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Exploring Synergistic Effects of Cowdung and Vermicompost on Radish (*Raphanus sativus* L.) Morphology and Yield

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Abstract: The integration of organic amendments in crop cultivation is gaining attention for its potential to improve soil health and boost radish yield in Bangladesh. The experiment was conducted at Noakhali Science & Technology University to evaluate the impact of organic manures on the growth and yield of radish. Using a randomized complete block design, the experiment included four treatments: T_0 (no organic manure), T_1 (cowdung at 30 tha^{-1}), T_2 (vermicompost at 30 tha^{-1}), and T_3 (combination of cowdung and vermicompost at 15 tha^{-1} each). Both cowdung and vermicompost significantly enhance radish cultivation compared to the control condition. Growth parameters, including plant height, leaf length, leaf breadth, and leaf number, showed the highest values in treatment T_3. Yield-contributing parameters, such as root length, root diameter, root weight, and gross yield were also highest in treatment T_3 with a gross yield of 17.73 t/ha. Conversely, the lowest values for both growth and yield parameters, including a gross yield of 6.11 t ha^{-1}, were observed in the control treatment (T_0). The findings indicate that the application of both cowdung and vermicompost significantly enhances radish growth and yield, with the combined treatment (T_3) showing superior performance compared to other treatments.

Keywords: Cowdung, Vermicompost, Radish, Growth, Yield

Radish (*Raphanus sativus* L.) is a herbaceous annual root crop from the Brassicaceae family, originated in Central or Western China, as well as the Indo-Pak subcontinent (Kaur et al 2023). It is planted mostly as an annual vegetable and a biannual crop, depending on its use and is a cool-weather vegetable crop in particular. Asian variants, on the other hand, tolerate higher temperatures than European kinds. Except for a few months in the summer, radishes can be cultivated in Bangladesh virtually all year (Sharma et al 2019). Radish have a variety of skin colours (yellow, red, black, purple, and sometimes pinkish white), but their flesh is usually white. The taste, size, and length of the edible radish root vary throughout the world. This plant's noteworthy characteristic is its short cycle time of roughly 30 days, which allows for significant benefits in working capital (Sa'id et al 2022). It contains calcium, potassium, phosphorus, and vitamin C. It is high in ascorbic acid and a range of minerals (Pathak et al 2017). Numerous antioxidants, including vanillic acid, pyrogallol, catechin, and other phenolic compounds, are found in radishes. While radish is typically grown on large farms in Bangladesh, urban farmers typically grow the crop on their roofs and homesteads (Ali et al 2023). In Bangladesh, radish is currently grown on 26228 hectares of land, yielding 286543 metric tonnes of radishes a year (BBS 2020).

Farmers usually apply nitrogenous, phosphatic, and other chemical fertilizers that increase plant yield significantly and supply plant nutrients (Pahalvi et al 2021). But, most of these chemical fertilizers are costly and degrade the quality of produce, which lowers net profit and returns to farmers. Additionally, consumers' expectations regarding the quality of produce and its availability throughout the year are rising (Kushwah et al 2020). One substitute for conventional methods of giving plants nutrients is the application of organic fertilizers. The status of soil fertility can be ascertained by evaluating the properties of the soil after the addition of organic matter (Islam et al 2023, Hashan et al 2023). In addition to its many other beneficial effects on the soil, organic compost has a slow-release effect on nutrients. Because organic fertilizers release nutrients into the plant gradually, using them is therefore cost-effective for farmers. To maintain soil fertility and productivity while increasing crop productivity, organic manures like cow dung, and vermicompost have become more popular in recent years (Pokharel et al 2023).

The past several years has seen a sharp increase in the usage of sustainable farming methods due to growing consumer concerns about issues like soil conservation, food safety, and quality. The fundamental principle of sustainable agriculture defined as a set of methods that protect the

environment and resources without sacrificing human needs is the use of organic manures (Kumar et al 2018). In consideration of the aforementioned data, a field investigation was conducted to determine the effect of different organic manures and evaluate the potential of organic manures to improve radish growth and yield that can be economically beneficial for farmers.

MATERIAL AND METHODS

The study was carried out at the agricultural research field of Noakhali Science and Technology University, which is situated in Noakhali-3814, Bangladesh (Latitude: 22.7916° N; Longitude: 91.1028° E) from February 2022 to May 2022(Table 1 , 2). The experiment was in randomized complete block design with four treatments and three replications, designated as T_0 (No organic manure), T_1 (Cow dung 30 tha^{-1}), T_2 (Vermicompost 30 tha^{-1}) and T_3 (Cow dung 15 tha^{-1} and Vermicompost 15 tha^{-1}), respectively. Radish seeds were sown on 14th February 2022, using the line sowing method with a plant spacing of 25 cm x 15 cm with appropriate agronomic practices. Harvesting of radishes began on 1st April 2022.

Observations were recorded for various growth and yield parameters, including plant height (cm), number of leaves per plant, leaf length (cm), leaf breadth (cm), root length (cm), root diameter (cm), fresh weight of root per plant (g), and gross yield (t ha^{-1}). The collected data for the study's parameters were analysed statistically using Statistix10. Analysis of variance for different parameters was conducted using the "F" test, and mean differences were determined following the approach suggested by Gomez and Gomez 1984.

RESULTS AND DISCUSSION

Growth parameters: The growth parameters of radishes such as plant height, leaf length, number of leaves per plant, and leaf breadth at various stages of growth (15, 30, and 45 days after sowing) varied significantly in treatments (Table 3). Application of combined cow dung and vermicompost exhibited significantly higher plant height at each growth stage, reaching 27.43 at 45 DAS than all other treatments. The highest leaf length (22.1 cm at 45DAS) was in T_3whereas the shortest leaf length at the same stage (10 cm) was in T_0. The number of leaves per plant, displayed the highest count at all stages in T_3, reaching 13.4 at 45DAS, emphasizing the positive influence of cow dung and vermicompost. The leaf breadth was significantly influenced by organic manures, with T_3 resulting in the broadest leaves (8.9 cm) at 45DAS. Conversely, T_0 had the narrowest leaves at 45DAS (4.8 cm), emphasizing the impact of organic manure on leaf breadth (Table 3).

These findings collectively underscore the positive impact of the application of cow dung and vermicompost on various growth parameters, highlighting their role in enhancing the overall development and quality of radish plants. The comparison with the control underscores the significance of organic manures in mitigating growth limitations and fostering robust plant development. These findings agree with earlier researchers (Kiran et al 2016, Khatri et al 2019, Diya et al 2023).

Table 2. Characteristics of soil

Constitution	Value
A. Physical properties of the initial soil (0-15 cm depth)	
Sand (%)	20
Silt (%)	67
Clay (%)	13
Soil textural class	Silt Loam
Particle density (g/cc)	2.60
Bulk density (g/cc)	1.35
Porosity (%)	46.67
B. Chemical characteristics of soil	
pH	7.501
Organic matter (%)	0.109
Total nitrogen (%)	0.101
Available phosphorus (ppm)	12.000
Exchangeable potassium (me %)	0.014

Source: Soil Resource and Development Institute (SRDI), Noakhali

Table 1. Average monthly temperature, humidity, and rainfall on the experimental plot during radish growth (Feb-May 2022)

Month	Temperature°C			Relative humidity (%)	Total rainfall (mm)	Sunshine(hrs)
	Maximum	Minimum	Average			
February	28.0	18°C	23°C	58	12.3	9.3
March	32°C	22°C	27°C	55	8.1	9.1
April	34°C	25°C	29°C	65	73.4	8.5
May	34°C	26°C	30°C	73	178.5	8.0

Source: Weather Station, Maijdee, Noakhali

Table 3. Effect of cow dung and vermicompost on growth parameters of radish (DAS)

Treatment	Plant height			Leaf length			Leaf number			Leaf Breath		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
T_0	6.03c	10.23c	12.9d	5.3c	8.5b	10b	3.7b	5.3b	6.7b	2.1b	3.1b	4.8b
T_1	15.8b	19.7b	21.86c	14.7b	17.8a	19.4a	8.4a	10.4a	12.4a	4.3a	6.8a	7.9a
T_2	16.7b	21.3b	23.1b	15ab	18a	20.4a	8.1a	10.4a	13.2a	4.7a	6.9a	8.2a
T_3	18.16a	24.46a	27.43a	15.3a	19.8a	22.1a	9.5a	11.4a	13.4a	5.6a	7.4a	8.9a
Level of significant	**	**	**	**	**	**	**	**	**	**	**	**
CV%	3.53	4.78	1.93	5.81	4.78	5.39	10.45	7.06	5.48	12.37	9.2	7.8

** Indicates a significant level at 0.1%. $T_{0=}$ no organic manure, $T_{1=}$ cowdung at 30 tha^{-1}, T_2= vermicompost at 30 tha^{-1}, and $T_{3=}$ combination of cowdung and vermicompost at 15 tha^{-1}each; DAS= Days after sowing

Table 4. Effect of cow dung and vermicompost on yield and yield contributing parameters of radish

Treatment	Root length	Root diameter	Root weight	Gross yield (t/ha)
T0	9.26b	2.24b	67.91a	6.11c
T1	14.2ab	3.2ab	143.37a	12.9ab
T2	18.08a	3.88a	190.39a	17.13a
T3	20.57a	4.01a	196.98a	17.73a
Level of significant	**	**	*	**
CV%	16.7	13.07	29.62	13.1

* and ** indicate a significant level at 1 and 0.1%, respectively. $T_{0=}$no organic manure, $T_{1=}$cowdung at 30 tha^{-1}, T_2= vermicompost at 30 tha^{-1}, and $T_{3=}$combination of cowdung and vermicompost at 15 tha^{-1}each.

Yield contributing parameters: The impact of various organic manures on radish root characteristics was assessed, revealing significant effects on both root length and root diameter (Table 4). In terms of root length, application of cow dung and vermicompost at 15 t ha^1 exhibited the longest roots, measuring 20.57 cm. The control with no organic manure he shortest root length (9.26 cm). This result highlights the positive influence of different levels of organic fertilizer, specifically cow dung and vermicompost, in enhancing the root length of radish plants. Similarly, for root diameter, the application of different organic fertilizers significantly influenced the diameter of radish roots. Treatment T_3 demonstrated the highest root diameter (4.01 cm), followed by T_2 and T_1, while the lowest root diameter (2.24 cm) was observed in T_0 . These findings emphasize that the incorporation of organic manures, particularly cow dung and vermicompost, led to a substantial increase in the diameter of radish roots. Similar findings were reported by earlier researchers (Kiran et al 2016, Khatri et al 2019, Diya et al 2023).

Yield parameters: The application of different organic manures profoundly influenced yield-related parameters of radish, manifesting in notable effects on both the fresh weight of roots per plant and the gross yield per hectare (Table 4). In terms of fresh weight of roots per plant, treatment T_3, incorporating cow dung and vermicompost at 15 t ha^1, yielded the highest fresh weight at harvest (196.98 g), followed closely by T_2 (190.39 g). Conversely, treatment T_0 recorded the lowest fresh weight of roots per plant (64.91 g). These results underscore the positive impact of different organic manures, particularly Cow dung and Vermicompost, in enhancing the fresh weight of radish roots. Similarly, for gross yield per hectare, the influence of various treatments on radish yield was significant. Treatment T_3 again emerged as the top-performing, producing the highest gross yield of radish at 17.73 t^{ha1}, while treatment T_0, the control with no organic manure, exhibited the lowest gross yield at 6.11 t ha-1 . This outcome demonstrates that the application of different organic manures, specifically Cow dung and vermicompost, positively impacted the gross yield of radish, highlighting the efficacy of these organic inputs in enhancing overall productivity. These findings are also aligned with other researchers (Kiran et al 2016, Khatri et al 2019, Diya et al 2023).

CONCLUSIONS

The application of organic manures, such as cowdung and vermicompost, substantially improves radish cultivation in comparison to control conditions. The combination of cowdung and vermicompost has a more positive impact on all growth and yield parameters than their separate applications. Further extensive research across different locations is recommended to substantiate these findings and

fully exploit the potential of these organic amendments in radish cultivation.

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