological environment for maximum vegetative growth expression.

A similar trend was observed for dry matter accumulation, where 100% RDF recorded the highest values of 14.87, 27.29 and 34.44 g plant⁻¹ at 60, 90 DAS and at harvest (Table 1), respectively followed by 75% RDF with 13.96, 25.46 and 32.67 g plant⁻¹. The reason is that adequate supply of nitrogen, phosphorus and potassium under higher fertility levels might have accelerated cell division, chlorophyll synthesis, photosynthetic activity and translocation of assimilates, thereby promoting faster crop growth and earlier transition from vegetative to reproductive stages. Phosphorus plays an important role in energy transfer and root development, while potassium regulates enzymatic activities and carbohydrate movement, collectively contributing to accumulation of dry matter in plant. Leaf area index (Table 1) also

improved with fertility level and was maximum under 100% RDF at 60, 90 DAS and at harvest with 2.94, 4.88 and 4.55, respectively. The number of tillers plant⁻¹ (Table 2) was highest under 100% RDF (5.48) followed by 75% RDF (5.15). Adequate nitrogen supply during active tillering phase (20-40 DAS) activates axillary buds through localized cytokinin accumulation and prevents apical dominance. Enhanced leaf area index resulted from increased tiller number coupled with larger individual leaf size, creating expansive photosynthetic canopy for superior light interception and CO₂ assimilation. Crop growth rate under 100% RDF was also superior between 30-60 and 60-90 DAS (Table 2) with 10.95 and 13.79 g m⁻² day⁻¹, respectively, while relative growth rate followed the same trend. This is due to exponential dry matter synthesis driven by peak photosynthetic activity. Relative growth rate (Table 2) superiority during early vegetative phase reflects nitrogen ability to maximize growth per unit existing biomass when plants have small initial size. These results indicate that balanced nutrient supply under 100% RDF promoted better vegetative growth through greater availability of nitrogen and other nutrients throughout the crop growth period. These findings are in close conformity with the results reported by Harika *et al.* (2019) [5] and Prashanth *et al.* (2017) [8] who demonstrated that optimized fertility levels significantly enhance the vegetative vigor and biomass accumulation of finger millet.

Organic sources: Among the organic sources, vermicompost @ 4 t ha⁻¹ recorded the best growth performance for almost all parameters. It produced the highest plant height at 30, 60 DAS and at harvest (Table 1) with 78.29, 102.38 and 105.77 cm, respectively and these values were statistically at par with FYM @ 10 t ha⁻¹ but superior to ghanjeevamrit and control. Vermicompost also recorded the highest dry matter accumulation of 12.88, 23.82 and 30.33 g plant⁻¹ at 60, 90 DAS and at harvest (Table 1), respectively. The highest leaf area index (Table 1) under vermicompost was 2.86, 4.52 and 4.21 at 60, 90 DAS and at harvest, respectively, while effective tillers plant⁻¹ (Table 2) were also maximum under this treatment (5.31). Crop growth rate (Table 2) under vermicompost between 30-60 and 60-90 DAS was 9.24 g m⁻² day⁻¹, 12.15 g m⁻² day⁻¹, respectively which was higher than FYM, ghanjeevamrit and control. Ghanjeevamrit also improved growth over control but its values remained lower than vermicompost and FYM for all growth traits. The superiority of vermicompost in promoting growth may be attributed to its nutrient-rich composition, better mineralization kinetics and its profound beneficial effect on soil physical and biological properties. Vermicompost acts as a reservoir of essential macro and micronutrients, vitamins, enzymes and plant growth-promoting hormones (auxins, gibberellins and cytokinins) which collectively stimulate meristematic activity and vegetative growth. It is widely recognized that vermicompost enhances microbial biomass and activity, improves soil structure by increasing aeration, porosity and water-holding capacity and creates a more favorable rhizosphere environment for root proliferation.

The favourable effect of vermicompost on crop phenology may be attributed to its balanced nutrient supply, enhanced microbial activity and improved soil physical conditions which together created a favourable rhizosphere environment for rapid crop growth and development. The gradual and sustained release of nutrients from vermicompost might have maintained continuous nutrient availability throughout the crop growth period, resulting in better vegetative growth and timely initiation of reproductive stages. Similar findings have been reported by Kujur *et al.* (2021) [6] who observed significant enhancement in the vegetative growth attributes of finger millet under organic nutrient management.

Table 1: Effect of different fertility levels and organic sources on plant height, dry matter accumulation and leaf area index

Treatments	Plant height (cm)				Dry matter accumulation (g plant ⁻¹)				Leaf area index			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
Fertility levels												
F ₀ : Control	30.27	64.56	84.24	86.94	3.40	8.24	16.07	21.17	0.29	1.75	3.01	2.74
F ₁ : 50% RDF	31.58	69.82	92.12	95.06	4.19	11.47	20.40	25.23	0.41	2.17	3.69	3.39
F ₂ : 75% RDF	32.95	76.47	100.94	103.77	4.84	13.96	25.46	32.67	0.47	2.74	4.49	4.29
F ₃ : 100% RDF	33.64	82.67	110.44	113.62	5.01	14.87	27.29	34.44	0.49	2.94	4.88	4.55
S.Em.±	0.99	1.83	2.79	3.08	0.36	0.27	0.61	0.57	0.05	0.07	0.13	0.11
C.D. (P=0.05)	NS	6.32	9.66	10.65	NS	0.93	2.11	1.97	NS	0.24	0.46	0.37
Organic sources												
O ₀ : Control	31.74	68.56	92.38	94.31	4.07	11.08	20.94	25.85	0.38	2.26	3.71	3.52
O ₁ : Vermicompost @ 4 t ha ⁻¹	32.42	78.29	102.38	105.77	4.56	12.88	23.82	30.33	0.44	2.55	4.27	3.94
O ₂ : FYM @ 10 t ha ⁻¹	32.30	75.04	98.12	101.60	4.52	12.67	23.14	29.10	0.43	2.48	4.21	3.85
O ₃ : Ghanjeevamrit @ 1 t ha ⁻¹	32.00	71.62	94.86	97.71	4.28	11.91	21.32	28.23	0.42	2.32	3.87	3.67
S.Em.±	0.86	1.29	2.41	2.59	0.13	0.30	0.62	0.61	0.01	0.06	0.11	0.08
C.D. (P=0.05)	NS	3.76	7.03	7.55	NS	0.88	1.80	1.77	NS	0.19	0.32	0.24

Table 2: Effect of different fertility levels and organic sources on crop growth rate, relative growth rate and number of tillers

Treatments	Crop Growth rate (g m ⁻² day ⁻¹)				Relative Growth Rate (g g ⁻¹ day ⁻¹)				Number of tillers plant ⁻¹
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	45 DAS
Fertility levels									
F ₀ : Control	5.38	8.70	5.67	5.38	0.030	0.022	0.009	0.030	2.42
F ₁ : 50% RDF	8.09	9.92	5.36	8.09	0.033	0.019	0.007	0.033	3.19
F ₂ : 75% RDF	10.13	12.78	8.01	10.13	0.036	0.020	0.008	0.036	4.07
F ₃ : 100% RDF	10.95	13.79	7.95	10.95	0.037	0.020	0.008	0.037	4.34
S.Em.±	0.24	0.39	0.09	0.24	0.002	0.0002	0.0002	0.002	0.10
C.D. (P=0.05)	0.83	1.33	0.29	0.83	0.007	0.001	0.001	0.007	0.36
Organic sources									
O ₀ : Control	7.78	10.96	5.45	7.78	0.033	0.021	0.007	0.033	3.30
O ₁ : Vermicompost @ 4 t ha ⁻¹	9.24	12.15	7.23	9.24	0.035	0.021	0.008	0.035	3.71
O ₂ : FYM @ 10 t ha ⁻¹	9.05	11.63	6.62	9.05	0.034	0.020	0.0078	0.034	3.62
O ₃ : Ghanjeevamrit @ 1 t ha ⁻¹	8.48	10.46	7.68	8.48	0.034	0.020	0.009	0.034	3.39
S.Em.±	0.22	0.52	0.58	0.22	0.0003	0.001	0.001	0.0003	0.09
C.D. (P=0.05)	0.63	1.52	1.69	0.63	0.001	0.001	0.002	0.001	0.28

Conclusion

Based on findings, it is proposed that application of 100% RDF recorded the best growth performance in finger millet, with the highest plant height, dry matter accumulation, leaf area index, tiller number, crop growth rate and relative growth rate. Among the organic sources, vermicompost @ 4 t ha⁻¹ performed best and was better than FYM, ghanjeevamrit and control. Overall, the combined use of 100% RDF and vermicompost was most effective for improving growth of finger millet under Udaipur conditions.

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