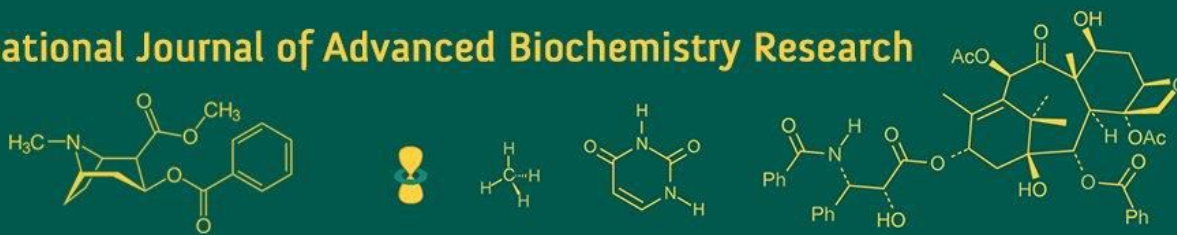


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Effect of organic manures and bio-fertilizers on qualitative characters of radish (*Raphanus sativus* L.) cv. Pusa Chetki

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Abstract

This study evaluated the effect of combining phosphorus-soluble bacteria (PSB) and bioremediation on the nutritional quality of radish PSB (4 kg/ha) combined with vermicompost (5 t/ha). (T₁₂) is more effective than other treatments. significantly, which led to ascorbic acid (14.5 mg/100 g), total soluble solids (TSS, 7.195 °brix) and chlorophyll content increased (1.09 mg/g fw) These improvements were due to increased nutrient availability. especially phosphorus Promoting photosynthesis sugar storage and overall plant health, conventional fertilizer (RDF) and other treatments such as BD 500 and neem cake are less effective. Between two growing seasons, T₁₂ also received a good organoleptic score (8.5), reflecting its improved taste and consumer attractiveness. These findings highlight the potential of combining PSB with vermicompost for sustainable agriculture. It provides higher nutritional quality and marketable produce. At the same time, it supports environmental health. Future research should focus on optimizing the combination of these biological and organic fertilizer modifications for wider crop application.

Keywords: Vermicompost, bio-fertilizer, organic manure and radish

1. Introduction

Radish (*Raphanus sativus*), belonging to the Brassicaceae family, is a popular root vegetable valued for its taste and nutritional benefits. It flourishes in cooler seasons but adapts well to various climates, with Asiatic varieties enabling continuous cultivation in areas like peninsular India. Eaten both raw and cooked, radishes are a rich source of calcium, potassium, phosphorus, and vitamin C. Traditionally, they are used for their digestive and urinary health benefits. The leaves are known for their diuretic properties, while the seeds produce oil with industrial applications. In 2022–23, India's radish production reached 2.512 million metric tonnes. Sustainable practices such as organic farming and bio-fertilizers improve yields, but further regional research is required for optimal outcomes.

2. Materials and Methods

2.1 Study area

The study was conducted at the Horticulture Farm of Sunrise University in Alwar, situated in southeastern Rajasthan.

2.2 Layout and Design of Experiment

The experiment followed a randomized block design consisting of 15 treatments, each replicated three times. Details of the treatments are provided in Table 1.

2.3 Qualitative attributes

Estimation of qualitative attributes *i.e.* Ascorbic acid, Total soluble solid and chlorophyll content of leaves was done by the A.O.A.C. (1995) ^[1], Titration method and Sadasivam and Manickam (1997) ^[2], respectively.

2.4 Statistical analysis

To evaluate the significance of variation in the data related to growth, yield, and quality characteristics, the analysis of variance (ANOVA) method, as outlined by Fisher (1950) ^[3]

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for a randomized block design, was employed. The treatment effects' significance was assessed using the 'F' test at a 5% significance level. The critical difference (CD) was

determined when the results were found to be statistically significant.

Table 1: Details of treatments

S. No.	Treatments	Symbols
1	FYM (20 t/ha)	T ₁
2	Vermicompost (5 t/ha)	T ₂
3	Neem cake (2.5 t/ha)	T ₃
4	BD 500 (75 g/ha)	T ₄
5	<i>Azotobacter</i> (4 kg/ha)	T ₅
6	<i>Azotobacter</i> (2 kg/ha) with FYM (10 t/ha)	T ₆
7	<i>Azotobacter</i> (2 kg/ha) with Vermicompost (2.5 t/ha)	T ₇
8	<i>Azotobacter</i> (2 kg/ha) with Neem cake (1.25 t/ha)	T ₈
9	<i>Azotobacter</i> (2 kg/ha) with BD 500 (75 g/ha)	T ₉
10	Phosphate solubilizing bacteria (PSB) (4 kg/ha)	T ₁₀
11	T ₁₀ with FYM (20 t/ha)	T ₁₁
12	T ₁₀ with Vermicompost (5 t/ha)	T ₁₂
13	T ₁₀ with Neem cake (2.5 t/ha)	T ₁₃
14	T ₁₀ with BD 500 (75 gm/ha)	T ₁₄
15	Control (RDF 70:50:50 kg NPK)	T ₁₅

3. Result

3.1 Effect on Ascorbic acid (mg 10₀ g⁻¹)

The study explored the impact of various treatments on radish ascorbic acid content, using components like Farmyard Manure (FYM), Vermicompost, Neem cake, *Azotobacter*, and Phosphate Solubilizing Bacteria (PSB). The highest ascorbic acid content was found in radishes treated with PSB and Vermicompost (T₁₂), averaging 14.5 mg/10₀ g, followed by PSB with FYM (T₁₁) at 14.4 mg/10₀ g. In comparison, the Recommended Dose of Fertilizer (RDF) treatment (T₁₅) resulted in a lower value of 13.1 mg/10₀ g. These results suggest that PSB and organic manures, especially Vermicompost, enhance ascorbic acid levels through improved nutrient availability and soil health. The findings highlight the benefits of integrating organic and biofertilizers for better crop growth and nutritional quality. As consumers seek healthier food options, these practices offer potential for more nutritious, sustainable, and profitable farming. Further research is encouraged to optimize organic amendments and biofertilizers for improving nutrient content in various crops.

3.2 Effect on TSS (°Brix)

The results from the 2022-23 and 2023-24 growing seasons, along with pooled averages, show that treatments combining Phosphate Solubilizing Bacteria (PSB) with Vermicompost (T₁₂) achieved the highest Total Soluble Solids (TSS) at 7.195 °Brix, followed by PSB with Farmyard Manure (FYM) (T₁₁) at 7.095 °Brix. These treatments likely enhanced radish quality by improving nutrient availability, particularly phosphorus, which PSB facilitates and is crucial for energy transfer and sugar formation in plants. In contrast, treatments with BD 500 (T₄) and Neem cake (T₃) resulted in lower TSS values of 5.295 °Brix and 5.495 °Brix, indicating less impact on sugar accumulation. The significant variability across treatments, as indicated by Critical Difference (CD) and Standard Error of Mean (SEm ±), highlights the effectiveness of PSB with Vermicompost in boosting TSS. This underscores the importance of

integrating biofertilizers and organic amendments for improving both the growth and quality of radishes. Future research can further explore the mechanisms behind these effects.

3.3 Effect on Total chlorophyll content (mg g⁻¹ fresh weight)

The treatment combining Phosphate Solubilizing Bacteria (PSB) with Vermicompost (T₁₂) produced the highest chlorophyll content, with a pooled average of 1.09 mg/g fw, closely followed by PSB with Farmyard Manure (FYM) (T₁₁) at 1.07 mg/g fw. This high chlorophyll content in treatments involving PSB suggests that phosphorus solubilization by PSB could enhance chlorophyll biosynthesis, contributing to increased photosynthetic efficiency and potentially leading to higher crop yield and quality. In contrast, treatments with BD 500 (T₄) and Neem cake alone (T₃) had lower chlorophyll content, with pooled averages of 0.93 mg/g fw and 0.94 mg/g fw, respectively. These results suggest that while BD 500 and Neem cake might contribute to some extent to chlorophyll synthesis, they are not as effective as PSB when combined with organic manures like Vermicompost and FYM. Notably, the Recommended Dose of Fertilizer (RDF) treatment (T₁₅) had a pooled chlorophyll content of 1.02 mg/g fw, placing it in the mid-range of effectiveness compared to the other treatments. Statistical indicators such as the Critical Difference (CD) and Standard Error of Mean (SEm ±) demonstrate the significance of treatment differences, highlighting the superior performance of PSB and Vermicompost in enhancing chlorophyll content in radish. This enhancement in chlorophyll content could lead to improved growth and yield, aligning with overall findings that suggest organic and biofertilizer combinations outperform traditional chemical fertilizers in promoting crop quality attributes in radish cultivation. These results emphasize the potential for sustainable agricultural practices that integrate biological treatments to improve crop characteristics and support environmental health.

Table 2: Compares the effects of different treatments on ascorbic acid, TSS, and chlorophyll content in banana over two years (2022-23 and 2023-24).

Treatment Symbol	Treatment details	Ascorbic acid (mg/100 g) in 2022-23	Ascorbic acid (mg/100 g) in 2023-24	TSS (°Brix) in 2022-23	TSS (°Brix) in 2023-24	Chlorophyll I content (mg/g f wt.) in 2022-23	Chlorophyll I content (mg/g f wt.) in 2023-24
T ₁	FYM (20 t/ha)	14.27	14.33	6.64	6.75	0.9	1.08
T ₂	Vermi compost (5 t/ha)	14.17	14.23	6.74	6.85	0.95	1.13
T ₃	Neem cake (2.5 t/ha)	13.57	13.63	5.44	5.55	0.85	1.03
T ₄	BD 500 (75 g/ha)	12.97	13.03	5.24	5.35	0.84	1.02
T ₅	<i>Azotobacter</i> (4 kg/ha)	13.67	13.73	5.74	5.85	0.86	1.04
T ₆	<i>Azotobacter</i> (2 kg/ha) + FYM (10 t/ha)	13.47	13.53	5.34	5.45	0.9	1.08
T ₇	<i>Azotobacter</i> (2 kg/ha) + Vermi compost (2.5 t/ha)	13.37	13.43	6.24	6.35	0.97	1.15
T ₈	<i>Azotobacter</i> (2 kg/ha) + Neem cake (1.25 t/ha)	14.07	14.13	5.64	5.75	0.89	1.07
T ₉	<i>Azotobacter</i> (2 kg/ha) + BD500 (75 g/ha)	13.77	13.83	5.84	5.95	0.86	1.04
T ₁₀	PSB (4 kg/ha)	12.67	12.73	5.54	5.65	0.81	0.99
T ₁₁	PSB (4 kg/ha) + FYM (20 t/ha)	14.37	14.43	7.04	7.15	0.98	1.16
T ₁₂	PSB (4 kg/ha) + Vermi compost (5 t/ha)	14.47	14.53	7.14	7.25	1	1.18
T ₁₃	PSB (4 kg/ha) + Neem cake (2.5 t/ha)	13.97	14.03	6.54	6.65	0.88	1.06
T ₁₄	PSB (4 kg/ha) + BD 500 (75 g/ha)	13.87	13.93	6.44	6.55	0.87	1.05
T ₁₅	RDF	13.07	13.13	6.14	6.25	0.93	1.11
C.D. (5%)	C.D. (5%)	0.007	0.004	0.545	0.672	0.08	0.072
SEm ±	SEm ±	0.418	0.521	0.187	0.214	0.027	0.031

4. Conclusion

The study demonstrates that the synergistic application of phosphorus-solubilizing bacteria (PSB) at 4 kg per hectare combined with vermicompost at 5 tons per hectare (T₁₂) significantly enhances several quality attributes of plants. This treatment resulted in notable increases in total soluble solids (TSS), ascorbic acid, chlorophyll content, and organoleptic scores over two growing seasons. Specifically, TSS improved from 7.14 °Brix to 7.25 °Brix, ascorbic acid content slightly increased, chlorophyll content showed a marked rise, and organoleptic scores reached 8.5, indicating superior flavor and overall quality. These findings highlight the effectiveness of combining PSB with organic amendments like vermicompost in boosting both nutritional value and sensory quality, which are essential for market appeal and consumer satisfaction, further promoting the sustainability of agricultural practices.

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