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Effect of integrated nutrient management on yield and yield attributes of summer sesame (*Sesamum indicum* L.)

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Abstract

Integrated Nutrient Management (INM) is a sustainable approach for improving crop productivity while maintaining soil fertility through the combined use of inorganic fertilizers, organic manures and beneficial microorganisms. A field experiment was conducted during the summer season of 2026 at the Agricultural Research Station, Karimnagar, Telangana state, India, on red sandy loam soil that was low in organic carbon (0.49%) and available nitrogen (212.5 kg ha⁻¹), medium in available phosphorus (24.5 kg ha⁻¹) and potassium (255.75 kg ha⁻¹) to evaluate the effect of integrated nutrient management on the yield and yield attributes of summer sesame (*Sesamum indicum* L.). The experiment was laid out in a Randomized Block Design (RDF) with eleven treatments and three replications. The treatments consisted of different levels of recommended fertilizer dose (RDF) applied alone and in combination with farmyard manure (FYM), vermicompost, poultry manure, sheep manure and microbial consortia. Among the different nutrient management, application of 100% recommended nitrogen dose (RDN) along with 25% nitrogen through poultry manure and microbial consortia (T₉) recorded superior yield attributes and yield, including capsules plant⁻¹ (66.4), seeds capsule⁻¹ (67.87), capsule length (3.57 cm), seed yield (1143 kg ha⁻¹) and stalk yield (2407 kg ha⁻¹) compare to other treatments, while capsule width (8.4 mm), test weight (2.89 g) and harvest index (32.3%) were numerically higher but remained statistically non-significant. The study demonstrated that substitution of 25% recommended nitrogen through poultry manure along with microbial consortia is an effective integrated nutrient management strategy for enhancing the yield and yield attributes of summer sesame, while reducing dependence on inorganic fertilizers and promoting sustainable crop production.

Keywords: Sesame, integrated nutrient management, poultry manure, microbial consortia, vermicompost

1. Introduction

Sesame (*Sesamum indicum* L.) is among the most ancient and prominent edible oilseed crop cultivated globally, classified under the Pedaliaceae family and commonly referred to as 'til', is often regarded as the "queen of oilseeds." It is a drought-tolerant crop, valued for its high nutritional and medicinal properties with seeds containing about 50% oil, 18-20% protein, 14-16% carbohydrates and rich in linoleic acid (40%) that imparts antibacterial, antifungal, antiviral and anti-inflammatory properties while also providing 6335 K Cal kg⁻¹ of dietary energy. (Chaturvedi *et al.*, 2025) ^[1].

India had a total area of 1576 thousand hectares under sesame cultivation in 2024-25, yielding 893 thousand tonnes with an average productivity of 567 kg ha⁻¹ (Indiastat, 2024-25) ^[5]. Major sesame producing states are Madhya Pradesh, Rajasthan, Gujarat, Uttar Pradesh, West Bengal, Andhra Pradesh, Tamil Nadu and Telangana.

Continuous reliance on chemical fertilizers in intensive cropping systems deteriorates soil nutrient balance and negatively affects its physical, chemical and biological properties. Therefore, to ensure sustainable productivity, emphasis should be placed on integrated nutrient management (Vani *et al.*, 2017) ^[13].

Integrated Nutrient Management (INM) refers to the practice of applying mineral fertilizers in combination with organic inputs such as farmyard manure, crop residues, composts, urban and rural wastes, green manures and biofertilizers. The core principle behind integrated nutrient management is to sustain soil fertility and crop yields by making optimal use of all available

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nutrient sources in a balanced and integrated way (Chauhan *et al.*, 2022) [2]. FYM is the oldest form of organic manure used by the farmers in growing crops because of its easily availability and presence of all the nutrients required by the plants. Farmyard manure refers to the decomposed mixture of dung and urine of farm animals along with litter and left over material from roughages or fodder fed to the cattle. On an average, well decomposed farmyard manure contains 0.5% N, 0.2% P₂O₅ and 0.5% K₂O (Salman *et al.*, 2020) [11]. Poultry and sheep manures are valuable organic fertilizers commonly used in sustainable soil management. They not only supply essential nutrients for plant growth and development but also enrich the soil with organic matter. Their application has been shown to positively influence both the yield and quality of sesame seeds (Ismail *et al.*, 2021) [6]. Vermicompost is a nutrient-rich organic amendment, it improves soil structure, porosity, aeration and moisture retention while promoting root growth and natural hormone production. Vermicompost not only serves as a fertilizer and soil conditioner but also boosts microbial activity, crop growth and yield (Mokariya *et al.*, 2021) [8]. Biofertilizers have an important place in modern agriculture. *Azotobacter*, one such biofertilizer, provides nitrogen a key nutrient for plant growth and yield through biological nitrogen fixation. This organism generally colonizes the rhizosphere rather than the root surface and contributes to root protection by suppressing soil pathogens (Lokhande *et al.*, 2020) [7]. Therefore, it becomes essential to scientifically evaluate the effectiveness of different organic sources, in combination with inorganic fertilizers and microbial inoculants, especially in sesame. Based on this rationale, the present investigation is entitled “Effect of integrated nutrient management on the yield and yield attributes of summer sesame (*Sesamum indicum* L.)”.

2. Materials and Methods

A field experiment was conducted during the summer season of 2026 at the Agricultural Research Station (ARS), Karimnagar, Professor Jayashankar Telangana Agricultural University (PJTUA), Hyderabad, Telangana, India. The experimental site is situated at 18°30' N latitude and 79°15' E longitude, at an altitude of 259.15 m above mean sea level and falls under the Northern Telangana Zone with a semi-arid tropical climate according to Troll's climatic classification. The experimental soil was sandy clay loam in texture with a pH of 6.5, electrical conductivity (EC) of 0.36 dS m⁻¹, organic carbon of 0.49%, available nitrogen of 212.5 kg ha⁻¹, available phosphorus (P₂O₅) of 24.5 kg ha⁻¹ and available potassium (K₂O) of 255.75 kg ha⁻¹ before sowing. The experiment was laid out in a Randomized Block Design (RBD) comprising eleven treatments with three replications. Sesame variety JCS-2454 (Jagtial Til-2) was sown on 21 January 2026 at a spacing of 30 X 15 cm using a seed rate of 6.25 kg ha⁻¹. The gross and net plot sizes were 4.5 X 4.5 m and 3.9 X 4.2 m, respectively. The treatments consisted of different combinations of inorganic fertilizers, organic manures and microbial consortia as follows: T₁: 75% Recommended Dose of Fertilizers (RDF), T₂: 100% RDF (80:20:20 kg N: P₂O₅: K₂O ha⁻¹), T₃: 125% RDF, T₄: 75% Recommended Dose of Nitrogen (RDN) + 25% nitrogen through farmyard manure (FYM) + Microbial Consortia (MC) @ 5 kg ha⁻¹, T₅: 100% RDN + 25% nitrogen through farm yard manure (FYM) + MC @ 5 kg ha⁻¹, T₆: 75% RDN + 25% nitrogen through vermicompost + MC @ 5 kg ha⁻¹, T₇: 100% RDN + 25% nitrogen through vermicompost + MC @ 5 kg ha⁻¹, T₈: 75% RDN + 25% nitrogen through poultry manure + MC @ 5 kg ha⁻¹, T₉: 100% RDN + 25% nitrogen through poultry manure + MC @ 5 kg ha⁻¹, T₁₀: 75% RDN + 25% nitrogen through sheep manure +

MC @ 5 kg ha⁻¹ and T₁₁: 100% RDN + 25% nitrogen through sheep manure + MC @ 5 kg ha⁻¹.

2.1 Nutrient composition of organic manures

S. No.	Organic manures	Nutrient content%		
		N	P	K
1	FYM	0.5	0.2	0.5
2	Vermicompost	1.8	0.2	0.6
3	Poultry manure	2.5	2.0	1.3
4	Sheep manure	1.5	0.8	1.1

The recommended dose of fertilizer (80:20:20 kg N: P₂O₅: K₂O ha⁻¹) was supplied through urea, single superphosphate (SSP) and muriate of potash (MOP). In integrated nutrient management treatments, the quantities of farmyard manure, vermicompost, poultry manure and sheep manure required to supply 25% of the recommended nitrogen were calculated based on their nutrient composition. The remaining nitrogen was supplied through urea in two equal splits at sowing and 30 days after sowing (DAS). The full doses of phosphorus and potassium were applied basally. Microbial consortia containing *Azotobacter*, phosphorus-solubilizing bacteria, potassium-solubilizing bacteria and zinc-solubilizing bacteria were applied basally at 5 kg ha⁻¹ in all integrated nutrient management treatments. Biometric observations related to yield were recorded from five randomly selected and tagged plants in each experimental plot. The experimental data were subjected to analysis of variance (ANOVA) appropriate for a Randomized Block Design (RBD) following the procedure outlined by Panse and Sukhatme (1985) [9]. Treatment means were compared using the F-test at the 5% level of significance. Wherever treatment effects were significant, the Critical Difference (CD) at p = 0.05 was calculated, while non-significant treatment differences were denoted as NS.

3. Results and discussion

3.1 Yield attributes and yield

3.1.1 No. of capsules plant⁻¹

Integrated nutrient management significantly influences the no. of capsules plant⁻¹. The highest no. of capsules plant⁻¹ (66.4) was recorded under T₉, which was found to be on par with T₇ (64.7). Treatments T₁₁ (60.0), T₅ (60.0), T₃ (59.5), T₈ (59.0) and T₆ (58.8) recorded intermediate values, whereas the lowest no. of capsules plant⁻¹ (50.5) was recorded under T₁, which was significantly inferior to all the other treatments.

The increased no. of capsules under INM treatments due to improved nutrient availability throughout the crop growth period, which promoted better vegetative growth, greater photosynthetic activity and efficient translocation of assimilates towards reproductive organs. The combined application of organic manures, inorganic fertilizers and microbial consortia provided a favourable rhizosphere environment, resulting in better flower retention and capsule development. The superior performance of T₉ indicates the beneficial role of poultry manure in combined with recommended nitrogen and microbial consortia in enhancing reproductive growth and capsule formation. The present findings are in agreement with Haruna and Abimiku (2012) [4].

3.1.2 No. of seeds capsule⁻¹

The no. of seeds capsule⁻¹ was significantly influenced by the INM practices. The highest no. of seeds capsule⁻¹ (67.87) was recorded under T₉, which was found to be on par with T₇ (67.37). Treatments T₁₁ (61.01), T₅ (59.21), T₃ (58.43), T₈ (57.80) and T₆ (56.39) recorded intermediate values, whereas the lowest no. of

seeds capsule⁻¹ (48.30) was recorded under T₁, which was significantly inferior to all the other treatments.

The higher no. of seeds capsule⁻¹ under INM treatments due to improved nutrient uptake and better photosynthate production during the reproductive stage, which enhanced fertilization and seed setting. The continuous nutrient supply from organic manures along with inorganic fertilizers and microbial consortia improved assimilate availability for developing capsules, resulting in increased seed formation. The present results are supported by Pushpanjali *et al.* (2021) [10].

3.1.3 Capsule length (cm)

Capsule length was significantly influenced by the INM. The maximum capsule length (3.57 cm) was recorded under T₉, which was found to be on par with T₇ (3.30 cm). Treatments T₁₁ (3.17 cm), T₅ (3.10 cm), T₃ (3.00 cm), T₈ (2.86 cm) and T₆ (2.76 cm) recorded intermediate values. The minimum capsule length (2.36 cm) was recorded under T₁, which was significantly inferior to all the other treatments.

The improvement in capsule length under INM treatments due to balanced nutrient availability, which supported better cell division and cell elongation during capsule development. The sustained nutrient supply through organic manures and microbial consortia favoured proper reproductive growth, resulting in longer capsules. The present results are supported by Tirkey *et al.* (2021) [12].

3.1.4 Capsule width (mm)

Capsule width was not significantly influenced by the INM practices. Numerically, the highest capsule width (8.4 mm) was recorded under T₉, followed by T₇ (8.2 mm), T₁₁ (8.1 mm), T₅ (8.0 mm), T₃ (7.9 mm), T₈ (7.7 mm) and T₆ (7.6 mm) whereas the lowest capsule width (7.0 mm) was recorded under T₁. Although numerical differences were observed among the treatments, they were statistically non-significant.

Capsule width is largely governed by the genetic makeup of the variety and is therefore less responsive to nutrient management than other yield attributes. Although INM improved nutrient availability and overall crop growth, the variation in capsule width among treatments was not sufficient to produce statistically significant differences. The uniform genetic background of the crop and similar environmental conditions might have minimized treatment effects on this trait.

3.1.5 Seed yield (kg ha⁻¹)

The seed yield of sesame was significantly influenced by the INM. The highest seed yield (1143 kg ha⁻¹) was recorded under T₉, which was found to be on par with T₇ (1107 kg ha⁻¹). Treatments T₁₁ (940 kg ha⁻¹), T₅ (923 kg ha⁻¹), T₃ (827 kg ha⁻¹), T₈ (821 kg ha⁻¹) and T₆ (802 kg ha⁻¹) recorded intermediate values, whereas the lowest seed yield (588 kg ha⁻¹) was recorded under T₁, which was significantly inferior to all the other treatments.

Seed yield is the cumulative expression of various growth and yield attributes developed during the crop growth period. The significantly higher seed yield recorded under INM treatments due to improved plant growth, greater leaf area, higher dry matter accumulation and superior yield attributes such as no. of capsules plant⁻¹, no. of seeds capsule⁻¹ and capsule size. The combined application of inorganic fertilizers, organic manures and microbial consortia ensured a continuous and balanced supply of nutrients throughout the crop growth period, resulting in improved nutrient uptake and efficient utilization of photosynthates.

The superior performance of T₉ due to the comparatively higher nutrient content and faster mineralization of poultry manure, which ensured timely nutrient availability during the critical stages of flowering, capsule development and seed filling which ultimately contributed to higher seed yield. The microbial consortia might have further enhanced nutrient solubilization and uptake, thereby improving nutrient use efficiency and crop productivity. The lower seed yield recorded under T₁ could be attributed to comparatively lower nutrient availability, which adversely affected vegetative growth, yield attributes and assimilate production, thereby resulting in reduced seed yield. The higher seed yield obtained in the present investigation agrees with the observations of Haruna *et al.* (2011) [3].

3.1.6 Stalk yield

The stalk yield of sesame was significantly influenced by the integrated nutrient management. The highest stalk yield (2407 kg ha⁻¹) was recorded under T₉, which was found to be on par with T₇ (2376 kg ha⁻¹). Treatments T₁₁ (2167 kg ha⁻¹), T₅ (2153 kg ha⁻¹), T₃ (2052 kg ha⁻¹), T₈ (2045 kg ha⁻¹) and T₆ (2015 kg ha⁻¹) recorded intermediate values, whereas the lowest stalk yield (1569 kg ha⁻¹) was recorded under T₁, which was significantly inferior to all the other treatments.

The increased stalk yield under INM treatments may be attributed to enhanced vegetative growth and greater biomass production resulting from balanced nutrient availability. The superior stalk yield recorded under T₉ could be attributed to the relatively higher nutrient content and sustained nutrient release from poultry manure, coupled with improved nutrient mobilization by microbial consortia. The lowest stalk yield recorded under T₁ may be due to restricted vegetative growth under reduced fertilizer application, which limited biomass production throughout the crop growth period. Similar findings were reported by Venkatesh *et al.* (2023) [14].

3.1.7 Test Weight (g) (1000-Seed Weight)

The test weight of sesame was not significantly influenced by the INM. Numerically, the highest test weight (2.89 g) was recorded under T₉, followed by T₇ (2.77 g), T₁₁ (2.75 g), T₅ (2.75 g), T₃ (2.71 g), T₈ (2.69 mm) and T₆ (2.66 mm) whereas the lowest (2.53 g) was observed under T₁.

The non-significant variation in test weight indicates that seed size is largely governed by the genetic makeup of the variety and is comparatively less influenced by nutrient management practices. Although integrated nutrient management treatments recorded slightly higher numerical values, the differences were not sufficient to attain statistical significance. Similar findings were reported by Lokhande *et al.* (2020) [7].

3.1.8 Harvest Index (%)

The harvest index was not significantly influenced by the INM. Numerically, the highest harvest index (32.3%) was recorded under T₉, followed by T₇ (31.7%), T₁₁ (30.3%), T₅ (30.2%), T₃ (29.5%), T₈ (28.9%) and T₆ (28.5%) whereas the lowest harvest index (27.3%) was recorded under T₁. However, the differences among the treatments were statistically non-significant.

Harvest index represents the efficiency with which the plant partitions total dry matter into economic yield. The non-significant variation observed among the treatments indicates that although INM improved both seed yield and stalk yield, the proportion of biomass partitioned towards seed production remained relatively similar across the treatments. Since both economic yield and biological yield increased simultaneously

under integrated nutrient management, the harvest index did not vary significantly. The slight numerical increase observed under T₉ might be due to relatively better partitioning of assimilates towards developing seeds; however, the differences were not sufficient to attain statistical significance. The present findings

are in agreement with Tirkey *et al.* (2021) [12].

3.1 Effect of integrated nutrient management on yield and yield attributes of summer sesame

		No. of Capsules plant ⁻¹	No. of seeds capsule ⁻¹	Capsule length (cm)	Capsule width (mm)	Seed yield (kg ha ⁻¹)	Stalk yield (kg ha ⁻¹)	Test weight (g)	Harvest index (%)
T ₁	75% RDF (60:15:15 kg N-P ₂ O ₅ -K ₂ O ha ⁻¹)	50.5	48.30	2.36	7.00	588	1569	2.53	27.3
T ₂	100% RDF (80:20:20 kg N-P ₂ O ₅ -K ₂ O ha ⁻¹)	57.4	55.53	2.66	7.40	772	1959	2.63	28.2
T ₃	125% RDF (100:25:25 kg N-P ₂ O ₅ -K ₂ O ha ⁻¹)	59.5	58.43	3.00	7.90	827	2052	2.71	29.5
T ₄	75% RDN + 25% N through FYM + Microbial Consortia (MC) @ 5 kg ha ⁻¹	54.0	53.60	2.46	7.30	716	1805	2.63	28.4
T ₅	100% RDN + 25% N through FYM + Microbial Consortia (MC) @ 5 kg ha ⁻¹	60.0	59.21	3.10	8.00	923	2153	2.75	30.2
T ₆	75% RDN + 25% N through Vermicompost (VC) + Microbial Consortia (MC) @ 5 kg ha ⁻¹	58.8	56.39	2.76	7.60	802	2015	2.66	28.5
T ₇	100% RDN + 25% N through Vermicompost (VC) + Microbial Consortia (MC) @ 5 kg ha ⁻¹	64.7	67.37	3.30	8.10	1107	2376	2.77	31.7
T ₈	75% RDN + 25% N through Poultry manure (PM) + Microbial Consortia (MC) @ 5 kg ha ⁻¹	59.0	57.80	2.86	7.70	821	2045	2.69	28.9
T ₉	100% RDN + 25% N through Poultry manure (PM) + Microbial Consortia (MC) @ 5 kg ha ⁻¹	66.4	67.87	3.57	8.40	1143	2407	2.89	32.3
T ₁₀	75% RDN + 25% N through Sheep manure (SM) + Microbial Consortia (MC) @ 5 kg ha ⁻¹	56.9	55.27	2.56	7.10	752	1815	2.63	29.3
T ₁₁	100% RDN + 25% N through Sheep manure (SM) + Microbial Consortia (MC) @ 5 kg ha ⁻¹	60.0	61.01	3.17	8.20	940	2167	2.75	30.3
	S.Em ±	1.98	2.16	0.13	0.34	38.85	77.54	0.13	1.41
	CD (p=0.05)	5.9	6.42	0.37	NS	115.41	230.35	NS	NS

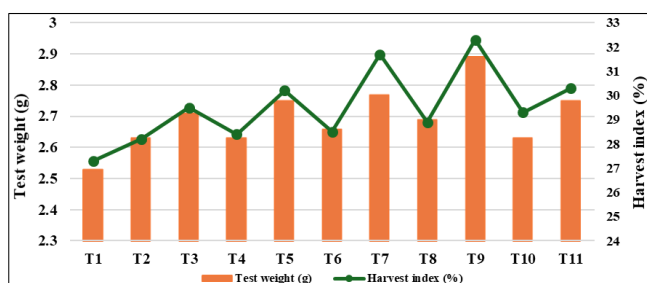


Fig 1: Effect of integrated nutrient management on Test weight (g) and Harvest index (%) of summer sesame.

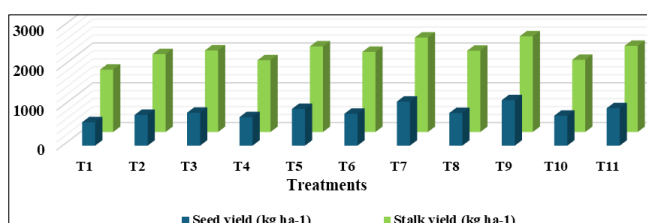


Fig 2: Effect of integrated nutrient management on seed and stalk yield of summer sesame.

Conclusion

The present investigation demonstrated that integrated nutrient management significantly improved the yield and yield attributes of summer sesame. Among the different nutrient management, application of 100% RDN + 25% nitrogen through poultry manure along with microbial consortia (T₉) recorded superior yield attributes, seed yield and stalk yield compared to the other treatments. Therefore, it can be concluded that substituting 25% of the recommended nitrogen through poultry manure along with microbial consortia is an effective integrated nutrient management strategy for enhancing sesame productivity while sustaining soil fertility. The adoption of this practice can reduce

dependence on inorganic fertilizers and promote sustainable sesame cultivation.

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