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Ganga Devi Netam
Department of Silviculture and Agroforestry, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Pratap Toppo
Department of Silviculture and Agroforestry, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Deo Shanker
Department of Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Corresponding Author:
Ganga Devi Netam
Department of Silviculture and Agroforestry, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Effect of organic and inorganic fertilizers on growth and yield of sesame (*Sesamum indicum*) under Indian rosewood (*Dalbergia sissoo*) based agroforestry in Chhattisgarh plain

Ganga Devi Netam, Pratap Toppo and Deo Shanker

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Abstract
A field experiment was carried out during the Kharif season of 2025 at the Crop Research Farm, Department of Silviculture and Agroforestry, College of Agriculture, IGKV, Raipur, India. The study aimed to evaluate the "Effect of Organic and Inorganic Fertilizers on the Growth and Yield of Sesame (*Sesamum indicum*) under Indian Rosewood (*Dalbergia sissoo*) Based Agroforestry in the Chhattisgarh Plain." using the variety Vibhuti 999 Super. The experiment was laid out in a randomized block design with nine treatments (T_1-T_9). Among the treatments, T_5 (75% inorganic + 25% organic fertilizer) consistently recorded the highest values for growth parameters, including plant height, number of leaves, number of branches, and collar diameter, at all growth stages. Similarly, the highest yield attributes and productivity—such as number of capsules per plant, capsule length, seeds per capsule, seed test weight, seed yield (kg ha^{-1}), stover yield (kg ha^{-1}), harvest index (%), oil content (%), and oil yield (kg ha^{-1})—were also observed under treatment T_5 (75% inorganic + 25% organic fertilizer).

Keywords: Organic and inorganic fertilizer, sesame, growth and yield

Introduction
Sesame (*Sesamum indicum* L.), also known by names such as til, gingelly, simsin, gergelin, and tillie, is an annual or perennial herb of the family Pedaliaceae, valued for its edible seeds. Sesame seeds are a rich source of food, nutrition, health-promoting compounds, edible oil, and bio medicinal applications. They contain up to 50% oil, 20.28% protein, 14-16% sugar, and 5-7% minerals, making them one of the most nutritious oilseeds. Known for their digestive, rejuvenating, and anti-aging properties, sesame seeds are often called the "Queen of Oilseed Crops."

As one of the oldest cultivated oilseed crops, sesame plays a significant role in Indian agriculture. The seeds are rich in antioxidants, earning them the nickname "seeds of immortality." Sesame adapts well to various multiple cropping systems, functioning effectively as either a catch crop or a sequential crop during rabi and pre-kharif seasons. India leads the world in sesame area, production, and exports. Nationally, sesame ranks third in total oilseed area and fourth in oilseed production. The combined use of organic nutrient sources, such as manures and biofertilizers, along with chemical fertilizers, has been widely recommended to enhance crop yield while improving the biological, physical, and chemical properties of the soil.

Sheesham, or sissoo (*Dalbergia sissoo*), is among the most valuable timber species in India. It occurs naturally and is also widely cultivated on alluvial soils. The species is commonly found along riverine beds in the sub-Himalayan region, extending from the Indus valley to Assam and the Himalayan foothills. *Dalbergia sissoo* thrives across much of India up to an elevation of 900 meters in the sub-Himalayan tract and occasionally reaches altitudes of 1500 meters. It often grows profusely, forming either pure or mixed forests on newly deposited alluvial soils composed of sand, gravel, and boulders along riverbeds in these areas.

Materials and Methods

Location: The Experiment was conducted at Indira Gandhi Krishi Vishwavidyalaya Raipur which is located in the South-Eastern part of Chhattisgarh. The altitude of site is 295m above mean sea level. Geographically the site is situated at 21°.23"39.77"N latitude and 81°.69"44.30″E longitude.

Methods

The Experimental field was ploughed with the help of tractor drawn cultivator twice in criss-cross direction. Hand labour was used to remove crop debris and weeds. The soil was first fine-tuned and then FYM was added. Thus, 27 plots of 4.0 x 2.5 meter were made by hand. Nine treatments and three replications were used in the randomized block design (RBD) experiment (Fig. 3.2). In a system based on Indian Rosewood, Sesame was planted as an intercrop. The plot measured 4.0 by 2.5 meters. Plots for each treatment were arranged randomly in accordance with statistical standards. using nine treatment and three replications, in accordance with the experimental sowing design in the cropping system, with a 30 cm x 30 cm spacing. Thus, 27 plots of 4.0 m x 2.5 m were used for sowing.

Treatment	Dose
T_1	100% Inorganic Fertilizer
T_2	75% Inorganic Fertilizer
T_3	50% Inorganic Fertilizer
T_4	25% Inorganic Fertilizer
T_5	75% Inorganic + 25% organic Fertilizer
T_6	50% Inorganic + 50% organic Fertilizer
T_7	25% Inorganic + 75% organic Fertilizer
T_8	100% Organic Fertilizer
T_9	Control (no application of organic/inorganic fertilizer)

Results and Discussion

This section presents the productivity and economic analysis of sesame, focusing on both yield-related and economic parameters. The study revealed that the yield of *Sesamum indicum* was strongly influenced by the various combinations and application rates of organic and inorganic fertilizers used within Indian rosewood-based agroforestry systems in the Chhattisgarh plains. Notably, the combined application of 75% inorganic fertilizer with 25% organic fertilizer had a marked positive impact on the growth and yield attributes of *S. indicum*. This treatment showed statistically significant improvements across all measured parameters, as confirmed by the F-test results.

Plant height

Plant height at maturity was markedly affected by the application of organic and inorganic fertilizers (Table 1). The treatment consisting of 75% inorganic and 25% organic fertilizer (T_5) produced the tallest plants, reaching 78.71 cm, which was significantly higher than all other treatments. In contrast, the shortest plants (35.44 cm) were observed in the control plot (T_9). These findings align with the observations reported by Ahirwar *et al.,* (2017) [1].

Number of branches

The number of branches per plant was significantly influenced by the fertilizer treatments. The highest number of branches (4.09) was recorded under the improved practice involving 75% inorganic and 25% organic fertilizer (T_5), while the control treatment (T_9) produced the fewest branches (2.05). These observations are consistent with the findings reported by Sahu *et al*., (2017) [2].

Number of leaves

A significant variation in the number of leaves per plant was recorded among the treatments. The improved practice involving 75% inorganic and 25% organic fertilizer (T_5) resulted in the highest leaf count (23.36), whereas the control treatment (T_9) produced the lowest number of leaves (10.22). These results align with the findings reported by Lokhande *et al.,* (2020) [3].

Collar diameter

A significant effect of fertilizer treatments on collar diameter was observed. The application of 75% inorganic and 25% organic fertilizer (T_5) produced the greatest collar diameter (2.15 cm), surpassing all other treatments, while the smallest diameter (0.95 cm) was recorded in the control (T_9). These results are consistent with the findings of Lokhande *et al.,* (2020) [3].

Table 1: Effect of Organic and Inorganic Fertilizers on Plant Growth Parameter

Treatment	Plant Height	No. of Branches	No. of Leaf/Plant	Collar Diameter
T_1: 100% Inorganic Fertilizer	73.15	3.90	20.24	2.08
T_2: 75% Inorganic Fertilizer	68.95	3.78	17.25	2.02
T_3: 50% Inorganic Fertilizer	65.88	3.72	16.43	1.99
T_4: 25% Inorganic Fertilizer	62.36	2.93	13.74	1.93
T_5: 75% Inorganic + 25% Organic Fertilizer	78.71	4.09	23.36	2.15
T_6: 50% Inorganic + 50% Organic Fertilizer	73.86	4.07	21.37	2.11
T_7: 25%Inorganic + 75% Organic Fertilizer	69.08	3.84	18.83	2.04
T_8: 100% Organic Fertilizer	52.02	3.01	15.94	1.86
T_9: Control (no application of organic /inorganic fertilizer)	35.44	2.05	10.22	0.95
SE(m)	2.82	0.13	0.86	0.07
C.V.	8.46	7.04	8.77	7.39
CD (at 5%)	7.96	0.4	2.60	0.23
F -test	S	S	S	S

Yield

The application of 75% inorganic + 25% organic fertilizer (T_5) produced the best yield attributes and productivity outcomes. Under this treatment, the highest number of capsules per plant (79.00), capsule length (2.84 cm), seeds per capsule (84.67), test weight (2.87 g), seed yield (993.00 kg ha^{-1}), stover yield (1986.00 kg ha^{-1}), and harvest index (33.3%) were recorded. These results were closely followed by the treatment combining 50% inorganic and 50% organic fertilizer (T_6) (Table 2). The findings align with those reported by Goswami *et al*., (2025) [4]. In contrast, the control treatment (T_9) produced the lowest values for all measured yield parameters, including number of capsules per plant (34.33), capsule length (1.54 cm), seeds per capsule (37.00), test weight (1.51 g), seed yield (471.00 kg ha^{-1}), stover yield (945.33 kg ha^{-1}), and harvest index (32.2%).

Table 2: Effect of Organic and Inorganic Fertilizers on Yield Parameter

Treatment	N0. of capsule	Capsule length(cm)	N0. of seed /capsule-1	Test weight(g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
T_1: 100% Inorganic Fertilizer	70.00	2.77	78.33	1.68	970.67	1888.00	33.9
T_2: 75% Inorganic Fertilizer	67.00	2.64	74.67	1.76	851.33	1769.33	32.4
T_3: 50% Inorganic Fertilizer	66.00	2.55	68.67	1.54	768.33	1562.67	32.9
T_4: 25% Inorganic Fertilizer	50.67	1.38	64.67	1.52	751.33	1348.67	35.7
T_5: 75% Inorganic + 25% Organic Fertilizer	79.00	2.84	84.67	2.87	993.00	1986.00	33.3
T_6: 50% Inorganic + 50% Organic Fertilizer	75.00	2.82	83.67	2.73	972.33	1974.67	33.0
T_7: 25%Inorganic + 75% Organic Fertilizer	67.33	2.74	70.33	2.60	952.33	1866.00	33.7
T_8: 100% Organic Fertilizer	65.33	2.44	74.67	2.31	697.67	1466.67	32.2
T_9: Control	34.33	1.54	37.00	1.51	471.00	945.33	32.2
SE(m)	2.24	0.07	70.74	0.07	27.96	57.98	-
C.V.	6.06	5.07	6.59	5.92	5.87	6.10	-
CD (at 5%)	6.70	0.21	8.07	0.21	83.82	173.82	-

Economic

The economic performance and benefit-cost (B:C) ratio of sesame, as shown in Table 3, reveal clear differences among the fertilizer treatments. The highest gross return (Rs. 82,419 ha^{-1}) was achieved under the improved practice (T_5), which involved the application of 75% inorganic and 25% organic fertilizer. This was closely followed by T_6 (50% inorganic + 50% organic fertilizer), which recorded gross returns of Rs. 80,703.39 ha^{-1}. Treatment T_5 also generated the maximum net return (Rs. 52,243.25 ha^{-1}) and the highest B:C ratio (1.73). The next best performance was observed in T_6, with a net return of Rs. 46,072.89 ha^{-1} and a B:C ratio of 1.59. These findings are in agreement with the results reported by Yadav *et al.*, (2009) [5].

Table 3: Effect of nutrient on benefit cost Ratio of sesame under Indian rosewood based agroforestry system.

Treatment	Cost of cultivation (Rs/ha)	Gross return (Rs/ha.)	Net return (Rs/ha.)	B:C Ratio
T_1: 100% Inorganic Fertilizer	25721	67400.15	41679.15	1.62
T_2: 75% Inorganic Fertilizer	25175.75	65671.26	40495.51	1.60
T_3: 50% Inorganic Fertilizer	24630.5	63771.39	39140.89	1.58
T_4: 25% Inorganic Fertilizer	24085.25	62360.39	38275.14	1.58
T_5: 75% Inorganic + 25% Organic Fertilizer	30175.75	82419	52243.25	1.73
T_6: 50% Inorganic + 50% Organic Fertilizer	34630.5	80703.39	46072.89	1.59
T_7: 25%Inorganic + 75% Organic Fertilizer	39085.25	79043.39	45958.14	1.38
T_8: 100% Organic Fertilizer	43540	66206.6	22666	0.52
T_9: Control Zero Fertilizer	23540	50630	27090	1.15

Conclusion

Among all treatments, T_5 (75% inorganic and 25% organic fertilizer) recorded the highest values for all key growth parameters: plant height, number of leaves per plant, number of branches, collar diameter, indicating its superior efficacy in promoting vegetative growth. and T_9 (control) showed the lowest performance. Among all treatments, T_5 (75% inorganic and 25% organic fertilizer) recorded the highest values for all key yield parameters: No. of capsule, capsule length(cm), No. of seed/ capsule^{-1}, Test weight(g), Seed yield (kg ha^{-1}), Stover yield (kg ha^{-1}) and Harvest index (%). T_9 (control) showed the lowest performance.

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