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Influence of organic manures on the growth of radish (*Raphanus sativus* L.)

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Abstract

*A field experiment was conducted during Rabi 2023-24 at the Campus for Research and Advanced Studies, Dhablan, to evaluate the effect of different organic manures on the growth and yield of radish (*Raphanus sativus *L.). The experiment was laid out in a Randomized Block Design with eight treatments comprising farmyard manure, vermicompost, poultry manure, goat manure, and their combinations. Results revealed significant variation among treatments for all growth and yield parameters. The integrated treatment T_7 (25% FYM + 25% VC + 25% PM + 25% GM) consistently outperformed all other treatments, recording the highest plant height (28.32 cm), number of leaves (11.88), leaf length (23.55 cm), leaf width (13.48 cm), root length (24.29 cm), root diameter (4.96 cm), and root yield (286.43 q ha^{-1}). Among single-source manures, vermicompost (T_3) showed superior performance, followed by poultry manure (T_4), indicating the importance of nutrient-rich and rapidly mineralizing organic inputs. The enhanced vegetative vigour and root development under integrated and high-quality organics align with previous findings highlighting the effectiveness of vermicompost and poultry manure in improving soil fertility and crop productivity. The study concludes that integrated organic nutrient management offers synergistic benefits, providing a balanced nutrient supply and improved soil conditions, and can be recommended as an efficient and sustainable strategy for maximizing radish growth and yield under subtropical conditions.*

Keywords: Integrated nutrient management, Organic manures, Poultry manure, Randomized Block Design, Vermicompost

Introduction

Radish (Raphanus sativus L.) is an important root vegetable of the family Brassicaceae, cultivated widely across tropical and temperate regions. It is primarily valued for its napiform edible root, although the entire plant, including the foliage, is consumed as a leafy vegetable (Kiran et al., 2016). Radish holds considerable nutritional significance, being rich in carbohydrates, proteins, and vitamins A and C, which contributes to its rising demand as a dietary component in developing countries (Singh and Bhandari, 2015). To meet this demand, farmers often apply high doses of chemical fertilizers and pesticides, particularly nitrogen (N). While high N levels can enhance vegetative growth and yield (Brintha and Seran, 2009), continuous reliance on inorganic fertilizers can deteriorate soil health and negatively impact environmental quality. Radish is also valued for its medicinal attributes. It has a cooling

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effect and is used traditionally to relieve digestive disorders, jaundice, liver problems, and urinary issues (Kushwah et al., 2020). Nutritionally, radish contains 93.7% water, 4.2% carbohydrates, 1.1% fat, vitamin C (15–40 mg per 100 g), and minerals such as calcium, manganese, fluorine, iodine, and silicon. Its characteristic pungency is due to volatile isothiocyanates (Bose et al., 2000). Radish leaves are rich in minerals and vitamins A, B, and C. The rat-tailed radish, however, does not form fleshy roots (Dhaliwal, 2018). Despite its nutritional and medicinal value, declining produce quality and reduced economic returns have been linked to excessive chemical fertilizer use.

Organic and integrated nutrient management approaches have gained attention as sustainable alternatives to chemical fertilizers. Organic manures such as farmyard manure (FYM), vermicompost, and neem cake help maintain soil productivity, improve organic carbon levels, and support long-term soil health (Kumar et al., 2013; Mahokar et al., 2007). As a short-duration winter crop with rapid physiological growth, radish responds strongly to nutrient availability, especially nitrogen (Khatri et al., 2019). Chemical N sources like urea, although effective, contribute to nutrient losses, higher production costs, and environmental degradation (Oad et al., 2004). In contrast, organic inputs including FYM, poultry manure, goat manure, and biogas slurry enhance soil physicochemical properties, improve nutrient retention, and ensure slow and sustained nutrient release suitable for diversified agroecosystems (Kale et al., 1991; Delate and Camberdella, 2004). Rising consumer preference for chemical-free vegetables has further encouraged the adoption of organic production systems. Though variable in composition, organic manures are vital sources of plant nutrients and significantly improve soil health (Gyewal et al., 2020; Bhatta et al., 2009). Given radish's short growth cycle and high nutrient demand for rapid root development, efficient organic nutrient management is crucial to achieving high yield and quality. Therefore, a field experiment was conducted to evaluate the effects of different organic manures on the growth of radish.

Materials and Methods

A field experiment was conducted during *Rabi* season 2023-24 at the Campus for Research and Advanced Studies, Dhablan. The experimental site is situated at about 30-20 p N latitude and 76-28 p E longitude at an altitude of 249 m above the mean sea level. Patiala falls under a semi-arid climatic zone, characterized by distinct seasonal variations. The region experiences hot and dry conditions from April to June, transitioning to hot and humid weather during the monsoon period from July to September, and turning cold from November to February. At the Campus for Research and Advanced Studies, Dhablan, the climate remains subtropical throughout the year, marked by dry summers, a humid monsoon phase, and chilly winters. Five plants were randomly picked and tagged from each plot for the purpose of documenting various observations at different growth stages. Organic manures viz., FYM, vermicompost, goat manure and poultry manure were incorporated as per treatment to respective plots. The nitrogen content in FYM, vermicompost, goat manure and poultry manure was 0.5, 2.5, 1.3 and 3%, respectively. Optimum soil moisture was maintained in the field by regular irrigation. Observations were recorded on plant growth parameters of radish roots. The data obtained on various observations for each treatment were statistically analysed as per standard procedures.

Details of layout

Experimental design	Randomised block design (RBD)
No. of replications	03
No. of treatments	8
Total no. of plots	24
Gross plot size	4.2 x 3.2 m
Net plot size	3.15 × 2.5 m
Spacing	45 x 10 cm
Seed rate	4 kg ha^{-1}
Variety	Scarlet Red Globe
Date of sowing	5 December 2023

Details of Treatments
T_1 Control
T_2 100% Farmyard Manure (FYM)
T_3 100% Vermicompost (VC)
T_4 100% Poultry Manure (PM)
T_5 100% Goat Manure (GM)
T_6 50% FYM + 25% VC + 25% PM
T_7 25% FYM + 25% VC + 25% PM + 25% GM
T_8 75% FYM + 25% VC

Results and Discussion

Growth parameters

The Table 1 shows clear variation in radish growth due to different organic manures. The integrated treatment T_7 (25% FYM + 25% VC + 25% PM + 25% GM) recorded the highest values for all parameters, with plant height 28.32 cm, 11.88 leaves, leaf length 23.55 cm, and leaf width 13.48 cm, indicating superior nutrient availability from combined organic sources. Among single manures, vermicompost (T_3) performed strongly with 27.85 cm height, 11.22 leaves, 22.36 cm leaf length, and 12.93 cm width, closely followed by poultry manure (T_4) with 27.39 cm height, 10.73 leaves, 21.65 cm leaf length, and 11.78 cm width.

The present findings on plant height are supported by earlier studies, as Kushwah *et al*. (2020) reported maximum height, longer leaves, leaf width to improved nutrient supply under vermicompost, while Gyewali *et al*. (2020) observed plant height and shoot growth with poultry manure-based combinations, both highlighting the strong influence of nutrient-rich organic sources on vegetative vigour.

Trends in the number of leaves and leaf length agree with Khatri *et al*. (2019), who recorded the maximum leaf breadth, highest leaf numbers under poultry manure./

Yield parameters

The Table 2 indicates that root growth and yield of radish varied significantly among the organic manure treatments. The integrated treatment T_7 (25% FYM + 25% VC + 25% PM + 25% GM) produced the greatest root length (24.29 cm), root diameter (4.96 cm), and the highest root yield (286.43 q ha^{-1}), demonstrating the advantage of combining different organic sources for improved nutrient availability and root development. Among single manures, vermicompost (T_3) showed the best performance with 22.73 cm root length, 4.36 cm diameter, and 273.80 q ha^{-1} yield, followed by poultry manure (T_4) and goat manure (T_5), which also enhanced root traits compared to FYM alone.

These results closely correspond with Khatri *et al*. (2019), who reported the highest root length and root diameter under poultry manure, demonstrating its rapid mineralization and superior nutrient supply. The similarity between the two

Table 1: Effect of different organic manures on growth parameters of radish

Treatment	Plant height (cm)	No. of leaf $plant^{-1}$	Leaf length (cm)	Leaf width (cm)
$T_{1:}$ Control	21.14	7.26	17.85	4.22
$T_{2:}$100% Farm Yard Manure (FYM)	26.18	9.18	20.35	7.84
$T_{3:}$ 100% Vermi Compost (VC)	27.85	11.22	22.36	12.93
T_4:100% Poultry Manure (PM)	27.39	10.73	21.65	11.78
$T_{5:}$ 100% Goat Manure (GM)	26.42	9.67	20.97	9.15
T_6:50%FYM +25%VM + 25 % PM	25.19	7.74	18.62	5.86
$T_{7:}$ 25% FYM+25% VC+25%PM+25%GM	28.32	11.88	23.55	13.48
T_8:75%FYM+ 25%VC	25.60	8.43	19.48	7.14
SE (m)	0.58	0.43	0.51	0.23
CD (0.05)	1.65	1.26	1.42	0.68

Table 2: Effect of different organic manures on yield parameters of radish

Treatment	Root length (cm)	Root diameter (cm)	Root yield q ha^{-1}
$T_{1:}$ Control	11.61	2.34	228.90
$T_{2:}$ 100% Farm Yard Manure (FYM)	17.41	3.26	245.14
$T_{3:}$ 100% Vermi Compost (VC)	22.73	4.36	273.80
$T_{4:}$ 100% Poultry Manure (PM)	21.84	3.79	265.39
$T_{5:}$ 100% Goat Manure (GM)	19.95	3.14	254.61
$T_{6:}$ 50%FYM +25%VM + 25 % PM	14.35	2.62	233.25
$T_{7:}$ 25% FYM+25% VC+25%PM+25%GM	24.29	4.96	286.43
$T_{8:}$ 75%FYM+ 25%VC	16.69	2.93	242.74
SE (m)	0.65	0.22	6.85
CD (0.05)	1.85	1.04	17.45

studies lies in the clear advantage of high-quality organics particularly poultry manure and vermicomposting enhancing root elongation, thickening, and yield, while the lowest values consistently occurred under control treatments in both cases. However, unlike Khatri *et al*. (2019), where poultry manure alone was the best performer, the present study showed that a balanced combination of FYM, VC, PM, and GM (T_7) surpassed all single-source manures, suggesting a synergistic effect of integrating multiple organics for better nutrient release, improved soil structure, and optimal root growth and yield.

Conclusion

The study clearly demonstrated that the application of organic manures significantly influenced both growth and yield attributes of radish. Among all treatments, the integrated organic formulation T_7 (25% FYM + 25% VC + 25% PM + 25% GM) proved superior, producing the highest plant height, leaf number, leaf size, root length, root diameter, and overall yield. This indicates that combining diverse organic sources ensures a more balanced nutrient supply, improved soil structure, and enhanced microbial activity, resulting in vigorous vegetative growth and optimal root development. Among the single organic amendments, vermicompost (T_3) consistently performed best, followed by poultry manure (T_4), highlighting their rapid mineralization and higher nutrient density. The trends in growth parameters and yield closely align with earlier findings that emphasize the effectiveness of nutrient-rich organics such as vermicompost and poultry manure in promoting plant vigour and superior root traits. Overall, the results suggest that integrated organic nutrient management offers a synergistic advantage over individual manures and can be recommended as an efficient and sustainable approach for enhancing radish growth and productivity.

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