GAS Journal of Clinical Medicine and Medical Research (GASJCMMR)

Volume 2, Issue 3, 2025 Journal Homepage: https://gaspublishers.com/gasjcmmr/ ISSN: 3049-1568
Email: gaspublishers@gmail.com

Impact of Vermicompost on Biopriming of Raphanus Sativus

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***Received:** 04.05.2025 | **Accepted:** 07.05.2025 | **Published:** 10.05.2025*

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DOI: *10.5281/zenodo.15381986*

Abstract **Original Research Article**

Background: Vermicompost is an organic fertilizer used for the production of chemical free safe food in both quality and quantity and an alternative of unhealthy agrochemicals. Vermicompost is the excreta of earthworm, which are capable of improving soil health and nutrient status. Vermiculture is a process by which all types of biodegradable wastes such as farm wastes, kitchen wastes, market wastes, bio-wastes of agro based industries, livestock wastes etc. are converted while passing through the worm-gut to nutrient rich vermicompost.

Aim: Study aimed to assess the impact of vermicompost on biopriming of *Raphanus sativus.* **Materials and Methods:** Analyse the growth of radish plant with comparison of fertilizers between normal soil and soil treated with vermicompost. Qualitative and quantitative analysis of phytochemicals, antioxidant level, chlorophyll level, rhizobium activity was measured. Unknown materials and contamination in leaf extract was done by FTIR method. Radish was grown in normal soil and with different dosage of vermicompost in separate pots and the impact was measured by changes in the radish root and leaves weight on 27th, 36th and 42nd day after emergence of plant.

Results: The results showed that there is significant increase in the radish root and leaves weight in vermicompost soiled plant compared to normal soil. The biggest was achieved in SV 4:1 ratio and the smallest in control. However, SV 1:1 ratio shown 50% increase in diameter and weight favouring the radish for tradable and affordable.

The macronutrients 48.7 nitrogen, 29.8 phosphorus, 12874 potassium, 3.92 sulphur, 90295 calcium, 27683 magnesium and micronutrients 145.7 copper, 31063 iron, 518.8 manganese, 953 zinc, 446 chloride levels was measured in mg/kg of soil. Electrical conductivity of the soil at 26.4 degree C (1:2 Ratio) contains 381µS/cm. The soil sample obtain the neutral PH level and it is the ideal type for the plant growth and Soil PH value – 7.96. The phytochemical analysis shown presence of flavonoids, alkaloid, tannins, terpenoid, protein, phenol, carbohydrates, amino acid and the absence of steroid, anthraquinone's, glycosides, saponins. The moisture content of soil 13.3% and improvised to 18.9% suitable for growth. The volumetric soil moisture content remaining at field capacity is about 50%. Vitamin C, more properly called ascorbic acid, is an essential antioxidant. *Raphanus sativus* leaf contains 80mg/100ml of anti-oxidant. It clearly reveals the leaf contains high anti-oxidant content. In the leaf extract of *Raphanus sativus* shows its peak in the 3278.99 in normal soil and 3290.56 in vermicompost soil which it has O-H and N-H stretching of amides and amines it is a saturated system.

Conclusion: Based on our results, we conclude *Raphanus sativus* plant growth on vermicompost gives the gradual growth based on the dosage. The study proves the growth of *Raphanus sativus* in vermicompost helps the growth of plant.

Keywords: Vermicompost, Raphanus Sativus, Biopriming.

Citation: Santhalakshmi, S., Hebsibah Elsie, B., Kasthuri, N., & Rajesh, R. (2025). Impact of vermicompost on biopriming of *Raphanus sativus*. *GAS Journal of Clinical Medicine and Medical Research*, *2*(3), 95-101.

INTRODUCTION

A revolution is unfolding in vermiculture studies for vermicomposting of diverse organic wastes by waste eater earthworms into a nutritive "organic fertilizer" and using them for production of chemical free safe food in both quantity & quality without recourse to agrochemicals. The scientific community all over the world is desperately looking for an economically viable, socially safe & environmentally sustainable alternative to the agrochemicals. Several farms in world especially in North America, Australia and Europe are going organic as the demand for "organic foods" are growing in society.

Vermicompost is the excreta of earthworm, which are capable of improving soil health and nutrient status. Vermiculture is a process by which all types of biodegradable wastes such as farm wastes, kitchen wastes, market wastes, bio-wastes of agro based industries, livestock wastes etc. are converted while passing through the worm-gut to nutrient rich vermicompost. Vermi worms are used here act as biological agents to consume those wastes and to deposit excreta in the process of vermicompost. It can increase crop production and prevent harmful pests, is eco-friendly, and is ideal organic manure for better growth and yield of many plants. Vermicompost can be prepared with the decomposition of waste things such as kitchen waste and agro residues.

Radish (*Raphanus sativus* L.) belongs to genus Raphanus, family Brassicaceae or Cruciferae originated from the Central and Western China and India. It has been identified as a widely held root vegetable in both tropical and temperate regions. There are different types of radish daikon long white, French breakfast. Green meat, cherry belle, watermelon radish, table radish, malage, easter egg, round black, white hailstone, helios, sparkler. Radishes are a good source of antioxidants like catechin, pyrogallol, vanillic acid, and other phenolic compounds. These root vegetables also have a good amount of vitamin C, which acts as an antioxidant to protect your cells from damage. Health benefits includes reduced risk of diabetes, enhance liver function, improves blood flow and cardiovascular system.

Our study aim is to assess the Impact of vermicompost on biopriming of *Raphanus sativus* and to analyse the growth of radish plant with the comparison of fertilizers between normal soil and the soil treated with vermicompost.

MATERIALS AND METHODS

Vermicompost Preparation:

Vermicompost was obtained from the degradable waste from the house. A total of 20kg of vermicompost was applied in 4 plots. The nutrient content in vermicompost varied depending on the waste material that is being used for composed preparation. The common nutrients content in vermicompost's organic carbon 13.4%, nitrogen 1.6%, phosphorus 1.02%, potassium 0.73%, and other micro nutrients in a small amount. **(Figure 1)**

Figure 1: Vermicompost and Radish (*Raphanus sativus)*

Radish Seed Preparation:

Radish seeds were obtained from the distributor in Katpadi, Vellore in March 2023. The experiment was carried out in the field Pallikuppam farm, from 16th March to 20th April 2023. Seeds were separated from stems and kernel manually and dried for 48 hours at 105 °C. The seeds were milled, sieved by particle size (d<0.4 mm) and kept in a desiccator until use. **(Figure 1)**

Soil Testing:

Sandy clay with 50% sand, 6% slit, 42% clay used for the study. Soil texture, moisture content, water holding capacity, pH of the soil, micro and macro nutrient levels was analysed. **(Figure 2).**

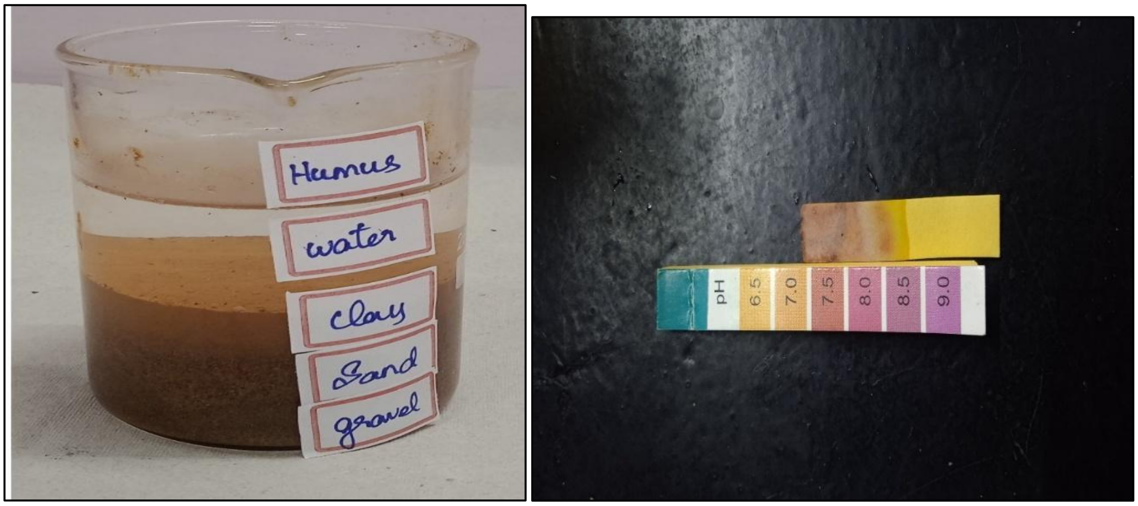

Figure 2: Soil testing – layers and pH, Thickness and layers of soil, pH of Soil.

Experimental Design:

The experiment was set up in a Randomized Complete Block Design (RCBD) with 5 treatments and each treatment was replicated 4 times. **(Figure 3).** Treatment protocol as follows: T1- Control (Without vermicompost application), T2- Vermicompost (5 ton/ha), T3- Vermicompost (10 ton/ha), T4- Vermicompost (15 ton/ha), T5 - Vermicompost (20 ton/ha).

Figure 3: Experimental setup of plant.

Extract Preparation

The *Raphanus sativus* leaves were collected and shade dried in room temperature at (32ºC-35ºC) for 5 days without heavy sunlight. Then grind the leaves using mechanical blender for the further analysis. The aqueous extract of leaves with different concentration of dry powder i.e., 5gm and 10 gm was taken in conical flasks having equal amount (100ml) of deionized water. Both the flasks were heated at 90°C in water bath for 1 hour. After 1 hour, flasks were taken out from water bath and kept at room temperature for cooling purpose. Then the extract was filtered with the help of filter paper and stored at 4°C for analysis. **(Figure 4).**

Figure 4: ***Raphanus sativus*** **leaves powder and aqueous extract, Aqueous leaf extract of** ***Raphanus sativus.***

RESULTS AND DISCUSSIONS:

Growth of Raphanus Sativus Plant in Normal Soil and Different Dosages of Vermicompost

Along with the change of the ratio of soil to vermicompost also the formation (weight) of the aboveground and underground radish was hanged. Regardless of the ratio of soil (S) and vermicompost (V) more was formed in the treatments 2–5, compared to the treatment without vermicompost. The weight of the aboveground and underground was increased in all those samplings where the ratio of soil to vermicompost was lower or equal 4:1.

The addition of compost above this ratio resulted in the gradual decrease of the formation of radish. As a result, the highest yield of roots and leaves was formed in the treatment 3 with the ratio S:V = 4:1. A higher quantity of vermicompost in the substrate, i.e., a lower ratio of soil to vermicompost than 4:1, resulted in the gradual decline of the formation. In spite of that, on the last days before the harvest of radish plants in the treatment with the lowest ratio of soil to vermicompost (1:1) five times more root was formed and about six times more leaves than in the control treatment without vermicompost. It was clear that the ratio of vermicompost and soil at the level of 1:1 was not optimal. However, even this high quantity of vermicompost in the growing medium did not have the negative impact on the weight of the aboveground and under vermicompost ground in comparison with the control treatment.

The positive impact of all tested quantities of vermicompost in the substrate on the radish was measurable on 24 April, i.e., 27 days from the radish emergence. The highest weight was recorded on the 42th day after emergence (May 9). If we assess the percentage of the growth in the treatments with vermicompost and the control treatment (in the individual samplings), we can claim that mostly roots reacted by more significant weight growth than leaves weight.

The contrary results were recorded, when the leaves grew more dynamically than radish roots after the application of fertilisers containing nitrogen. On the 27th day after the plant emergence the weight ratio of leaves and roots was on average 7.42:1 in all treatments. In the later growth phases, i. e. on 36th and 42nd day after emergence the ratio was lower than 1:1. The dynamic changes in the ratio of leaves and root weight indicated that in the initial vegetation period leaves were predominantly formed. The roots, as a reserve organ into which photosynthates are transferred, increased their weight in the last third of radish vegetation (before harvest). If we evaluate the ratios of leaves weight (L) and roots weight (R), it can be stated that the ratio L:R in the treatments with the vermicompost was lower than in the control treatment, apart from the treatment 5 and partially the treatment 3 (only in the last sampling). This finding approved our statement that the roots reacted to vermicompost mostly by more significant weight growth than leaves. The highest ratio L:R was recorded in the treatment with the highest proportion of vermicompost in the substrate (Tr. 5). Along with the change of treatments the root weight was changing, similarly the diameters of radish roots were changing. The biggest root diameter was achieved in the ratio S:V = 4:1 (Tr. 3) and the smallest one was in the control treatment. In the treatment 1 the root diameter was lower than 2.0 cm, therefore those roots were no t suitable for market according to the Slovak Technical Standard 46 31 20. 50% proportion of vermicompost in the growing medium (Tr. 5) compared with 20% proportion (Tr. 3) resulted in the significant decrease of the root diameter. However, 50% proportion of vermicompost in the growing medium (Trt. 5) in comparison with the control treatment 1 (without vermicompost) increased considerably the radish root diameter, and the radish became tradable.

Table 1: Impact of Vermicompost on the Changes of Radish Root Weight

TREATMENT		**(27days after emergence of plant)**		**(36days after emergence of plant)**		**(42days after emergence of plant)**	
Number	**Mark**	**[g/10 ind]**	**[%]**	**[g/10 ind]**	**[%]**	**[g/10 ind]**	**[%]**
1	**S**	**1.95**	**100.00**	**20.03**	**100.00**	**27.83**	**100.00**
2	**SV-9:1**	**2.83**	**145.13**	**148.71**	**742.39**	**185.80**	**667.62**
3	**SV-4:1**	**3.58**	**183.59**	**153.83**	**768.00**	**219.15**	**787.46**
4	**SV-3:1**	**2.70**	**138.46**	**145.82**	**728.00**	**214.23**	**769,78**
5	**SV-1:1**	**2.08**	**106.67**	**101.07**	**504.59**	**140.38**	**504.42**
		0.333		**6.376**		**2.832**	

Table 2: Impact of Vermicompost on the Changes of Radish Leaves Weight

Treatment		**(27days after emergence of plant)**		**(36days after emergence of plant)**		**(42days after emergence of plant)**	
Number	**Mark**	**[g/10 ind]**	**[%]**	**[g/10 ind]**	**[%]**	**[g/10 ind]**	**[%]**
1	**S**	**14.53**	**100.00**	**15.70**	**100.00**	**18.23**	**100.00**
2	**SV-9:1**	**20.88**	**145.13**	**83.60**	**532.48**	**104.20**	**571.59**
3	**SV-4:1**	**22.30**	**183.59**	**95.63**	**609.11**	**147.38**	**808.45**
4	**SV-3:1**	**20.10**	**138.46**	**85.65**	**545.54**	**135.95**	**745.75**
5	**SV-1:1**	**17.08**	**106.67**	**84.53**	**538.41**	**112.83**	**618.92**
		3.035		**6.880**		**3.520**	

Table 3: Macro and Micro Nutrient Level in Soil

The amount of macro and micro nutrient present in the soil sample is interpreted.

Table 3a: Macro Nutrients in Soil

S.No	**Parameters**	**Unit**	**Test Result**
1	Nitrogen as N	mg/kg	48.7
2	Phosphorus as P	mg/kg	29.8
3	Potassium as K	mg/kg	12874
4	Sulphur as S	mg/kg	3.92
5	Calcium as Ca	mg/kg	90295
6	Magnesium as Mg	mg/kg	27683

Table 3b: Micro Nutrients in Soil

S.No	Parameters	Unit	Test Result
1	Copper as Cu	mg/kg	145.7
2	Iron as Fe	mg/kg	31063
3	Manganese as Mn	mg/kg	518.8
4	Zinc as Zn	mg/kg	953
5	Chloride as Cl	mg/kg	446

CONCLUSION

Vermicompost is a great method of increasing plant and soil fertility. It is primarily concerned with worm breeding to increase its population. It is then prepared to aid crop growth and development. Earthworms not only turn garbage into valuable manure but also help maintain the ecosystem's health. There are many vermiculture uses and benefits. With the help of vermicompost the *Raphanus sativus* plant growth was increased. Soil test was done to check the nutrient level for plant growth. The utility of *Raphanus sativus* in vermicompost with Biopriming seed it gives the immense growth in the plant with the various dosage of vermicompost. This study has shown antioxidant activities in good percent. The extract also showed much better scavenging potential. Based on our results, we indicate *Raphanus sativus* plant growth on vermicompost gives the gradual growth based on the dosage. The study proves the growth of *Raphanus sativus* in vermicompost helps the growth of plant.

ACKNOWLEDGEMENT

We are thankful to the owner of Pallikuppam farm for seeds, vermicompost distributor, DKM college for women for workspace and analysis.

FUNDING: Self-funding

CONFLICT OF INTEREST: There is no conflict of interest between authors

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