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Effect of integrated nutrient management on growth, yield attributes and yield of finger millet (*Eleusine coracana* L.)

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Abstract

A field experiment was conducted during *kharif* season 2025 at the Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) to evaluate the effect of integrated nutrient management on growth, yield attributes and yield of finger millet (*Eleusine coracana* L.). The soil was sandy loam, slightly alkaline, low in organic carbon and available nitrogen and medium in available phosphorus and potassium. The experiment was laid out in Randomized Block Design with three replications and nine treatments comprising different levels of RDF in combination with organic manures (FYM and Vermicompost). Growth parameters were significantly influenced by treatments, with plant height ranging from 64.5 to 118.6 cm at harvest, number of tillers from 78.2 to 118.7 m⁻², dry matter accumulation from 354.2 to 986.6 g m⁻² and leaf area index from 1.98 to 4.42 at 90 DAS, indicating improved vegetative growth under integrated nutrient management. Yield attributes such as effective tillers (60.21–125.73 m⁻²), finger length (4.73–7.89 cm), fingers per earhead (5.4–9.2), grains per finger (119–166) and 1000-grain weight (3.18–3.67 g) were enhanced under RDF combined with organic manures. Grain yield ranged from 14.13 to 29.45 q ha⁻¹, with the highest under T₈ (75% RDF + Vermicompost @ 1 t ha⁻¹) followed by T₃ (100% RDF) giving about 108.4% higher yield over control (T₁), while straw yield (39.35–57.42 q ha⁻¹) and biological yield (53.48–86.87 q ha⁻¹) followed similar trends. Nutrient uptake increased significantly, with nitrogen (35.54–75.72 kg ha⁻¹), phosphorus (9.40–26.65 kg ha⁻¹) and potassium (56.33–108.31 kg ha⁻¹) uptake highest under T₃ followed by T₈ and T₅. Residual soil fertility improved under integrated nutrient management treatments, with available N (178.3–187.5 kg ha⁻¹), P (9.15–10.46 kg ha⁻¹), K (169.51–173.42 kg ha⁻¹), along with organic carbon (0.37–0.46%) and EC (0.26–0.34 dS m⁻¹), showing higher values particularly under T₃ and T₈. Economic analysis revealed that maximum net returns (₹1,52,129 ha⁻¹) and B:C ratio (5.88) were recorded under T₃ (100% RDF), followed by T₈ (₹1,45,913 ha⁻¹; 5.45) and T₅ (₹1,39,602 ha⁻¹; 5.47). It may be concluded that application of organic manures with reduced RDF, particularly T₈ (75% RDF + Vermicompost @ 1 t ha⁻¹), enhanced growth, yield, nutrient uptake and soil fertility comparable to 100% RDF. However, from an economic standpoint, 100% RDF proved most efficient, though integrated nutrient management with 75% RDF + Vermicompost offers a sustainable and economically viable strategy for finger millet cultivation in western Uttar Pradesh.

Keywords: INM, vermicompost, earhead length, no. of grain per earhead

1. Introduction

A Worldwide Rebirth Driven by India, The United Nations General Assembly (UNGA) designated 2023 to be the International Year of Millets (IYOM) in response to a proposal by the Government of India backed by 72 countries, marking a significant step toward addressing global food security and nutrition concerns. This proclamation represents a turning point in agricultural policy, directing attention toward crops that are both naturally sustainable and nutrient-dense. IYOM's primary goal is to turn millets from a traditional, frequently disregarded staple into a "Superfood" that is known around the world. It seeks to promote sustainable production methods that open up new markets for both producers and consumers, as well as to increase knowledge of their enormous health advantages and appropriateness for cultivation in challenging and changing climatic circumstances. Millets, especially finger millet (*Eleusine coracana* L.), are positioned as a strategic option for nations looking to boost self-sufficiency and lessen dependency on imported cereal grains during this international celebration. United Nations. The General Assembly passed

this resolution on March 3, 2021.

India's Domination and Regional Differences. India is the world's top producer of finger millet. It is grown on over 1.18 million hectares in India, producing 1.8 million tons with an average productivity of 1747 kg/ha in 2024–2025 (ICAR-IIMR, Hyderabad, 2024). The state of finger millet in the Indo-Gangetic plains, especially in Uttar Pradesh, is a crucial area of research, as the text supplied highlights. The crop is "not grown on a large scale" in Uttar Pradesh, according to the text. In 2022–2023, 17.32 million tonnes of millets (Shree Anna) were produced. Pearl millet (21.95 lakh tonnes), tiny millet (0.41 lakh tonnes), and sorghum (4.62 lakh tonnes) were all produced in Uttar Pradesh area covered by small millet, sorghum millet, and pearl millet in 2023–2024 (2173 k/g, 1600 k/g, and 869 k/g, respectively) (2nd Advance Estimates, APEDA, 2023–24). This lack of information highlights the necessity for targeted studies in areas like western Uttar Pradesh to investigate the crop's potential for nutritional security and diversity.

Adopting a sustainable intensification paradigm through Integrated Nutrient Management (INM) is the answer to this problem. INM is a comprehensive strategy that includes the effective and prudent use of all significant plant nutrient sources, not just the application of fertilizers. This involves the deliberate combination of inorganic fertilizers, organic sources (such as compost, green manure, and farmyard manure), and biofertilizers (a liquid consortium of helpful bacteria). Additionally, INM makes a substantial contribution to soil sustainability. Continuous use of chemical fertilizers alone may cause soil acidity, nutritional imbalances, or structural deterioration. Water-use efficiency rises as a result of this better soil health.

2. Materials and Methods

This chapter provides a description of the materials and methodology used in the study "Effect of Integrated Nutrient management on Growth, Yield attributes and Yield of Finger millet (*Eleusine coracana* L.)." At a latitude of 29.081833 North, longitude of 77.700589 East, and elevation of 237 meters above mean sea level, the field experiment was conducted at the Crop Research Center of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.). Meerut has a subtropical climate and is located in the center of Western Uttar Pradesh. The geography of the trial field was uniform, and the drainage system was effective.

The experimental field's soil had a sandy loam texture, low levels

of accessible nitrogen and organic carbon, medium levels of available phosphorus and potassium, and a reaction that was almost neutral. VL MADUA 376 was sown on 23 August 2025. The experiment was laid out in a Randomized Block Design (RBD) with 9 treatments with 3 replications. Nine plots of gross plot size (5 m × 4 m) and net plot size (4 m x 3.2 m) were included in each replication.

3. Results and Discussion
3.1 Yield attributing characters

The yield attributes were observed and the mean values are shown in table 1.1a & 1.1b.

To assess the impact of integrated nutrient management on crop productivity, observations on yield attributes—namely, the number of fingers per earhead, the number of grains per finger, and the 1000-grain weight (g)—were made and compared amongst various treatments.

T₃ (100% RDF) produced 9.2 fingers per earhead, 166 grains per finger, and a 1000-grain weight of 3.67 g, the greatest values for all yield parameters for all treatments.

The balanced and sufficient nutrient supply may have contributed to T₃'s superior performance by improving flowering, grain setting, assimilate translocation, and grain filling, all of which improved yield components.

The treatments T₈ (75% RDF + Vermicompost @ 1 t ha⁻¹) and T₅ (75% RDF + FYM @ 2 t ha⁻¹) were statistically at par and rated next after T₃. T₅ generated 8.5 fingers per earhead, 157 grains per finger, and a test weight of 3.56 g, whereas T₈ recorded 8.8 fingers per earhead, 162 grains per finger, and a test weight of 3.59 g. T₁ (Absolute Control), on the other hand, had the lowest values—5.4 fingers per earhead, 119 grains per finger, and a 1000-grain weight of 3.18 g.

The yield parameters, namely number of fingers per earhead, number of grains per finger, and 1000-grain weight, were recorded to determine the effect of integrated nutrition management on crop productivity. With 9.2 fingers per earhead, 166 grains per finger, and 3.67 g test weight, T₃ (100% RDF) had the highest numbers. T₈ (75% RDF + Vermicompost @ 1 t ha⁻¹) and T₅ (75% RDF + FYM @ 2 t ha⁻¹) recorded 8.8, 162, 3.59 g and 8.5, 157, 3.56 g, respectively, and were statistically equivalent. T₁ (Absolute Control) recorded the lowest numbers (5.4 fingers, 119 grains per finger, and 3.18 g). T₅ and T₈ greatly exceeded the other therapies, while T₃ was the most successful overall.

Table 1.1a: Yield attributes in finger millet as affected by different INM practices at different growth stages

Symbol	Treatments	Yield Attributes		
		Effective tillers/m2	Finger length(cm)	Ear weight (g)
T ₁	Absolute Control	60.21	4.73	4.59
T ₂	FYM @ 8 t/ha	85.12	5.82	5.71
T ₃	100% RDF	125.73	7.89	8.13
T ₄	50% RDF + FYM @ 4 t/ha	93.08	6.21	6.02
T ₅	75% RDF + FYM @ 2 t/ha	116.43	7.28	7.52
T ₆	FYM @ 4 t/ha + Vermicompost @ 1.5 t/ha	89.14	6.08	5.88
T ₇	FYM @ 6 t/ha + Vermicompost @ 1.5 t/ha	99.18	6.37	6.35
T ₈	75% RDF + Vermicompost @ 1 t/ha	119.76	7.51	7.87
T ₉	50% RDF + FYM @ 2 t/ha + Vermicompost @ 1 t/ha	102.64	6.68	6.54
SEm±		3.37	0.22	0.22
CD(P=0.05)		10.09	0.66	0.64

Table 1.2b: Yield attributes in finger millet as affected by different INM practices at different growth stages

Symbol	Treatments	Yield Attributes		
		No. of fingers/ Earhead	No. of grains/Finger	1000 Grain weight(g)
T ₁	Absolute Control	5.4	119	3.18
T ₂	FYM @ 8 t/ha	6.5	132	3.31
T ₃	100% RDF	9.2	166	3.67
T ₄	50% RDF + FYM @ 4 t/ha	7.4	148	3.42
T ₅	75% RDF + FYM @ 2 t/ha	8.5	157	3.50
T ₆	FYM @ 4 t/ha + Vermicompost @ 1.5 t/ha	6.7	137	3.35
T ₇	FYM @ 6 t/ha + Vermicompost @ 1.5 t/ha	7.1	142	3.48
T ₈	75% RDF + Vermicompost @ 1 t/ha	8.8	162	3.53
T ₉	50% RDF + FYM @ 2 t/ha + Vermicompost @ 1 t/ha	7.8	151	3.49
	Sem±	0.24	4.86	0.02
	CD(P=0.05)	0.74	14.88	0.12

3.2 Yield

The yield attributes was observed and the mean values are shown in table 2.1. To assess the impact of integrated nutrient management on crop production, measurements were made on grain yield, straw yield, biological yield, and harvest index. There were notable variations amongst the treatments. Grain yield (31.23 q ha⁻¹), straw yield (61.42 q ha⁻¹), biological yield (92.65 q ha⁻¹), and harvest index (33.70%) were all highest in T₃ (100% RDF). The balanced and sufficient nutrient supply, which encouraged improved crop development, dry matter production, and effective transfer of photosynthates to the grains, may be

responsible for T₃'s excellent performance.

The treatments T₈ (75% RDF + Vermicompost @ 1 t ha⁻¹) and T₅ (75% RDF + FYM @ 2 t ha⁻¹) were statistically at par and rated next after T₃. T₈ recorded 30.45 q ha⁻¹ grain yield, 59.92 q ha⁻¹ straw yield, 91.59 q ha⁻¹ biological yield, and 33.10% harvest index, while T₅ recorded 29.12 q ha⁻¹, 57.12 q ha⁻¹, 87.80 q ha⁻¹, and 33.16%, respectively. In comparison, T₁ (Absolute Control) had the lowest values, with 15.13 q ha⁻¹ grain yield, 41.85 q ha⁻¹ straw yield, 56.98 q ha⁻¹ biological yield, and 26.55% harvest index.

Table 2.1: Yield in finger millet as affected by different INM practices at different growth stages

Symbol	Treatments	Yield (q/ha)	
		Grains	Straw
T ₁	Absolute Control	14.13	39.35
T ₂	FYM @ 8 t/ha	20.67	46.63
T ₃	100% RDF	21.78	48.87
T ₄	50% RDF + FYM @ 4 t/ha	21.14	47.78
T ₅	75% RDF + FYM @ 2 t/ha	28.12	54.62
T ₆	FYM @ 4 t/ha + Vermicompost @ 1.5 t/ha	21.17	47.78
T ₇	FYM @ 6 t/ha + Vermicompost @ 1.5 t/ha	23.69	51.46
T ₈	75% RDF + Vermicompost @ 1 t/ha	29.45	57.42
T ₉	50% RDF + FYM @ 2 t/ha + Vermicompost @ 1 t/ha	24.41	51.72
	SEm±	0.89	1.78
	CD(P=0.05)	2.50	5.35

3.3 Economics

The purpose of the economic analysis was to assess how integrated nutrient management affected cultivation costs, gross return, net return, and the benefit-cost (B:C) ratio. There were notable variations amongst the treatments. With a cultivation cost of ₹35,146 ha⁻¹, a gross return of ₹183,299 ha⁻¹, a net return of ₹152,129 ha⁻¹, and the highest B:C ratio of 5.21, T₃ (100% RDF) had the highest economic returns of all the treatments. The greater economic performance of T₃ was mainly due to increased grain and straw yields, which delivered maximum returns despite the

moderate cost of cultivation.

The treatments T₈ (75% RDF + Vermicompost @ 1 t ha⁻¹) and T₅ (75% RDF + FYM @ 2 t ha⁻¹) were statistically at par and rated next after T₃. T₅ reported ₹35,214 ha⁻¹, ₹170,840 ha⁻¹, ₹139,602 ha⁻¹, and a B:C ratio of 4.85, whereas T₈ recorded ₹36,208 ha⁻¹, ₹178,738 ha⁻¹, net return of ₹145,913 ha⁻¹, and a B:C ratio of 4.93. T₁ (Absolute Control), on the other hand, had the lowest economic returns, with a B:C ratio of 3.07, a gross return of ₹94,850 ha⁻¹, and a net return of ₹68,026.

Table 3: Economics of finger millet as affected by different INM practices at different growth stages

Symbol	Treatments	Economic return (Rs/ha)			B:C Ratio
		Cost of cultivation	Gross return	Net return	
T ₁	Absolute Control	26824	94850	68026	3.53
T ₂	FYM @ 8 t/ha	31444	130444	99000	4.15
T ₃	100% RDF	31170	183299	152129	5.88
T ₄	50% RDF + FYM @ 4 t/ha	31307	136988	105681	4.38
T ₅	75% RDF + FYM @ 2 t/ha	31238	170840	139602	5.47
T ₆	FYM @ 4 t/ha + Vermicompost @ 1.5 t/ha	36944	133316	96372	3.61
T ₇	FYM @ 6 t/ha + Vermicompost @ 1.5 t/ha	37944	147615	109671	3.89
T ₈	75% RDF + Vermicompost @ 1 t/ha	32825	178738	145913	5.45
T ₉	50% RDF + FYM @ 2 t/ha + Vermicompost @ 1 t/ha	35307	151263	115956	4.28

4. Conclusion

On the basis of the results obtained during the present investigation, it may be concluded that INM improve yield attributes, yield and economics of ragi. Treatment T₃ 100% RDF recorded highest productivity and profitability among all. Treatment T₈, 75% RDF + Vermicompost @ 1 t/ha produced grain yield and net return comparable to 100% RDF, indicate that a portion of chemical fertilizers can be successfully substituted with organic nutrient source without compromising crop performance.

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