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Impact of integrated nutrient management on growth, yield and its contributing traits of sesame (*Sesamum indicum* L.)

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Abstract

A research trial was sown at Experimental Farm of Sardar Patel University, Balaghat (M.P.) in the starting of agricultural year *i. e. Kharif* season of 2024-25 with an improved variety of sesame PKDS-8. The title of this experiment was "Impact of integrated nutrient management on growth, yield and its contributing traits of sesame (*Sesamum indicum* L.)". Ten treatments were replicated three times considering the Randomized Block Design (RBD). The details of treatments are T_0-Control, T_1-100% RDN, T_2-100% RDN + 1% foliar spray-Humic acid, T_3-100% RDN + 1% foliar spray-Fulvic acid, T_4-75% RDN + 25% N through FYM, T_5-75% RDN + 25% N through Vermicompost, T_6-75% RDN + 25% N through Poultry manure, T_7-50% RDN + 50% N through FYM, T_8-50% RDN + 50% N through Vermicompost and T_9-50% RDN + 50% N through Poultry manure. Randomly 5 plants were selected from each treatment and each replication to take the observations different growth, yield and its contributing characters such as Plant height (cm) at 20, 40 and 60 DAS (Days after Sowing), Number of trifoliate leaves per plant at 20, 40 and 60 DAS, Number of branches per plant at 40 and 60 DAS, Number of capsules per plant, Number of seeds per capsules, Seed yield per plant (g), Seed yield per plot (kg) and Seed yield (q ha^{-1}). The mean value over five randomly selected plants was considered for further statistical analysis. The result revealed that among all treatments, T_8 (50% RDN + 50% N through Vermicompost) consistently recorded superior performance across various growth stages and yield attributes. It resulted in the maximum plant height (92.43 cm at 60 DAS), highest number of trifoliate leaves (31.00 at 60 DAS), and the most branches (9.00 at 60 DAS). In terms of yield, T_8 also produced the greatest number of capsules per plant (58), number of seeds per capsule (83) and the highest seed yield per plant (14.10 g), seed yield per plot (1.354 kg), and seed yield per hectare (11.28 q/ha). Thus, integrating 50% recommended nitrogen dose with 50% N through vermicompost (T_8) proves to be a promising approach for enhancing sesame growth and yield.

Keywords: Sesame, INM, RBD and RDN

Introduction

From the padaliaceae family, sesame (*Sesamum indicum* L.) is an important and historically significant oilseed crop. Naturally it is a self-pollinated crop having chromosome number 2*n* = 26. Asian and African countries are commonly cultivated this as a major seed oil crop and in the earth it is cultivated more than 60 countries (Satankar *et. al*., 2019) [15]. The sesame is commonly distributed in the major part of tropical Africa, Madagascar, Arabia, India, Pakistan, Sri Lanka, tropical Australia and a some areas of eastern islands of the Malayan Archipelago. It covers most of the land of the states of India such as Maharashtra, Uttar Pradesh, Rajasthan, Orissa, Andhra Pradesh, Tamil Nadu, West Bengal, Gujarat and Karnataka. Its seed contains 44-52% oil with rich Vitamin E and also contains significant contribution of Linoleic acid which is beneficial to control the blood cholesterol level (Sundari *et al*. 2012) [18]. Sharma *et al*. 2014 [16] estimated the chemical composition of the white seeded sesame cultivar and reported the range of 18.3 to 25.18% protein in this seed.

For fully exploitation of genetic potential of an improved variety, the researchers should know about appropriate production technology such as suitable sowing time as per agronomical zone, intercultural operations, integrated nutrient management (including organic as well as inorganic nutrient sources with the addition of bio-fertilizers), integrated disease and pest management etc.

Synchronization in the optimum environmental abiotic factors such as temperature, light, humidity, rainfall etc. at vegetative as well as reproductive phase of the crop may also be responsible for boosting the production with standard quality oil.

Application of well decomposed farm yard manure, vermicompost and poultry manure increase the production of economic portion of crop along with increase the organic carbon and microbial population in the soil. It is also helpful to improve the soil composition without any harmful effect on the any living body, and these are naturally rich in nitrogen and other macro and micro nutrients in comparison to the inorganic fertilizers. However, inadequate soil fertility management has hampered its productivity despite its substantial international market demand. Some researchers *viz*., USDA (1980), Pannase *et al*., (1995) [13], Tiwari *et al*. (1995) [20], Hegde (1998) [10] and Deshmukh *et al*., (2002) [6] also suggested that, sustainably we can get more economic yield from our available resources by using organic and inorganic sources in an appropriate combination. Narkhede *et al*., (2001) [12] recommended the application of 40 kg nitrogen, 30 kg phosphorous and 20 kg potassium along with 10 ton per hectare farm yard manure may help to produced significantly more seed yield of sesame than other combinations of micro and macro nutrient. Since the cost of inorganic fertilizers are increasing day by day and their residual effects are harmful to soil, its organic content and microbial population as well as microbial activities, so the farmers becoming sincere about the application of integrated nutrient management. That's why, keeping in view the above facts this investigation entitled "Impact of integrated nutrient management on growth, yield and its contributing traits of sesame (*Sesamum indicum* L.)" was conducted with the aim to find out the best combination of organic and inorganic sources of nutrients in relation to the yield of sesame.

Materials and Methods

An research trial was sown at Experimental Farm of Sardar Patel University, Balaghat (M.P.) in the starting of agricultural year *i. e. Kharif* season of 2024-25 with an improved variety of sesame PKDS-8, the title of this experiment was "Impact of integrated nutrient management on growth, yield and its contributing traits of sesame (*Sesamum indicum* L.)". Ten treatments were replicated three times considering the Randomized Block Design (RBD). The details of treatments are T_0-Control, T_1-100% RDN, T_2-100% RDN + 1% foliar spray-Humic acid, T_3-100% RDN + 1% foliar spray-Fulvic acid, T_4-75% RDN + 25% N through FYM, T_5-75% RDN + 25% N through Vermicompost, T_6-75% RDN + 25% N through Poultry manure, T_7-50% RDN + 50% N through FYM, T_8-50% RDN + 50% N through Vermicompost and T_9-50% RDN + 50% N through Poultry manure. Note: RDN = Recommended Dose of Nitrogen. In each treatment, observations were recorded on five randomly selected plants in all replications for all the growth and yield contributing characters such as Plant height (cm) at 20, 40 and 60 DAS (Days after Sowing), Number of trifoliate leaves per plant at 20, 40 and 60 DAS, Number of branches per plant at 40 and 60 DAS, Number of capsules per plant, Number of seeds per capsules, Seed yield per plant (g), Seed yield per plot (kg) and Seed yield (q ha^{-1}). The mean value over five randomly selected plants was considered for further statistical analysis.

Results and Discussion

Plant height (cm) 20, 40 and 60 DAS

At the early growth stages of sesame (20, 40, and 60 Days After Sowing), the maximum plant height was recorded under T_8 (50% RDN + 50% N through Vermicompost) with 24.65 cm, 57.33 cm & 92.43 cm, respectively. This was closely followed by T_5 (75% RDN + 25% N through Vermicompost) with 22.55 cm, 55.21 cm & 88.55 cm and T_1 (100% RDN) with 21.44 cm, 54.66 cm & 85.44 cm at the same intervals. The lowest plant height was observed under T_0 (Control) with 16.22 cm, 44.22 cm & 71.44 cm respectively. The improved plant height under vermicompost based treatments (T_8 and T_5) can be attributed to the gradual release of nutrients, better soil structure, enhanced microbial activity, and increased availability of macro and micronutrients throughout the vegetative growth period of crop. In addition to NPK vermicompost have harmones such as auxins, cytokinins and gibberellins which are responsible to enhance the vegetative growth of plant through cell elongation and division (Edwards *et al*., 2004; Arancon *et al*., 2006) [8, 2].

Number of trifoliate leaves per plant at 20, 40 and 60 DAS

The number of trifoliate leaves per plant increased steadily from 20 to 60 DAS under all treatments. The maximum number of trifoliate leaves at all growth stages (20, 40, and 60 DAS) was recorded under T_8 (50% RDN + 50% N through Vermicompost) with 9.00, 20.00 & 31.00 leaves respectively. This was followed by T_5 (75% RDN + 25% N through Vermicompost) with 8.00, 19.00 & 29.00 leaves and T_1 (100% RDN) with 7.00, 18.00 & 28.00 leaves. The minimum number of trifoliate leaves was observed under T_0 (Control) with 3.00, 13.00 & 21.00 leaves respectively. The higher number of trifoliate leaves in treatments involving vermicompost can be attributed to its ability to improve soil structure, enhance microbial activity and provide a slow and steady release of essential nutrients. Vermicompost is rich in humic substances and plant growth promoting hormones such as auxins, cytokinins and gibberellins which stimulate leaf initiation and expansion (Arancon *et al*., 2006) [2]. Moreover, the balanced and integrated nutrient supply (from both organic and inorganic sources) optimizes photosynthetic activity, resulting in increased leaf formation (Edwards *et al*., 2004) [8].

Number of branches per plant at 40 and 60 DAS

At 40 DAS, the maximum number of branches per plant was recorded under T_8 (50% RDN + 50% N through Vermicompost) and T_5 (75% RDN + 25% N through Vermicompost), both showing 6.00 branches, which were statistically at par. These were followed by T_1 (100% RDN) with 5.00 branches. The minimum branching was observed in the control treatment (T_0) with just 1.00 branch per plant. Similarly, at 60 DAS the maximum branching was observed in T_8 and T_5, both with 9.00 branches, followed by T_1 with 8.00 branches, while the control (T_0) had the least with only 3.00 branches per plant. The increased branching in vermicompost-amended treatments can be attributed to the improved soil fertility and sustained nutrient release, especially nitrogen, which promotes axillary bud development leading to enhanced branching (Edwards *et al*., 2004) [8]. Vermicompost also contains plant growth regulators such as cytokinins which are directly involved in stimulating the outgrowth of lateral buds and branching (Atiyeh *et al*., 2002) [3]. The integrated use of organic and inorganic nitrogen sources further optimizes nutrient availability, supporting vigorous vegetative growth and branching (Gopinath *et al*., 2008) [9].

Number of capsules per plant

The data revealed that the highest number of capsules per plant was recorded under T_8 (50% RDN + 50% N through Vermicompost) with 58 capsules, followed by T_5 (75% RDN + 25% N through Vermicompost) with 54 capsules and T_1 (100% RDN) with 51 capsules, while the lowest exhibited from the control i.e. treatment (T_0) with 32 capsules per plant. Integrated nutrient management with vermicompost also improves soil physical properties and nutrient use efficiency, resulting in better flowering and higher capsule counts (Singh *et al*., 2018) [17].

Number of seeds per capsules

The data indicated that the maximum number of seeds per capsule was recorded under T_8 (50% RDN + 50% N through Vermicompost) with 83 seeds, followed by T_5 (75% RDN + 25% N through Vermicompost) with 81 seeds and T_1 (100% RDN) with 79 seeds per capsule. The minimum number of seeds per capsule was observed under the control treatment (T_0) with 57 seeds. Additionally, the slow and steady nutrient release from vermicompost promotes consistent metabolic activity throughout the flowering and capsule filling stages, resulting in better seed set and filling (Kumar & Sharma, 2017) [11]. Studies have also shown that combining organic and inorganic sources of nitrogen leads to improved pollen viability, ovule fertilization, and seed development in sesame (Singh *et al*., 2018) [17]. Furthermore, organic amendments like vermicompost contribute humic substances and growth promoting hormones that stimulate better reproductive outcomes.

Seed yield per plant (g)

The results exhibited the superior performance in term of seed yield per plant was performed through T_8 (50% RDN + 50% N through Vermicompost) with 14.10 g. followed by T_5 (75% RDN + 25% N through Vermicompost) with 13.56 g. and T_1 (100% RDN) with 12.78 g. The minimum seed yield per plant was noted in the control treatment (T_0) with 8.50 g. The improvement in seed yield per plant under vermicompost integrated nutrient management can be attributed to enhanced nutrient availability, better soil health and improved physiological performance of the crop. Vermicompost supplies readily available macro and micronutrients, enzymes and beneficial microbes which enhance root growth, nutrient uptake and hormonal stimulation, ultimately leading to better seed setting and development (Suthar, 2009; Edwards *et al*., 2007) [19, 7]. Organic manures like vermicompost also increase soil Cation Exchange Capacity (CEC) and improve nutrient retention and uptake over time, thereby contributing to sustained plant growth and higher productivity per plant (Bhunia *et al*., 2006; Reddy *et al*., 2019) [5, 14].

Seed yield per plot (kg)

The superior performance in term of seed yield per plot was exhibited by treatment T_8 (50% RDN + 50% N through Vermicompost) with 1.354 kg, followed by T_5 (75% RDN + 25% N through Vermicompost) at 1.302 kg & T_1 (100% RDN) at 1.227 kg. The lowest yield was recorded in the control treatment T_0 with 0.816 kg. These results are with the good agreement with Babu Lal *et al*., (2018) [4], which reported that, when we increase the amount of vermicompost up to 3.0 t/ha. resulted to increased seed yield of sesame through improvement of nutrient use efficiency and soil structure.

Seed yield (q ha^{-1})

Treatment T_8 also recorded the highest seed yield per hectare at 11.28 q ha^{-1}, followed by T_5 (10.85 q ha^{-1}) & T_1 (10.22 q ha^{-1}). The control treatment T_0 had the lowest yield at 6.80 q ha^{-1}. This increase in seed yield can be attributed to the combined use of organic and inorganic fertilizers, which enhances nutrient availability and uptake. This result have conformity with Ahirwar *et al*., (2017) [1], which suggested combination of organic and inorganic nutrition are responsible for enhancement of seed yield of sesame.

Table 1: Impact of integrated nutrient management on growth parameters of sesame at different stages.

Treatment Notations	Plant height (cm)			Number of trifoliate leaves per plant			Number of branches per plant	
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	40 DAS	60 DAS
T0	16.22	44.22	71.44	3.00	13.00	21.00	1.00	3.00
T1	21.44	54.66	85.44	7.00	18.00	28.00	5.00	8.00
T2	18.90	51.22	79.65	5.00	17.00	25.00	3.00	6.00
T3	17.44	47.54	75.54	4.00	14.00	22.00	2.00	4.00
T4	19.66	52.44	82.44	6.00	18.00	27.00	4.00	7.00
T5	22.55	55.21	88.55	8.00	19.00	29.00	6.00	9.00
T6	17.97	48.33	76.66	4.00	15.00	23.00	3.00	5.00
T7	18.55	49.76	77.22	5.00	15.00	24.00	3.00	6.00
T8	24.65	57.33	92.43	9.00	20.00	31.00	6.00	9.00
T9	16.88	45.55	73.55	3.00	13.00	22.00	2.00	3.00
S.Em.±	0.078	0.125	0.196	0.060	0.073	0.098	0.050	0.065
CD at 5% levels	0.231	0.371	0.583	0.177	0.217	0.291	0.147	0.194

Table 2: Impact of integrated nutrient management on yield parameters of sesame.

Treatment Notations	Number of capsules per plant	Number of seeds per capsules	Seed yield per plant (g)	Seed yield per plot (kg)	Seed yield (q ha^{-1})
T0	32.00	57.00	8.50	0.816	6.80
T1	51.00	79.00	12.78	1.227	10.22
T2	45.00	76.00	10.88	1.044	8.70
T3	38.00	67.00	9.21	0.884	7.37
T4	48.00	77.00	12.34	1.185	9.87
T5	54.00	81.00	13.56	1.302	10.85
T6	39.00	71.00	10.11	0.971	8.09
T7	43.00	73.00	10.54	1.012	8.43
T8	58.00	83.00	14.10	1.354	11.28
T9	35.00	63.00	8.90	0.854	7.12
S.Em.±	0.245	0.240	0.058	0.006	0.046
CD at 5% levels	0.728	0.712	0.171	0.016	0.137

Conclusion

The application of integrated nutrient management significantly influenced the growth and yield parameters of sesame. Among all treatments, T_8 (50% RDN + 50% N through Vermicompost) consistently recorded superior performance across various growth stages and yield attributes. It resulted in the maximum plant height (92.43 cm at 60 DAS), highest number of trifoliate leaves (31.00 at 60 DAS), and the most branches (9.00 at 60 DAS). In terms of yield, T_8 also produced the greatest number of capsules per plant (58), number of seeds per capsule (83) and the more seed yield per plant (14.10 g), seed yield per plot (1.354 kg), and seed yield per hectare (11.28 q/ha). Thus, integrating 50% recommended nitrogen dose with 50% N through vermicompost (T_8) proves to be a promising approach for enhancing sesame growth and productivity. This treatment supports sustainable nutrient management by partially substituting chemical fertilizers with organic sources, improving both crop performance and soil health.

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