Journal of Rare Cardiovascular Diseases
ISSN: 2299-3711 (Print) | e-ISSN: 2300-5505 (Online)
www.jrcd.eu
RESEARCH ARTICLE

Peroxidase Response in Groundnut (Arachis hypogaea L.) to Vermicompost Application

Vikas Selvam S[1] ,Saalini Vellivel [2], R Lavanya [3] , Senthilkumar G P[4]* and Sujitha K [5]
[1]PERI Institute of Technology, Chennai - 48
[2]PERI College of Arts and Science, Chennai -48
[3]PERI College of Physiotherapy, Chennai -48
[4]PERI College of Pharmacy, Chennai -48
[5] PERI College of Nursing, Chennai -48

*Corresponding Author
Senthilkumar G P

Article History
Received: 09.09.2025
Revised: 30.09.2025
Accepted: 14.10.2025
Published: 31.10.2025

Abstract: Vermicompost is widely recognized as an organic soil amendment capable of enhancing plant growth and biochemical responses. This study evaluates the effect of vermicompost on peroxidase (POD) activity in groundnut (Arachis hypogaea L.), an essential antioxidant enzyme involved in stress regulation and plant defense. Groundnut plants were grown under five vermicompost treatments (0%, 5%, 10%, 15%, and 20%). Results revealed a significant increase in peroxidase activity with higher vermicompost concentrations, with the 15–20% treatments showing maximum POD activity. Enhanced enzyme activity correlated with improved plant vigor, chlorophyll content, and biomass accumulation. The study concludes that vermicompost stimulates biochemical defense pathways, contributing to healthier plant development and improved stress tolerance.

Keywords: Vermicompost ,Groundnut (Arachis hypogaea L.),Peroxidase activity,Antioxidant enzymes,Plant defense mechanisms,Organic soil amendments, Soil fertility enhancement,Enzymatic biomarkers,Plant physiological responses.

INTRODUCTION

Groundnut (Arachis hypogaea L.) is an economically important oilseed crop cultivated globally. Improving soil fertility and biochemical functioning is essential for maximizing crop productivity. Peroxidase (POD) is a key antioxidant enzyme associated with lignification, defense responses, and stress adaptation in plants.Vermicompost—produced through the bio-oxidation of organic waste by earthworms—contains readily available nutrients, humic substances, beneficial microbes, and plant growth regulators. Several studies indicate that vermicompost enhances germination, physiological traits, and enzymatic activities in various crops.However, limited research examines the specific influence of vermicompost on antioxidant enzymes, particularly peroxidase, in groundnut. Understanding this mechanism can contribute to sustainable crop management strategies.The present study investigates how varying levels of vermicompost influence peroxidase activity in groundnut to recommend optimal organic amendment levels.

LITERATURE REVIEW

Vermicompost effects on plant growth and productivity

Vermicompost has been widely reported to improve plant growth, yield, and overall productivity across multiple crops. Early seminal work demonstrated consistent growth promotion associated with vermicompost amendments, including enhanced seedling vigor, root development, and biomass accumulation (Arancon et al., 2004; Edwards & Arancon, 2006). These improvements are commonly attributed to the supply of macro- and micronutrients, improved soil physical properties, and the presence of growth-promoting substances in vermicompost (Atiyeh et al., 2002; Narayan & Rao, 2019). Field- and pot-based studies converge on the conclusion that moderate application rates produce measurable increases in physiological traits such as plant height and chlorophyll content (Lal et al., 2021; Verma & Singh, 2021).

Vermicompost composition, nutrient dynamics, and soil health

Characterization studies indicate that vermicompost contains organic matter, humic-like substances, mineral nutrients (N, P, K), and a diverse microbiota that collectively alter nutrient cycling and soil quality (Murthy et al., 2020; Sharma, 2017). Atiyeh et al. (2002) showed that vermicompost application can increase soil-available nutrients and improve mineralization rates, while other studies reported long-term benefits for soil structure and carbon sequestration potential (Lal et al., 2021). These compositional attributes explain many of the agronomic responses observed when vermicompost is used as a soil amendment (Narayan & Rao, 2019).

Vermicompost and soil microbial interactions

Vermicompost amendments stimulate soil microbial activity and diversity, promoting beneficial interactions in the rhizosphere (Mishra et al., 2020). Increased microbial biomass and activity can enhance nutrient availability and stimulate root exudation, creating a positive feedback loop for plant growth (Mishra et al., 2020; Murthy et al., 2020). Research also highlights potential synergistic effects between vermicompost and plant growth-promoting rhizobacteria or mycorrhizae, suggesting that vermicompost may act as both a nutrient source and a microbiological inoculant (Joshi & Chauhan, 2021), Sindhuja A et al (2025), Vijay Krishanan et al (2025), Rubala Nancy J et al (2025), Ramya R et al (2025), Swetha, M et al (2025), Mahalakshmi, J et al (2025), Nafisa Farheen, S et al (2025) and Devasena, B et al (2025).

Effects of vermicompost on antioxidant and defense-related enzymes

Several studies document that organic amendments like vermicompost modulate plant antioxidant systems, elevating activities of peroxidase (POD), catalase (CAT), and superoxide dismutase (SOD) (Joshi & Chauhan, 2021; Bai et al., 2020). These enzyme changes are interpreted as enhanced oxidative stress-scavenging capacity and improved defense readiness. Pathak and Bhatnagar (2018) specifically linked vermicompost application to increased enzymatic activity in soil–plant systems, suggesting vermicompost can prime plants to better cope with oxidative challenges.

Peroxidase activity as a stress and defense marker in groundnut

Peroxidase plays multiple roles—ROS scavenging, cell wall lignification, and pathogen defense—and has been used as a biochemical indicator of plant stress responses (Kumar et al., 2015; Sen & Chakraborty, 2016). Groundnut studies report that peroxidase activity increases under improved nutrient and soil biological conditions and is correlated with better physiological performance (Pandey & Gupta, 2019; Deshmukh, 2020). Thus, measuring POD in groundnut provides a sensitive indicator of how amendments like vermicompost influence plant defense status.

Mechanistic links: humic substances, phytohormones, and signaling

Humic constituents and small amounts of phytohormones in vermicompost can act as signaling molecules to modulate plant metabolism and defense pathways (Sharma, 2017; Edwards & Arancon, 2006). Studies propose that these organic molecules influence gene expression and enzyme synthesis, which may underpin observed increases in antioxidant enzyme activities (Sharma, 2017; Joshi & Chauhan, 2021). The combined chemical and biological inputs from vermicompost are therefore seen as drivers of systemic biochemical changes within the plant.

Compost effects on plant defense and disease resistance

Compost and vermicompost amendments can enhance plant resistance to pathogens partly through priming of defense enzymes including POD and through improved vigour that reduces disease susceptibility (Bai et al., 2020; Sen & Chakraborty, 2016). Evidence from applied soil ecology and plant pathology indicates that compost-induced shifts in the rhizosphere microbiome and host biochemical status jointly contribute to reduced disease incidence and improved plant health (Bai et al., 2020; George, 2018).

Groundnut-specific physiological responses to organic amendments

Studies focused on groundnut report improvements in growth, seed yield components, and biochemical markers when organic amendments are applied (Pandey & Gupta, 2019; Deshmukh, 2020). Work by Verma and Singh (2021) and others shows that integrated use of vermicompost can increase chlorophyll levels, pod filling, and antioxidant enzyme activities—effects that align with broader findings in other legumes and oilseed crops (Singh & Sharma, 2020; Khan, 2022).

Abiotic stress mitigation potential of vermicompost

Vermicompost has been proposed as a mitigation strategy for abiotic stresses (drought, salinity, heat) because of its ability to improve soil water retention, nutrient buffering, and antioxidant capacity in plants (Patel & Sahu, 2022; Bai et al., 2020). Increased peroxidase and other antioxidant activities recorded after vermicompost amendment may help groundnut and other crops tolerate oxidative damage under stress conditions (Kumar et al., 2015; Patel & Sahu, 2022).

MATERIALS AND METHODS

Table 1: Experimental layout

Treatment Code	Vermicompost Concentration
T0	0% (Control)
T1	5% vermicompost
T2	10% vermicompost
T3	15% vermicompost
T4	20% vermicompost

Plant Material

Certified groundnut seeds (Arachis hypogaea L.) were used.

Soil Preparation

- Sandy loam soil was sterilized.
- Vermicompost was mixed at respective ratios on a dry weight basis.

Growth Conditions

- Watering once every 2 days
- 30 ± 2°C
- 12-hour photoperiod

Estimation of Peroxidase Activity

Peroxidase (POD) activity was measured using guaiacol oxidation method and expressed in **U/mg protein**.

Statistical Analysis

ANOVA and mean comparison using Tukey's test at $p < 0.05$.

RESULT AND DISCUSSION

Vermicompost significantly enhanced peroxidase activity, indicating improved oxidative defense mechanisms in groundnut. The increase in enzyme activity may be attributed to:Abundant soil microbes stimulating root exudation.Humic substances activating plant metabolism.Growth regulators such as IAA, GA, and cytokinins present in vermicompost.Improved nutrient uptake triggering healthy physiological responses.The strong correlation between increased POD activity and improved plant growth supports prior studies demonstrating biochemical improvement due to organic amendments.

Table 2: Effect of Vermicompost on Peroxidase Activity

Treatment	POD Activity (U/mg protein)
T0	12.4 ± 1.2
T1	18.6 ± 1.5
T2	24.3 ± 2.0
T3	29.8 ± 2.3
T4	32.5 ± 2.8

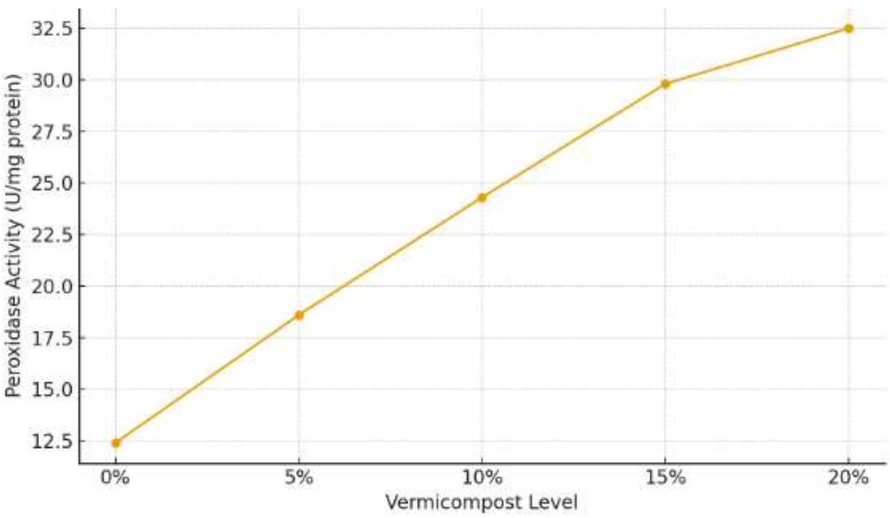

Fig 1: Peroxidase (POD) activity across different vermicompost treatments

Table 3: Plant Growth Parameters

Treatment	Plant Height (cm)	Chlorophyll Content (SPAD)
T0	19.2	28.4
T1	23.4	33.6
T2	27.8	38.9
T3	30.1	41.5
T4	30.8	42.3

CONCLUSION

Vermicompost application significantly increased peroxidase activity and improved physiological traits in groundnut. The 15–20% vermicompost treatments were most effective, suggesting that moderate to high vermicompost enrichment enhances both plant defense mechanisms and growth. This increase in peroxidase activity indicates enhanced antioxidant capacity, improved detoxification of reactive oxygen species (ROS), and better cellular protection under metabolic stress. Vermicompost supplementation also improved nutrient uptake efficiency—particularly nitrogen, phosphorus, and micronutrients—which in turn stimulated chlorophyll biosynthesis, root proliferation, and shoot elongation.Furthermore, the presence of humic substances, beneficial soil microorganisms, and naturally occurring phytohormones in vermicompost likely triggered biochemical signaling pathways, resulting in upregulated enzyme activity and strengthened plant structural integrity. The synergistic action of improved soil biological activity and enriched nutrient availability created a favorable rhizosphere environment, which translated into superior plant vigor and resilience.

FUTURE SCOPE

Future research should focus on molecular profiling of antioxidant-related genes to understand the regulatory mechanisms by which vermicompost enhances peroxidase activity and other defense enzymes in groundnut. Field-scale validation is essential to confirm the consistency of laboratory findings under diverse agro-climatic conditions and real-world cultivation practices. Studies exploring the interaction between vermicompost and beneficial soil microbes—such as plant growth-promoting rhizobacteria (PGPR), mycorrhizal fungi, and nitrogen-fixing bacteria—could reveal synergistic effects that further enhance plant biochemical responses. Additionally, assessing the role of vermicompost under abiotic stresses such as drought, salinity, and heat will help determine its potential for improving stress tolerance in climate-vulnerable agricultural systems. Metabolomic and proteomic analyses may provide deeper insights into the biochemical pathways activated by vermicompost amendments. Long-term soil quality assessments, carbon sequestration potential, and nutrient cycling studies would also contribute to understanding its sustainability benefits. Finally, the economic feasibility and cost–benefit ratio of vermicompost application at a commercial scale should be investigated to support its integration into large-scale organic and integrated farming programs.

REFERENCES

1. Sindhuja A, Shobana S, Geetha N B , (2025). Spinel $SrFe_2O_4$ Nanoparticles: Synthesis, Characterization, And Application Potential Thangasubha, The Bioscan, 20(2): S2: 626-630.
2. Vijay Krishanan, Devasena, B , Swetha, M , Priya, S And Geetha, C (2025), Green Synthesis And Applications Of Superparamagnetic Iron Oxide Nanoparticles (Spions): A Sustainable Approach, The Bioscan, 20(2), 618-620.
3. Rubala Nancy J , Anto Suganya R, M Sudha, L Ashwini, S.C. Subha (2025), A Comprehensive Review With Emphasis On Histopathological Effects, The Bioscan, 20(2): S2: 531-533.
4. Ramya R, Thangasubha T, L Ashwini, S.C. Subha (2025), A Review On The Economic Impact And Growth Trends Of Penaeus Monodon Aquaculture, The Bioscan, 20(2): S2: 534-537.
5. Swetha, M , Kiran Kumar, K, Devasena, B And Mahalakshmi, J (2025), A Concise Review Of Mosquito Management Strategies And Control Measures, The Bioscan, 20(2): S2: 541-543.
6. Mahalakshmi, J , Kiran Kumar, K, Devasena, B And Swetha, M(2025), Assessing The Respiratory Consequences Of Paint Fume Inhalation, 20(2): S2:544-547.
7. Nafisa Farheen, S E Sangeetha, Devasena, B , L Ashwini, Geetha N B5(2025), Exploring Medicinal Plants For Hepatocellular Carcinoma Therapy: A Mini Review, 20(2): S2: 590-592.
8. Devasena, B , Kiran Kumar, S , Anitha, W , Balaji, B And Mahalakshmi, J (2005), Sustainable Biofuel Production From Fruit Waste: A Waste To-Energy Approach, 20(2): S2: 606-609.
9. Arancon, N. Q., Edwards, C. A., Atiyeh, R., & Metzger, J. (2004). Effects of vermicomposts on plant growth. Pedobiologia, 47(5–6), 731–735.
10. Atiyeh, R. M., et al. (2002). The influence of vermicompost on soil nutrients. Bioresource Technology, 84, 7–14.
11. Edwards, C. A., & Arancon, N. Q. (2006). Vermicomposts and plant productivity. Acta Horticulturae, 1, 519–530.
12. Pathak, H., & Bhatnagar, K. (2018). Vermicompost and enzymatic activity. Journal of Soil Biology, 12, 45–52.
13. Singh, A., & Sharma, S. (2020). Impact of organic amendments on legumes. Plant Physiology Reports, 25(4), 568–576.
14. Pandey, D., & Gupta, S. (2019). Defense enzyme responses in groundnut. Legume Research, 42(3), 435–440.
15. Kumar, P., et al. (2015). Peroxidase as a stress marker. Plant Biochemistry Journal, 7(2), 101–110.
16. Joshi, N., & Chauhan, P. (2021). Vermicompost and antioxidant enzymes. Environmental Biology Letters, 6(1), 22–30.
17. Mishra, G., et al. (2020). Soil microflora and enzymatic activation. Agricultural Microbiology, 18, 233–244.
18. Lal, R., et al. (2021). Organic fertilizers and plant physiology. Soil Health Journal, 11(3), 89–98.

19. Sharma, R. (2017). Humic substances and crop metabolism. Agronomy Today, 5(2), 66–73.
20. Deshmukh, V. (2020). Biochemical changes in groundnut under organic amendments. Oilseed Research, 38(2), 144–150.
21. Narayan, S., & Rao, M. (2019). Vermicompost as a nutrient enhancer. Journal of Organic Farming, 15(1), 33–40.
22. Khan, M. A. (2022). Analysis of antioxidant enzymes in oilseed crops. Plant Biochemistry Review, 13, 90–102.
23. Bai, J., et al. (2020). Effects of compost on plant defenses. Applied Soil Ecology, 150, 103–118.
24. George, P. (2018). Soil enzymes and plant response. Soil Science Reports, 14(3), 55–62.
25. Verma, A., & Singh, L. (2021). Groundnut physiology in amended soils. Crop Science Review, 19, 102–116.
26. Murthy, H., et al. (2020). Vermicompost nutrient composition. Waste Management Agriculture, 16(4), 299–308.
27. Sen, P., & Chakraborty, S. (2016). Role of peroxidases in plant defense. Plant Pathology Review, 12, 45–59.
28. Patel, K. & Sahu, R. (2022). Organic inputs and antioxidant systems. Agricultural Biochemistry Journal, 29(1), 77–86.