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Effect of Organic and Inorganic Fertilizers on Growth and Yield of Sunflower (Helianthus annuus L.)

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Abstract— *A field experiment was conducted during Rabi 2024–25 at the ASPEE Agricultural Research & Development Foundation Farm, Nare village, Taluka Wada, District Palghar, Maharashtra, to study the influence of organic and inorganic fertilizers on growth and yield of sunflower. The experiment comprised seven treatments involving farmyard manure (FYM) and vermicompost integrated with varying levels of recommended dose of fertilizer (RDF) and was laid out in a Randomized Block Design with three replications. Growth and yield parameters such as plant height, filled and unfilled seeds per plant, seed yield per plant, test weight, seed yield per hectare, and stalk yield were recorded. Application of vermicompost @ 5 t ha^{-1} + 75% RDF recorded the highest values for plant height (160.4 cm), number of filled seeds (665.33), seed yield per plant (38.37 g), test weight (47.61 g), and seed yield (993.77 kg ha^{-1}). The control treatment recorded the lowest values for all parameters. The study revealed that integration of organic manures with chemical fertilizers significantly improves growth and productivity of sunflower while also enhancing nutrient use efficiency. The results strongly support the adoption of integrated nutrient management for sustainable sunflower cultivation.*

Keywords— *Sunflower, vermicompost, FYM, RDF, seed yield, integrated nutrient management.*

I. Introduction

Sunflower (*Helianthus annuus* L.) is one of the most important oilseed crops cultivated in India due to its high oil quality, adaptability to diverse climatic conditions, and short duration. However, productivity of sunflower is often constrained by nutrient imbalances and improper fertilizer management. Indiscriminate use of chemical fertilizers has resulted in declining soil health, reducing productivity and sustainability over time.

Organic manures such as farmyard manure (FYM) and vermicompost improve soil physical structure, increase microbial activity, enhance nutrient availability, and improve moisture retention capacity. Vermicompost, in particular, is known to contain enzymes, plant growth regulators, and beneficial microbes, which promote root growth and nutrient uptake.

Integrated nutrient management, combining organic and inorganic sources of nutrients, has proved to be a viable strategy to enhance crop production while minimizing environmental hazards. Keeping these aspects in view, the present investigation was undertaken to study the effect of organic and inorganic fertilizers on growth and yield of sunflower under Palghar district conditions.

II. Materials and Methods

The field experiment was conducted during the Rabi season of 2024–25 at the ASPEE Agricultural Research & Development Foundation Farm, Nare village, Taluka Wada, District Palghar, Maharashtra. The experiment was laid out in a Randomized Block Design (RBD) with three replications to minimize the experimental error and ensure valid comparison among treatments.

Sunflower (*Helianthus annuus* L.) variety 'Suryakiran' was used as the test crop. The crop was sown on 11 December 2024 at a spacing of 45 cm × 30 cm using a plot size of 4.5 m × 3.0 m. All recommended cultural practices were followed uniformly for raising a healthy crop throughout the growing period. The recommended dose of fertilizer (RDF) for sunflower was fixed at 60:90:30 kg N:P:K per hectare.

The experiment consisted of seven treatments involving different combinations of organic and inorganic nutrient sources. The treatments included a control without fertilizer, FYM @ 10 t ha^{-1} combined with 50%, 75%, and 100% RDF, and vermicompost @ 5 t ha^{-1} combined with 50%, 75%, and 100% RDF. Farmyard manure and vermicompost were applied as basal doses before sowing and were thoroughly incorporated into the soil.

Chemical fertilizers were applied as per RDF using urea, single super phosphate, and muriate of potash as the sources of nitrogen, phosphorus, and potassium, respectively. Nitrogen was applied in split doses to improve uptake efficiency, while phosphorus and potassium were applied as basal doses.

Observations were recorded on important growth and yield parameters including plant height, number of filled and unfilled seeds per plant, seed yield per plant, test weight, seed yield per hectare, and stalk yield. The data collected were subjected to statistical analysis using analysis of variance (ANOVA) appropriate for the Randomized Block Design to test the significance of treatment effects at the prescribed level of significance.

III. Results and Discussion

Effect on Growth Parameters

Plant Height

Plant height was significantly influenced by different nutrient management treatments (Table 1). The tallest plants were observed under T6 (Vermicompost @ 5 t ha^{-1} + 75%

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RDF), recording 160.40 cm, which was significantly superior to all other treatments. This was followed by T7 (151.50 cm) and T5 (149.73 cm). The control treatment (T1) recorded the shortest plants (126.47 cm). The marked increase in plant height in vermicompost-treated plots can be attributed to improved soil physical condition, enhanced microbial activity, and continuous availability of essential nutrients. Vermicompost also supplies biologically active substances such as humic acids, which promote cell elongation and shoot growth (Atiyeh et al., 2000). Similar improvements in sunflower plant height with vermicompost application were reported by Joshi and Vig (2010) and Kumar et al. (2015).

The statistically significant differences observed among treatments are supported by the critical difference (C.D.) value of 6.5, confirming that integrated nutrient management significantly affects sunflower growth performance.

Number of Filled and Unfilled Seeds per Plant

Significant variations were observed in the number of filled seeds per plant due to application of organic and inorganic fertilizers. The highest number of filled seeds (665.33) was obtained in T6 followed by T7 (628.53) and T5 (578.33). The control recorded the lowest filled seeds (467.93). This improvement may be attributed to better photosynthetic efficiency and enhanced assimilate partitioning under integrated nutrient management systems (Gaur and Adholeya, 2004).

Conversely, the number of unfilled seeds was highest in the control (75.40) and minimum in T6 (39.80). Reduced unfilled seeds indicate improved seed set due to balanced nutrient supply and increased phosphorus and boron availability, which positively influences flower development and fertilization (Sharma and Mittra, 1991). Results confirm earlier findings by Reddy et al. (2013), who observed reduced seed sterility under organic-inorganic nutrient combinations in sunflower.

Effect on Yield Attributes

Seed Yield per Plant

Seed yield per plant ranged from 26.73 g in the control to 38.37 g in T6. Higher per-plant marketable yield under vermicompost treatments could be due to enhanced nutrient uptake, increased photosynthate accumulation, and improved source–sink relationship (Arancon et al., 2005). The ability of vermicompost to supply both macro- and micronutrients contributes significantly to increased seed weight and grain number.

Test Weight

The test weight varied significantly among treatments and was highest in T6 (47.61 g), followed by T7 (44.33 g) and T5 (42.11 g). Higher grain weight reflects better translocation of assimilates toward seeds during grain filling stages. Vermicompost improves nutrient availability, particularly potassium and micronutrients, that enhance grain plumpness and seed uniformity (Edwards et al., 2011). These results corroborate findings of Singh and Agarwal (2005), who also observed improvement in test weight with organic nutrient application.

Seed Yield and Stalk Yield

A significant increase in seed yield was observed with integrated nutrient management practices. The highest seed yield (993.77 kg ha^{-1}) was recorded in T6, followed by T7 (904.31 kg ha^{-1}) and T5 (818.80 kg ha^{-1}), whereas the control recorded the lowest yield (501.29 kg ha^{-1}).

Interestingly, T6 outperformed T7, indicating that reduction of inorganic fertilizer by 25% in combination with vermicompost resulted in higher yield. This could be due to enhanced nutrient use efficiency and improved soil microbial population under integrated systems (Yadav et al., 2009). Similar responses have been reported by Bhattacharyya et al. (2008), where combined application of organic manures and fertilizers resulted in higher crop productivity than sole chemical fertilizer use.

Stalk yield also followed the same trend, with T6 recording the highest biomass (4105.85 kg ha^{-1}). Improved above-ground biomass under integrated nutrient management may be attributed to improved nitrogen availability and better moisture retention capacity of soil due to organic matter addition (Sharma and Mittra, 1991).

TABLE. 1: Effect of Organic and Inorganic Fertilizers on Growth and Yield of Sunflower

Treatment	Plant height (cm)	No. of filled seed per plant	No. of unfilled seed per plant	Seed yield per plant (g)	Test wt. (g)	Seed yield (kg/ha)	Stalk Yield (kg/ha)
T1	126.47	467.93	75.4	26.73	35.85	501.29	2067.65
T2	140.03	544.4	63.73	30.33	39.42	617.2	2548.76
T3	142	550.87	59.2	32.33	40	692.65	2860.35
T4	144.23	562.53	52.8	34.2	41.23	751.88	3106.65
T5	149.73	578.33	48.67	34.77	42.11	818.8	3381.77
T6	160.4	665.33	39.8	38.37	47.61	993.77	4105.85
T7	151.5	628.53	45.93	35.8	44.33	904.31	3733.97
S.Em.±	2.11	18.63	1.61	0.61	0.85	23.26	95.88
C.D.	6.5	57.4	4.97	1.88	2.6	71.66	295.45

Overall Interpretation

The results clearly demonstrate that integrated nutrient management significantly improves sunflower growth and productivity. Among the organic sources, vermicompost performed better than FYM in all growth and yield parameters. The treatment T6 achieved higher productivity with reduced chemical fertilizer input, suggesting better nutrient synchronization and soil health improvement. These findings strongly support the incorporation of organic manures into nutrient management regimes for sustainable sunflower cultivation.

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IV. Conclusion

The present investigation clearly demonstrates that integrated use of organic and inorganic fertilizers significantly enhances sunflower growth and productivity.

Key conclusions:

- Vermicompost @ 5 t ha^{-1} + 75% RDF recorded the highest yield and growth attributes.
- Vermicompost performed better than FYM.
- Reduction of chemical fertilizers up to 25% is possible without yield loss when integrated with vermicompost.
- Control treatment showed poor performance.
- Integrated nutrient management is recommended for sustainable sunflower cultivation.

Recommendation

For sunflower cultivation under Palghar district conditions, application of vermicompost @ 5 t ha^{-1} + 75% RDF is recommended for achieving higher productivity with reduced chemical fertilizer dependency.

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