Impact of Vermicompost and Intercropping on Morphophysiological and Yield Performance of Sesame (*Sesamum indicum* L.)

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Abstract— *A field experiment was conducted at the Agricultural Farm, Himalayan University, Jollang, to investigate the Impact of Vermicompost and Intercropping on the Morphophysiological and Yield Performance of Sesame (Sesamum indicum L.).*

The study was laid out in a Randomized Block Design (RBD) with seven treatments replicated thrice. Sesame variety INDO US-5 and green gram variety KANIKA were evaluated at 30, 60, and 90 days after sowing (DAS). Among the treatments, T7 (100% RDF + Vermicompost 6 t/ha + Intercropping 2:2) consistently recorded superior results in terms of plant height (84.3 cm), number of leaves (67.6), number of branches (5.0), were observed during 60–90 DAS in T7. Moreover, T7 showed significant improvement in yield attributes such as capsule number (45.6), seed per capsule (38.6), capsule length (3.6 cm), test weight (3.7 g), biological yield (1.22 t/ha), and economic yield (0.46 t/ha). The highest harvest index (37.50%), were also recorded in T7. These results highlight the potential of integrated nutrient management and intercropping in enhancing sesame productivity and profitability.

Keywords— Sesame, Vermicompost, Intercropping, Organic manure, physiological traits, Agronomic traits.

I. INTRODUCTION

The scientific name of sesame is (*Sesamum indicum* L) belongs to the family of Pedaliaceae. Sesame is commonly known as till, simsim, beniseed etc. sesame is an oilseed plant therefore it has been used as oil since ages. Sesame crop's oil consists of 85% unsaturated fatty acid, is highly stable, reduces cholesterol, and prevents coronary heart diseases (Choudhary *et al*., 2017).

Sesame seeds are highly beneficial as seed contain 42-50% oil (25% protein, 16-18% carbohydrate and 42% essential linoleic acid) (Miah *et al*., 2015).

Sesame seeds are also rich in essential minerals, including magnesium, phosphorus, calcium, iron, and zinc. In addition, they contain vitamins B and E and have potent antioxidant properties (Langyan *et al*., 2022.

A wide range of animals can benefit from eating sesame oilcake, such as poultry, fish, cattle, goats, and sheep (Khan *et al*., 2009).

India and China are the world's largest producers of sesame, followed by Myanmar, Sudan, Uganda, Ethiopia, Nigeria, Tanzania, Pakistan and Paraguay (FAOSTAT, 2022). India ranks first in world with 19.47 Lakh ha area and 8.66 Lakh tones production.

India is one of the four major players in the global oilseeds/vegetable oils scenario, being one of the important oilseed grower, producer, importer, and exporter (De and Sinha, 2011).

India's major gains in oilseeds export have come from sesame apart from groundnut and gained 90% of European and 50% of US market in oilseed export (Vittal *et al*., 2004).

Vermicomposting is one of the biological processes in which the organic wastes has been converted into nutrient rich manure by the action of earthworms. The characteristic feature of vermicompost such as high porosity and moisture holding capacity increases the growth of pathogen free plants (Yadav and Garg 2019).

Vermicompost has positive effects on plant growth and soil structure. One of the attractive elements of vermicompost production is its positive effect on the environment. This is because the materials used as worm feed have a wide range of organisms that can rot in nature. Any material such as plant, animal, industrial and urban wastes can be transformed into beneficial fertilizers through the digestive system of worms (Edwards, 1995).

Intercropping is a sustainable strategy that includes cultivating many crop species together in the same area to take advantage of the beneficial interactions between them (Maitra *et al.*, 2021).

Organic materials are a major source of organic matter and plant nutrients, incorporating organic materials into soil results in improved soil physical attributes namely, soil structure, soil aggregate stability, water holding capacity, soil drainage, soil aeration and root penetration and soil chemical attributes namely. soil nutrient content and composition and soil pH (Carswell *et al*., 2001 and Murphy 2015).

Application of organic manures on sesame in form of crop residues and animal manure would most likely improve its yields and seed quality (Morris *et al*., 2002).

II. MATERIALS AND METHODS

The experiment was conducted during the kharif season of 2024-2025 at the Agriculture Research Farm of Himalayan University, Itanagar, Arunachal Pradesh. The soil of experimental plot was Sandy-loam and loamy sand in texture with pH ranges from 4 to 6. The experiment was conducted by following Randomized Block Design (RBD) with the construction of 21 plots. The Agriculture Research Farm is situated at 27.140 N latitude and 93.62° E longitudes and at an altitude of 320 m above mean sea level with total area of 83,743 sq. km. The site comes under the Eastern Himalayan region and the Agro - climatic zone is under sub- tropical zone of Arunachal Pradesh.

Sesame variety INDO US-5 and green gram variety KANIKA were used. Data were recorded on growth parameters (plant height, number of branches and leaves, biomass), yield attributes (capsule number, test weight).

III. RESULTS AND DISCUSSION

The present study highlights the significant influence of vermicompost and intercropping on the growth and yield of sesame. Among the seven treatments, T7 (100% RDF + Vermicompost 6 t/ha + Intercropping 2:2) consistently outperformed in almost all observed.

3.1 Plant Height:

At 90 DAS the maximum increase in plant height was found to be statistically significant in treatment T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) i.e., (84.3 cm) and T_6 (T6 100% RDF + Vermicompost 5 t/ha + intercropping (2:1) i.e., 83.0 (cm) and was found to be statistically at par with T_5 (T5 100% RDF + Vermicompost 5 t/ha + intercropping (2:2) i.e., (78.6 cm). Lowest plant height was observed in treatment T_1 (Control) i.e., 960.3 cm). This is because combination of vermicompost and intercropping likely to improved soil physical properties, enhanced moisture retention, and increased the availability of macro and micronutrients. It also contributed to better soil aeration and reduced weed competition, indirectly promoting the vertical growth of sesame plants. These findings are in agreement with studies by Sharma *et al*., (2017) and Patel *et al*., (2019).

3.2 Number of Leaves:

At 90 DAS the maximum increase in number of leaves was found to be statistically significant in treatment T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) i.e., 67.6 and T_6 (T6 100% RDF + Vermicompost 5 t/ha + intercropping (2:1) i.e., 66.3 and was found to be statistically at par with T_5 (T5 100% RDF + Vermicompost 4 t/ha + intercropping (2:2) i.e., 65.0. Lowest number of leaves was observed in treatment T_1 (Control) i.e., 60. These is because that combining vermicompost with inorganic fertilizer 50% VC + 50% NPK can improve sesame plant growth and seed nutrient content and is recommended for sesame production. These findings are similar to Shathi *et al.*, (2023) and Pandiyan *et al*., (2021).

3.3 Number of Branches:

At 90 DAS the maximum increase in number of branches was found to be statistically significant in treatment T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) i.e., 5.0 and T_6 (T6 100% RDF + Vermicompost 5 t/ha + intercropping (2:1) i.e., 4.8 and was found to be statistically at par with T_5 (T5 100% RDF + Vermicompost 5 t/ha + intercropping (2:2) i.e., 4.7. Lowest number of branches was observed in treatment T_1 (Control) i.e., 4.1. This can be attributed to the synergistic interaction between sesame and green gram, wherein the leguminous nature of green gram plays a crucial role in biological nitrogen fixation. The increased nitrogen availability in the rhizosphere likely stimulated greater vegetative growth in sesame, resulting in enhanced branching. These results are in similar with the findings of Kumar *et al.*, (2017) and Arpita *et al*., (2018).

3.4 Number of Capsule Plant^{-1}:

The maximum increase in number of capsule plant^{-1} was found to be statistically significant in treatment T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) i.e., 45.6 and T_6 (T6 100% RDF + Vermicompost 5 t/ha + intercropping (2:1) i.e., 44.9 and was found to be statistically at par with T_5 (T5 100% RDF + Vermicompost 5 t/ha + intercropping (2:2) i.e., 44.3. Lowest number of capsule/plants was observed in treatment T_1 (Control) i.e., 37.2. This is because the transition from flower to capsule depends on proper nutrient supply, pollination, and hormonal balance — all of which are positively influenced in an intercropping setup with a compatible legume like green gram. These results are like the findings of Kumar *et al.*, (2017) and Meena *et al*., (2020).

TABLE 1
IMPACT OF VERMICOMPOST AND INTERCROPPING ON THE MORPHOPHYSIOLOGICAL AND YIELD & YIELD ATTRIBUTES OF SESAME (*SESAMUM INDICUM* L.)

Treatments	Plant Height (cm)	No. of Branches	Leaves	Test weight (g)	Capsule length(cm)	Seed/ capsule	Capsule/ plant	Biological yield (t/ha)	Economical yield (t/ha)	Harvest index (%)
T1	60.3	4.1	60.0	2.1	2.5	31.4	37.2	0.74	0.22	30.03
T2	63.0	4.2	61.6	2.3	2.6	33.3	38.7	0.98	0.34	35.06
T3	69.3	4.4	62.3	2.6	2.6	34.0	40.5	0.95	0.35	37.46
T4	72.7	4.6	63.6	2.9	2.6	35.3	41.8	0.90	0.31	34.33
T5	78.6	4.7	65.0	3.2	2.8	35.8	44.3	0.99	0.35	35.80
T6	83.0	4.8	66.3	3.1	3.0	37.1	44.9	1.03	0.38	36.96
T7	84.3	5.0	67.0	3.7	3.6	38.6	45.6	1.22	0.46	37.50
SEd	2.6	0.07	1.3	0.16	0.2	0.4	0.7	0.03	0.01	0.79
S. Em (±)	1.8	0.05	0.9	0.12	0.1	0.3	0.5	0.02	0.00	0.56
CD	5.7	0.1	2.9	0.3	0.5	1.0	1.5	0.08	0.02	1.73
F test	S	S	S	S	S	S	S	S	S	S

3.5 Capsule Length (cm):

The maximum increase in capsule lengths was found to be statistically significant in treatment T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) i.e., 3.6 cm and T_6 (T6 100% RDF + Vermicompost 5 t/ha + intercropping (2:1) i.e., 3.0 cm and was found to be statistically at par with T_5 (T5 100% RDF + Vermicompost 5 t/ha + intercropping (2:2) i.e., 2.8 cm. Lowest number of capsule lengths was observed in treatment T_1 (Control) i.e., 2.5.These is because the application of both RDF and vermicompost ensured a balanced supply of macro and micronutrients. Vermicompost, being rich in humus, growth-promoting substances, and beneficial microbes, improved soil health, nutrient uptake, and enzymatic activity, which directly enhanced plant growth and capsule development. This finding is in line with the reports of Kumar *et al*., (2020) and Patel *et al*., (2018).

3.6 Number of Seed Capsule Plant^{-1}:

The maximum increase in number of seed capsule Plant^{-1} was found to be statistically significant in treatment T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) i.e., 38.6 and T_6 (T6 100% RDF + Vermicompost 5 t/ha + intercropping (2:1) i.e., 37.1 and was found to be statistically at par with T_5 (T5 100% RDF + Vermicompost 5 t/ha + intercropping (2:2) i.e., 44.3. Lowest number of seed/capsules was observed in treatment T_1 (Control) i.e., 35.8. These is because application of bulky organic manure likely played a vital role in improving the soil's physical, chemical, and biological properties. The improved soil structure and enhanced microbial activity fostered better nutrient availability and uptake, especially of essential macro-nutrients like nitrogen and phosphorus. These nutrients are crucial for the reproductive growth of sesame, and their improved availability under T7 conditions may have contributed to better pollination and fertilization, resulting in more seeds per capsule. These results are like the findings of Kumar *et al.*, (2017) and Arpita *et al*., (2019).

3.7 Test Weight (g):

The significant and the highest test weight was recorded in T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) i.e., 3.7g and T_6 (T6 100% RDF + Vermicompost 5 t/ha + intercropping (2:1) i.e., 3.1g and was found to be statistically at par with T_5 (T5 100% RDF + Vermicompost 5 t/ha + intercropping (2:2) i.e., 3.2g. Lowest test weight was observed in treatment T_1 (Control) i.e., 2.1g. The probable reason for recording highest test weight under treatment T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) is due to the increase in seed weight can be explained by the combined benefits of integrated nutrient management and intercropping, which positively influenced the physiological and nutritional status of sesame plants during seed development. This result aligns with the findings of Sharma *et al.,* (2019) and Meena *et al*., (2021).

3.8 Biological Yield (t/ha):

The highest biological yield was recorded under treatment T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) i.e., 2.0 t/ha and the lowest was seen under treatment T_1 (control). The synergistic effect of integrated nutrient management and intercropping creates favourable conditions for higher photosynthesis and efficient translocation of photosynthates. This increases both the economic yield (seed) and straw/stover yield, contributing to higher biological yield. Similar findings have been reported by Patel *et al*., (2017) and Arpita *et al.,* (2020),

3.9 Economical Yield (t/ha):

The significant and the highest biological yield was recorded in T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) i.e., 2.0 t/ha and T_6 (T6 100% RDF + Vermicompost 5 t/ha + intercropping (2:1) i.e., 1.8 t/ha and was found to be statistically at par with T_5 (T5 100% RDF + Vermicompost 5 t/ha + intercropping (2:2) i.e., 1.7 t/ha. Lowest biological yield was observed in treatment T_1 (Control) i.e., 1.1 t ha⁻1. The maximum economical yield was recorded under treatment T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) i.e., 69.9 t/ha. The synergistic effect of integrated nutrient management and intercropping creates favourable conditions for higher photosynthesis and efficient translocation of photosynthates. This increases both the economic yield (seed) and straw/stover yield. Similar findings have been reported by Patel *et al*., (2017) and Arpita *et al.,* (2020),

3.10 Harvest Index (%):

The significant and the highest harvest index was recorded in T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) i.e., 43.0% and T_6 (T6 100% RDF + Vermicompost 5 t/ha + intercropping (2:1) i.e., 41.3% and was found to be statistically at par with T_5 (T5 100% RDF + Vermicompost 5 t/ha + intercropping (2:2) i.e., 40.4%. Lowest harvest index was observed in treatment T_1 (Control) i.e., 30.3%. The probable reason for recording higher harvest index under treatment T_7 (T7 100% RDF + Vermicompost 6 t/ha + intercropping (2:2) is due to Vermicompost not only supplies nutrients but also improves soil structure, microbial activity, and moisture retention, creating a favourable environment for root and shoot growth. This synergistic effect enhances both biomass production and its efficient partitioning toward grain yield, ultimately increasing Harvest Index. These findings are consistent with the reports of Meena *et al.,* (2020) and Sharma *et al.,* (2018).

IV. CONCLUSION

The integrated application of 100% RDF with 6 t/ha Vermicompost and intercropping (2:2) significantly improved growth, yield, and quality parameters in sesame. T7 proved to be the most effective treatment, suggesting that combining organic inputs with legume intercropping can boost both agronomic performance and economic viability in sesame cultivation.

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