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Research Communication

Combined effect of organic sources of manure with inorganic fertilizer on growth, yield, quality and economics of sesame (*Sesamum indicum*) in foothill of Nagaland

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ABSTRACT

Sesame, traditionally grown in low-input systems, has been modernized and mechanized due to breeding advancements. However, there is a lack of research on fertilization needs for both modern and traditional agricultural systems. A field experiment was conducted to study the impact of organic manure and inorganic fertilizer on the growth, yield, and quality of sesame during the *Kharif* season of 2022. The experiment was laid out in randomized block design (RBD) with ten treatment combinations viz., T_1, Control; T_2, 25% N through pig manure + 75% RDN (recommended dose of nitrogen); T_3, 25% N through poultry manure+75% RDN; T_4, 25% N through FYM + 75% RDN; T_5, 25% N through vermicompost+75% RDN; T_6, 50% N through pig manure + 50% RDN; T_7, 50% N through Poultry manure + 50% RDN; T_8, 50% N through FYM + 50% RDN; T_9, 50% N through Vermicompost + 50% RDN; T_{10}, 100% RDN which were replicated thrice. The results indicated that maximum plant height at 90 days after sowing (DAS) and at harvest stage was noticed under T_{10} as compared to the other treatments, respectively. At 70 DAS, significant maximum number of branches per plant and 60 DAS highest leaf area index (LAI) was recorded under T_{10}. Similarly, treatment T_{10} resulted the highest value of crop growth rate (CGR) and relative growth rate (RGR) at 60 DAS as compared to the control plot. As compared to the T_1, significantly higher number of capsules/plant and length of capsule was recorded under T_{10} followed by T_3 and lowest was observed under control (T_1). The seed yield and stover yield significantly maximum observed in treatment T_{10} (100% RDN) but this treatment at par with treatment T_3 (25%N through poultry manure+75%RDN). Control (T_1) treatment recorded the minimum seed yield and stover yield. In case of quality parameters, maximum value of oil yield and protein content was recorded under T_{10} as compared to the control plot. However, due to the highest yield obtained under treatment T_{10}, followed by T_3, resulting in the highest B:C ratio of 2.60 and 2.17, respectively.

***Key words*:** Growth, Nutrient management, Quality, Yield

Sesame (*Sesamum indicum* L.) is an ancient and important oil seed crop in India. It is commonly grown in poor fertile land with very little attention and less use of required agro-inputs particularly manures and fertilizer. Sesame was cultivated on an area of 15.23 lakh ha with production of 8.02 lakh tonnes and productivity of 527 kg/ha during 2022–23 (Anonymous 2023). Sesame is an ancient oilseed crop with a long history of cultivation. The crop is valued for its high-quality edible oil and its applications in food, biomedicine and healthcare. Known as the "queen of oilseeds," sesame oil boasts superior nutritional, medicinal, cosmetic and culinary properties. It can be grown in all seasons and fits well into various cropping systems due to its short growth cycle. Sesame seeds are rich in quality proteins and essential amino acids, particularly methionine, which is associated with rejuvenation and anti-aging benefits. Additionally, they are a good source of linoleic acid, vitamins E, A, B_1, B_2, niacin and important minerals like calcium and phosphorus. Sesame seeds are often used in baby foods and are regarded as a suitable alternative to mother's milk (Mostashari and Mousavi, 2024). Sesame is an oilseed crop with a balanced ratio of unsaturated and saturated fatty acids and about 50% edible oil. Addition-

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ally, seeds are a great source of useful compounds including sesamol, sterols, and tocopherols. Because of their antioxidative qualities, these compounds not only benefit human health but also extend the oil's shelf life. This exceptional quality is why sesame is celebrated as the queen of oils (Rauf *et al.,* 2024).

Due to several production obstacles, sesame cultivation output remained extremely low for many years. One of the main things limiting output is inadequate soil fertility, which is made worse by bad cultural practices like monocropping. For extended periods, the Humera plains' soils have supported agricultural production without the need for outside assistance. Monocropping, or the repetitive cultivation of sesame, has caused the topsoil to lose nutrients, which has decreased productivity (Amare *et al.,* 2019). The widespread use of chemical fertilizers, careless pesticide application, an increase of pesticide/herbicide resistance, pesticide residue in food, and the disturbance and deterioration of agro-ecosystems are all consequences of contemporary agriculture. Overuse of agrochemicals causes nutritional imbalance, lowers soil production, and increases pollution (Sujatha *et al.,* 2023).

Integration of organic and inorganic fertilizers has proven to be effective in not only sustaining higher productivity but also enhancing the stability of crop production (Verma *et al.,* 2013). There is a pressing need to promote the use of organic inputs to decrease reliance on chemical fertilizers and support a pollution-free environment. Farmyard manure, vermicompost, poultry manure and pig manure are recommended as valuable organic manures within integrated nutrient management strategies for sesame crops in this state. However, it has not been demonstrated by science that appropriate and efficient nutrient management leads to increased productivity. Extended application of chemical fertilizers exclusively in intensive cropping systems results in an unfavourable nutritional status of the soil and detrimental impacts on its physico-chemical and biological characteristics (Sahoo *et al.,* 2022). Therefore, an integrated nutrient management strategy that emphasizes the prudent and efficient use of organic, chemical and biological sources of plant nutrients in combination is necessary to increase productivity on a sustainable basis.

Therefore, it is urgent need to design a system that uses organic and inorganic materials in a complimentary way to boost efficiency and reduce the requirement for inorganics. In this contest, the present study was planned to find out the suitable nitrogen combination of both organic and inorganic to realize higher and sustain sesame production during *Kharif* season.

The experimental research was carried out in the year 2022 during *kharif* season at the farm of School of Agricultural Sciences (SAS), Medziphema Campus, Nagaland University. The experiment site is situated at an altitude of 310 MSL with the geographical location at 25° 45′43″ North latitude and 95° 53′43″ East longitude. The climate is subtropical with high content of humidity, moderate temperatures and medium to high rainfall. The experimental field soil was sandy loam in the contest of soil texture and regard to organic carbon is (1.50%) rich where, *p*H (4.9) strongly acidic, available nitrogen (220.2 kg/ha) is low, phosphorus (17.2 kg/ha) and potassium (140.6 kg/ha) have medium range, with electrical conductivity (0.41 dS/m) found to a safe range. The experiment was conducted in randomized block design (RBD) with ten treatments, including control. viz. T_1, Control; T_2, 25% N through pig manure + 75% RDN (recommended dose of nitrogen); T_3, 25% N through poultry manure + 75% RDN; T_4, 25% N through FYM + 75% RDN; T_5, 25% N through vermicompost + 75% RDN; T_6, 50% N through pig manure + 50% RDN; T_7, 50% N through Poultry manure + 50% RDN; T_8-50% N through FYM + 50% RDN; T_9-50% N through Vermicompost + 50% RDN; T_{10}, 100% RDN which were replicated thrice. The RDF of sesame was 60 : 40 : 40 : 30 kg NPK/ha applied. The source of fertilizers used in the study were urea for N, SSP for P, MOP for K. Before sowing the crop, germination test was checked out in the laboratory (Paper towel method) and the percentage of sesame was found to 87%. Sesame variety 'GT-10' was sown @ 4 kg/ha seed rate. The sowing was done by hand seed drill at a spacing of 30 cm × 10 cm apart row to row and plant to plant respectively, and the crop was sown on 1st September 2022. Before sowing the seeds were treated with thiram 3 g/kg of seeds and the treated seeds were dried in shade for one night and sown the next day.

Table 1. Chemical properties of poultry manure, farm yard manure, vermicompost and pig manure

Nutrient	*p*H	Organic carbon (%)	N (%)	P (%)	K (%)
Poultry manure	6.54	38.9	2.80	2.30	1.40
FYM	6.43	38.2	0.50	0.25	0.50
Vermicompost	6.36	36.6	1.22	0.22	0.48
Pig manure	6.84	35.7	0.60	0.50	0.40

Reseeding of fresh treated seed was done at 7 days after sowing wherever gaps of more than 10 cm existed in the rows. The thinning operation was done to maintain the plant-to-plant distance in rows of around 10 cm and remove overcrowded plants. The crop was harvested at 95 days after sowing. Standard methods were used to gather data. From each plot randomly selected five plants excluding border row and measure them to estimate growth attributes, including plant height (cm), number of branches per plant, leaf area index, crop growth rate (g m^2/day), relative growth rate (g g/day) and yield attributes, including seed yield (kg/ha), stover yield (kg/ha) and harvest index (%). Data on yield was gathered during the harvest by harvesting the net plot to measure the yield of grain and stover. B:C ratio was calculated the net returns divided by the cost of cultivation.

Sesame growth and yield attributes was significantly influenced by conjoint application of organic and inorganic sources of nutrients (Table 2). Application of 100% RDN (T_{10}) led to maximum growth attributes i.e. plant height (157.5 and 165.9 cm) at 90 days after sowing (DAS) and at harvest, number of branches (9.83) at 70 DAS, leaf area index (0.33 and 0.90) at 30 and 60 DAS, crop growth rate (13.5 g/m^2/day) at 40-60 DAS and relative growth rate (0.083 g g/day) at 40-60 DAS and growth attributes was significantly at par with treatment T_3 (25% N through poultry manure + 75% RDN) and lowest was recorded in the control (T_1). This might be because nitrogen encourages vegetative development, which greatly improves growth traits. Nitrogen application increased the number of new nodes formed and improved nutrient absorption and translocation, all of which improved growth characteristics. The results conformed with Patel *et al.* (2018). The increased branching and leaf area of the plant canopy were caused by the improved meristematic activity and the ensuing vertical extension of growth brought on by the steady supply of nutrients. Better development of plant canopy so direct effect of translocation of photosynthates from source to sink due to an adequate supply of nutrients to the crop led to improved growth. Similar findings were found with Pattnayak *et al.* (2024).

The data presented in Table 3 showed the significant variation of conjoint application of organic and inorganic sources of nutrients on yield attributes and yield of sesame during the study period. Application of 100% RDN (T_{10}) produced the maximum number of capsules/plant (53.0), length of capsule (3.51 cm), seed yield (620.0 kg ha^{-1}) and stover yield (2338.5 kg/ha) whereas the lowest was observed in control and it was at par with T_3(25% N through poultry manure + 75% RDN) and significantly higher than remaining treatments, respectively. This is due to the availability of additional nutrients to the crops, which may boost the number of capsules $plant^{-1}$and the length of capsule that finally resulted in enhanced output of sesamum seed yield. In integrated nutrient management (25% poultry manure + 75% RDN), plant absorbed an adequate amount of all nutrients early in its life, which is to be essential for promoting vegetative and reproductive growth, expanding the plant's absorbing surface, and enhancing photosynthesis in general. In physiological terms, the test weight of sesame is determined by the relationship between sources and sinks (Verma *et al.* 2013). 100% RDN (T_{10}) recorded the maximum oil yield (297 kg/ha) and protein content (19.8%) and was at par with T_3 (25% N through poultry manure + 75% RDN). The lowest oil yield (126.7 kg/ha) and protein content (17.2%) was observed in treatment T_1 (Control). The increase in oil and protein yield may be due to poultry manure, which can lower soil pH slightly by pro-

Table 2. Response of sesame to organic sources of manure with inorganic fertilizer on growth attributes

Treatment	Plant height (cm)		Number of branches	Leaf area index (LAI)		CGR (g /m^2 day)	RGR (g/g/day)
	90 (DAS)	At harvest	70 DAS	30 (DAS)	60 (DAS)	40–60 (DAS)	40–60 (DAS)
T_1, Control	118	121	6.67	0.16	0.62	5.58	0.046
T_2, 25% N through pig manure + 75% RDN	142	159	9.00	0.24	0.74	10.40	0.070
T_3, 25% N through poultry manure + 75% RDN	155	162	9.60	0.30	0.82	12.73	0.079
T_4, 25% N through FYM + 75% RDN	150	161	9.53	0.29	0.80	11.10	0.076
T_5, 25% N through Vermicompost + 75% RDN	147	142	9.07	0.27	0.77	10.87	0.072
T_6, 50% N through pig manure + 50% RDN	136	157	7.73	0.15	0.66	8.25	0.057
T_7, 50% N through poultry manure + 50% RDN	140	153	8.87	0.22	0.72	10.07	0.068
T_8, 50% N through FYM + 50% RDN	137	152	8.67	0.20	0.70	9.54	0.065
T_9, 50% N through Vermicompost + 50% RDN	137	152	7.70	0.18	0.68	8.90	0.060
T_{10}, 100% RDN	158	166	9.83	0.33	0.90	13.59	0.083
SEm±	5.19	5.24	0.08	0.008	0.02	0.016	0.001
CD (P=0.05)	15.4	15.5	0.25	0.021	0.07	0.048	0.004

Table 3. Response of sesame to organic sources of manure with inorganic fertilizer on yield attributes, yield, quality and economics

Treatment	Number of capsules/ plant	Length of capsule (cm)	Seed yield (kg/ha)	Stover yield (kg/ha)	Oil content (%)	Oil yield (kg/ha)	Protein content (%)	Benefit: cost Ratio
T_1, Control	36.3	1.85	306	1,478	40.2	123	17.2	0.98
T_2, 25% N through pig manure + 75% RDN	41.2	2.32	485	2,085	47.0	228	19.2	1.69
T_3, 25% N through poultry manure + 75% RDN	49.3	3.33	570	2,169	47.7	272	19.4	2.17
T_4, 25% N through FYM + 75 % RDN	44.5	2.56	518	2,132	47.4	246	19.4	1.82
T_5, 25% N through vermicompost + 75% RDN	42.2	2.46	501	2,111	48.8	244	19.3	1.85
T_6, 50% N through pig manure + 50% RDN	39.9	2.15	360	1,670	45.0	162	17.9	0.91
T_7, 50% N through poultry manure + 50% RDN	40.3	2.30	469	2,058	46.4	218	19.2	1.52
T_8, 50% N through FYM + 50% RDN	39.5	2.29	441	2,032	45.5	200	18.9	1.26
T_9, 50% N through vermicompost + 50% RDN	39.4	2.25	365	1,687	48.7	178	18.4	1.04
T_{10}, 100% RDN	53.0	3.51	620	2,339	47.8	297	19.6	2.60
SEm±	0.91	0.09	17.1	61.3	2.19	11.2	0.60	-
CD (P=0.05)	2.73	0.27	51.0	182.3	NS	33.2	1.82	-

ducing organic acids during decomposition. This process improves the availability and movement of nutrients, especially micronutrients. Similar findings were supported by Sahu *et al*. (2024). In the treatment 100% RDN (T_{10}) recorded the highest B:C ratio (2.60) followed by treatment T_3 (25% N through poultry manure + 75% RDN) where, lowest B:C ratio was recorded in treatment T_6 (50% N through pig manure + 50% RDN) which was 0.91.

The study revealed that applying 100% RDN or 25% N through poultry manure + 75% RDN resulted in higher sesame growth, yield, and quality during the *kharif* season of 2022. Recommended dose of nitrogen through urea recorded the highest plant height, branches per plant, leaf area index and superior crop growth metrics. Yield attributes such as capsules per plant, capsule length, and seed yield were also maximized under 100% RDN, alongside quality parameters like oil yield and protein content. B:C ratio was maximum observed with application of 100% RDN (T_{10}) followed by 25%N through poultry manure + 75% RDN. It was due to highest yield recorded under this treatment resulted the maximum B:C ratio as compared to other inorganic and organic sources of nitrogen. Therefore 100% RDN followed by 25% N through poultry manure + 75% RDN (T_3) as a cost-effective nutrient management strategy for improving sesame production in the Indian Himalayan region or similar agroecological zones.

REFERENCES

Amare, M., Fisseha, D. and Andreasen, C. 2019. The effect of N and P fertilizers on yield and yield components of sesame (*Sesamum indicum* L.) in low-fertile soil of north-western Ethiopia. *Agriculture* **9**(10): 227–234.

Anonymous. 2023. Department of Agriculture and Farmers Welfare. https://upag.gov.in

Blackman, V.N. 1919. The compound interest law and plant growth. *Annals of Botany* **33**(3): 353–360.

Gomez, K.A. and Gomez, A.A. 1984. Statistical procedures for agricultural research. John Wiley & Sons.

Hunt, R. 1978. Plant Growth Analysis. E. Arnold. pp. 26–37.

Mostashari, P. and Mousavi Khaneghah, A. 2024. Sesame Seeds: A Nutrient-Rich Superfood. *Foods* **13**(8): 1,153–1,160.

Patel, S.G., Leva, R.L., Patel, H.R. and Chaudhary, N.N. 2018. Effect of spacing and nutrient management on summer sesame (*Sesamum indicum*) under south Gujarat conditions. *Indian Journal of Agricultural Sciences* **88**(4): 647–650.

Pattnayak, A., Mishra, G., Sar, K., Chowdhury, M. R. and Behera, S. D. 2024. Effect of Different Organic Nutrient Sources on the Growth and Yield of Summer Sesamum (*Sesamum indicum* L.). *Journal of Advances in Biology & Biotechnology* **27**(7): 400–407.

Rauf, S., Basharat, T., Gebeyehu, A., Elsafy, M., Rahmatov, M., Ortiz, R. and Kaya, Y. 2024. Sesame, an Underutilized Oil Seed Crop: Breeding Achievements and Future Challenges. *Plants* **13**(18): 2,662.

Sahoo, M., Satapathy, M., Mangaraj, S. and Paikaray, R.K. 2022. Effect of integrated nutrient management on yield and nutrient uptake of sesame (*Sesamum indicum* L.). **17**(2): 253–258.

Sahu, G., Baishnabi, B., Sancharita, M., Debadarshini, P. and Anchal, A.B. 2024. Effect of Irrigation and Nutrient Management Studies on Sesame (*Sesamum indicum* L.). *International Journal of Plant & Soil Science* **36**(2): 81–95.

Sujatha, V., Saritha, R. and Sirisha, A.B.M. 2023. Effect of Organic and Inorganic Nutrient Management on Productivity, Cost Economics and Energy Use Efficiency in Sesame. *International Journal of Environment and Climate Change* **13**(8): 1,901–1,912.

Verma, S., Singh, H.V. and Saxena, R. 2013. Relative performance of sesame (*Sesamum indicum*) under organic, inorganic and integrated nutrient management. *Indian Journal of Agricultural Sciences* **83**(3): 143–149.

Watson, D.J. 1952. The physiological basis of variation in yield. *Advances in Agronomy* **4**: 101–145.