International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 08-03-2026, Accepted: 08-04-2026, Published: 23-04-2026
Volume 11, Issue 2, 2026, Page No. 141-145

Impact of termite-mound soil and amended soil on the growth and yield of *Capsicum annum* L. and *Amaranthus tricolor* L.

Sunitha S[1*], Ramyakrishna M P[1], Nimisha R S[2]
[1] Department of Botany, University of Kerala, kariavattom, Trivandrum, Kerala, India
[2] National Centre for Nanoscience and Nanotechnology, University of Madras, Chennai, Tamil Nadu, India
Corresponding Author: Sunitha S

Abstract
Soil fertility plays a crucial role in determining the growth and productivity of vegetable crops. In recent years, interest has increased in the use of natural soil amendments as sustainable alternatives to chemical fertilizers. The present study evaluates the impact of termite-mound soil and termite-amended soil on the growth of Chilli and Red Amaranthus in comparison with normal soil. A field experiment was conducted using normal soil (control), termite-mound soil, and termite-amended soil. Selected vegetable crops were cultivated under uniform agronomic conditions, and measured plant height and number of leaves at regular intervals. The results indicated that plants grown in termite-mound soil and termite-amended soil exhibited significantly improved growth and yield compared to those grown in normal soil. Enhanced nutrient availability, better soil structure, and increased microbial activity in termite-associated soils are likely responsible for the observed improvements. Among the treatments, termite-mound soil showed the highest performance, followed by termite-amended soil. The findings suggest that termite-derived soils can serve as effective, eco-friendly biofertilizers for sustainable vegetable production.

Keywords: Termite-mound soil, amended soil, soil fertility, biofertilizer, crop productivity

Introduction

Termites have been used as an ecological indicator to assess soil quality and fertility. This is because they play an important role in soil transportation, nitrogen fixation, and nutrient circulation, thus improving the soil water content, pH, porosity, and organic carbon content (Shelke *et al*., 2023) [22].

Termites enhance the nutritional composition of the soil by the activities within and around the mounds (Liu *et al*., 2025; Lelisa Deke, 2016) [15, 14]. Termite activity significantly influences soil health and enhances crop productivity by accelerating organic matter decomposition and facilitating nutrient recycling (Adebajo *et al*.,2021; I. P. *et al*.,2025; Chisanga *et al.,*2020; Tilahun *et al.,* 2012) [1,9, 5, 23].

Termite mounds can be used as an environment friendly alternative for plant growth. These mounds were found to be a storehouse of nutrients that are needed for plant growth and development, which are inadequate in the surrounding soil (Murano, 2019) [18]. (Beyene & Getu, 2021) [4] state that termite mounds are enriched with both macro-and micronutrients, which are result of termite's soil reworking activities. These processes considerably enhance the exchangeable cations such as potassium (K), calcium (Ca), and magnesium (Mg), soil organic matter, pH, and trace elements including iron (Fe), zinc (Zn), and copper (Cu). This enrichment arises due to the collection, ingestion and excretion of the diverse materials that they acquire during feeding and mound construction. The mounds so constructed are highly valuable with rich nutrient content and beneficial microorganisms. Additionally, termite soil also contains useful plant growth promoting bacteria such as *Bacillus* sp., *Citrobacter freundii*, *Azotobacter* sp., and *Pseudomonas* sp., which are capable of solubilizing phosphate and potassium (Kathbaruah *et al.,* 2024) [12].

Chillies are one of the well-known crops of family Solanaceae belonging to the genus *Capsicum.* There are 5 domesticated chilli species which are, *C. annuum*, *C. baccatum*, *C. chinense*, *C. pubescens* and *C. frustescens*. Among all these species, *Capsicum annuum* is economically important and widely cultivated *Capsicum* sp. (Feldmann & Rutikanga, 2021) [6].

Amaranthus species (*A. blitum, A. caudatus, A. cruentus and A. tricolor*) collectively known as amaranths or pigweed, are members of the Amaranthaceae family. They have common names such as African Spinach, India Spinach and Chinese spinach; approximately 60 species are presently recognized with inflorescence and foliage ranging from purple and red to gold. Member of this genus share many characteristics and uses with members of the closely related genus (Jimoh *et al.,* 2022) [10].

Amaranth leaves are used similarly as spinach and can be boiled or fried as a tasty side dish. The leaves are high in fiber and contain high concentration of Vitamin A, B6 and C, riboflavin and foliate. Minerals include calcium, iron, magnesium, phosphorus, potassium, zinc, copper and manganese (Bang *et al.,* 2021) [3].

The effects of termite mound soil on crop growth have been studied by many workers in paddy (Miyagawa *et al.,* 2011)[16] maize (Mukalay *et al.,* 2026) [17]and tomato (Garba *et al.,* 2011) [8] due to its ability to supply nutrients. Such experiments showed excellent growth effect of termite mound soil on aforementioned crops. In the present study, we aim to investigate the effect of termite mound soil on the growth and yield of chilli (*Capsicum annuum L.)* and *red amaranthus (Amaranthus tricolor L.)*

Materials and Methods

Study Area

The experiment was conducted at the Department of Botany, University of Kerala, Kariavattom, Thiruvananthapuram, Kerala, India. The study site is geographically located at 8°34′6″ N latitude and 76°52′51″ E longitude, at an altitude of approximately 60 m above mean sea level.

Soil Collection and Preparation

Two soil treatments were used in the study: (i) pure termite-mound soil and (ii) termite-mound soil amended with normal garden soil in a 1:1 ratio (w/w). Termite-mound soil was collected from inactive termite mounds in the vicinity of the study area, while normal soil was obtained from a nearby garden. Both soil types were air-dried under ambient conditions, gently crushed, and sieved to remove stones, roots, and other debris. The amended soil was prepared by thoroughly mixing equal proportions of termite-mound soil and normal soil to ensure homogeneity.

Planting Material

Healthy, uniform, and viable seeds of chilli (*Capsicum annuum* L.) and red amaranth (*Amaranthus tricolor* L.) were collected from College of Agriculture, Kerala Agricultural University,Vellayani, Thiruvananthapuram, kerala.

Experimental Setup and Sowing Procedure

Experimental plots were prepared and filled with the respective soil treatments, maintaining equal quantities of soil in each plot. Seeds were sown at a uniform depth to ensure consistency in germination conditions. The experiment was maintained under natural environmental conditions. Irrigation was provided regularly to maintain adequate soil moisture, and no chemical fertilizers or growth regulators were applied during the experimental period.

Growth and Yield Parameters

Observations were recorded at regular intervals to assess plant growth and yield. Plant growth parameters such as Number of leaves per plant, shoot length (cm) and Number of fruits per plant were recorded.

Soil Analysis

The soil samples were analyzed for physicochemical parameters including pH (Bachha *et al*., 2022) [2] organic carbon (Nelson & Sommers, 1996) [19] organic matter, available nitrogen (Robert Okalebo *et al*., n.d.) [21]phosphorus (Kruse *et al*., 2015) [13]potassium was determined by the flame photometer method and water-holding capacity by Keen's cup method as outlined by (Okweche *et al.,* 2024) [20].

Statistical Analysis

The experimental data were analyzed using one-way analysis of variance (ANOVA) and the data were evaluated at $p \leq 0.05$ level of significance. All treatments were conducted with six replicates, and results are presented as mean ± standard error.

Results and Discussion

The physicochemical properties of termite mound soil showed improved nutrient status compared to normal soil. The termite mound soil exhibited higher nitrogen, phosphorus, and potassium levels. In the present study the pH was slightly neutral to alkaline (6.3) which is favorable for nutrient availability. The availability of nutrients by plant is directly influenced by pH. When the pH is between 6.0 and 6.5, macronutrients like nitrogen, potassium, calcium, magnesium, and sulphur are readily available, whereas micronutrients are less readily available at higher, alkaline pHs (pH > 7.0) (Ferrarezi *et al.,* 2022) [7]. These enhanced soil properties may be attributed to termite activity, which incorporates organic matter and improves soil structure.

Nitrogen, phosphorus, and potassium are important elements in plant metabolic processes and are included in plant macronutrients. Nitrogen is an important macronutrient that gives plants a dark green color, is a component of chlorophyll, nucleic acid, protein, and protoplasm and can boost the vegetative growth of cultivated plants. Phosphorus is essential for photosynthesis and cell division process. Phosphorus deficiency can inhibit plant growth. Meanwhile, potassium plays an important role in nutrient absorption and nutrient transportation, water absorption, and plant growth (Zewdie & Reta, 2021) [24]. According to (Kathbaruah *et al*., 2025) [11], macronutrients like phosphorus and potassium were high in termite soil compared to normal soil but nitrogen was lesser in quantity. Whereas in our study, available nitrogen (313.60kg/ha), phosphorus (40.5kg/ha) and potassium (221.90kg/ha) were significantly high in termite mound soil than normal soil (Table 1).

Plant growth parameters such as shoot length and number of leave were significantly higher in chilli and red amaranth grown in termite mound soil compared to control soil (Fig 1 & 3). Similar results were reported by (Kathbaruah *et al.,* 2025) [11]. The increased growth shown by both the plants may be due to improved nutrient availability and better water-holding capacity of termite mound soil.

Yield parameters showed a significant increase in termite mound soil treatments. *Capsicum annum* grown in termite mound soil and amended soil had higher number of fruits per plant compared to control plants (Fig 2). The improved yield could be attributed to the balanced nutrient supply and improved soil structure created by termite activity.

The results of the present study are in agreement with previous findings that termite mound soil enhances plant growth and productivity due to its enriched nutrient composition. Termites transport subsoil materials and organic matter to the surface, leading to nutrient accumulation. Additionally, microbial activity in termite mounds may contribute to nutrient mineralization.

Overall, the findings suggest that termite mound soil can be effectively used as a natural fertilizer to improve plant growth and yield. The improved soil fertility, enhanced nutrient availability, and better moisture retention collectively contribute to enhanced plant performance.

Table 1: physico-chemical parameters of termite mound soil and normal soil

Sl. No:	Parameters	Termite Mound Soil	Normal Soil
1.	pH	6.30	4.60
2.	Organic carbon (%)	0.6	0.85
3	Organic matter	1.34	1.46
4.	Water holding capacity (%)	36.25	27.38
5.	Clay%	55.80	22.60
6.	Available Nitrogen (kg/ha)	313.60	220.40
7.	Available Phosphorous (kg/ha)	40.5	20.1
8.	Available potassium (Kg/ha)	221.90	32.58

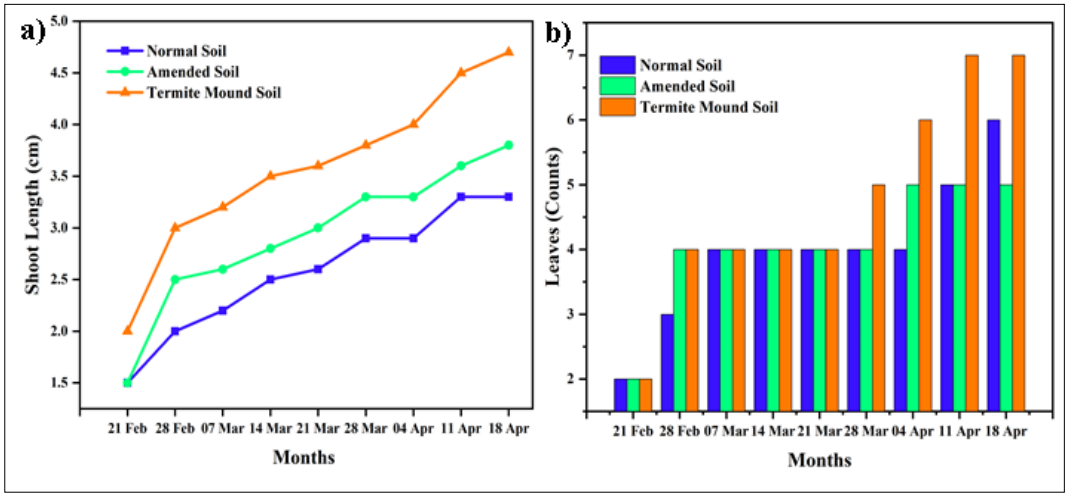

Fig 1: Comparative analysis of a) Shoot length b) Number of leaves of *Capsicum annum* grown in Normal, Amended and Termite Mound Soil

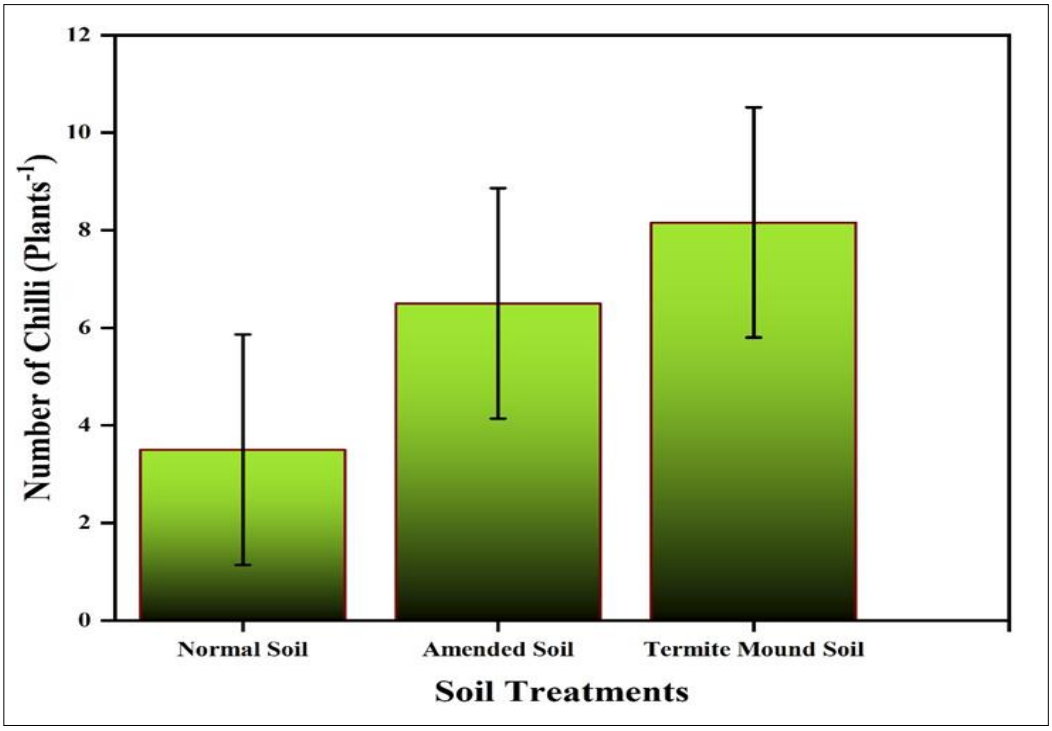

Fig 2: Yield performance of *Capsicum annuum* under different soil conditions, expressed as number of chilli per plant in normal, amended, and termite mound soils

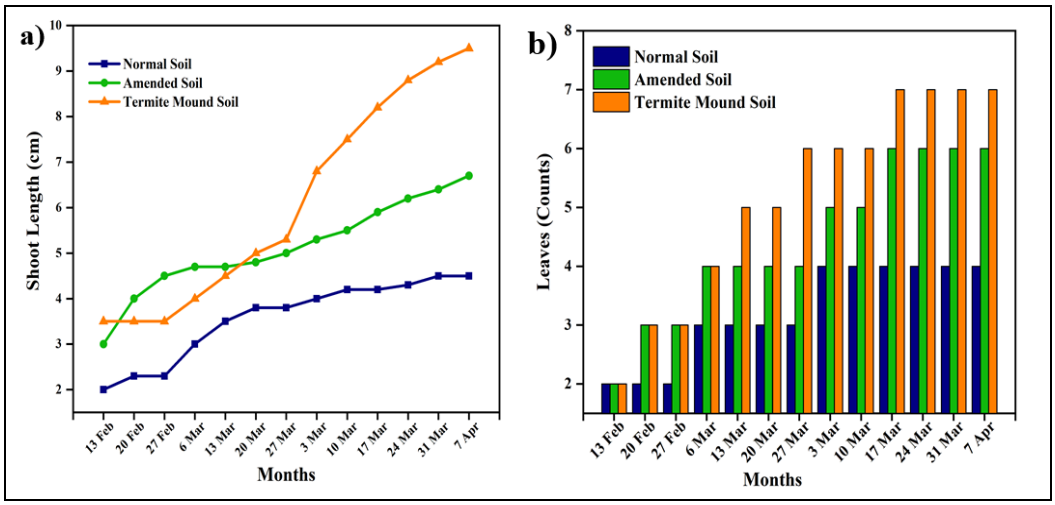

Fig 3: Comparative analysis of a) Shoot length b) Number of leaves of *Amaranthus tricolor* grown in Normal, Amended and Termite Mound Soil

Acknowledgement
The authors extend their sincere appreciation to the Department of Botany, University of Kerala, Kerala, India for providing the adequate facilities required for the study.

Conclusion
Plants grown in termite mound soil exhibited superior results compared to those grown in normal soil, showing its capacity to enhance soil fertility and plant productivity. The improved growth may be attributed to the enhanced physicochemical properties and nutrient availability in termite mound soil. Therefore, termite mound soil can be considered as a sustainable and eco-friendly alternative to conventional chemical fertilizers for promoting plant growth

References
1. Adebajo SO, Akintokun PO, Ezaka E, Ojo AE, Olannye DU, Ayodeji OD. Use of termitarium soil as a viable source for biofertilizer and biocontrol. Bulletin of the National Research Centre, 2021, 45(1). https://doi.org/10.1186/s42269-021-00560-8
2. Bachha B, Sahoo S, Mishra SS, Kusum A. Physicochemical properties and biochemical activities of Termitaria soil of *Odontotermes* spp. and surrounding soil in Sambalpur district, Odisha, India. Journal of Entomology and Zoology Studies,2022:10(2):124–128. https://doi.org/10.22271/j.ento.2022.v10.i2b.8978
3. Bang JH, Lee KJ, Jeong WT, Han S, Jo IH, Choi SH, *et al*. Antioxidant activity and phytochemical content of nine amaranthus species. Agronomy, 2021, 11(6). https://doi.org/10.3390/agronomy11061032
4. Beyene T, Getu E. Some physiochemical properties of termite mound soil and its effect on yield and yield components of maize (*Zea mays* L.) Under Greenhouse condition at Nekemte, western Ethiopia. SINET: Ethiopian Journal of Science,2021:44(1):38–46. https://doi.org/10.4314/sinet.v44i1.4
5. Chisanga K, Mbega ER, Ndakidemi PA. Prospects of using termite mound soil organic amendment for enhancing soil nutrition in Southern Africa. Plants,2020:9(5). https://doi.org/10.3390/plants9050649
6. Feldmann F, Rutikanga A. Phenological growth stages and BBCH-identification keys of Chilli (*Capsicum annuum* L., Capsicum chinense JACQ., *Capsicum baccatum* L.). Journal of Plant Diseases and Protection,2021:128(2):549–555. https://doi.org/10.1007/s41348-020-00395-x
7. Ferrarezi RS, Lin X, Gonzalez Neira AC, Tabay Zambon F, Hu H, Wang X, *et al*. Substrate pH Influences the Nutrient Absorption and Rhizosphere Microbiome of Huanglongbing-Affected Grapefruit Plants. Frontiers in Plant Science, 2022, 13. https://doi.org/10.3389/fpls.2022.856937
8. Garba M, Cornelis WM, Steppe K. Effect of termite mound material on the physical properties of sandy soil and on the growth characteristics of tomato (*Solanum lycopersicum* L.) in semi-arid Niger. Plant and Soil,2011:338(1):451–466. https://doi.org/10.1007/s11104-010-0558-0
9. PA, MK. HE D. An Investigation into the Effectiveness of Termite Mound Soil as a Natural Soil Amendment and Its Role in Promoting Sustainable Plant Growth. Journal of Advances in Biology & Biotechnology,2025:28(10):1261–1268. https://doi.org/10.9734/jabb/2025/v28i103143
10. Jimoh MO, Okaiyeto K, Oguntibeju OO, Laubscher CP. A Systematic Review on Amaranthus-Related Research. In Horticulturae, 2022, 8(3). https://doi.org/10.3390/horticulturae8030239
11. Kathbaruah S, Bhattacharyya B, Bhairavi KS. Properties of Termite Mounds and Its Impact on Crop Growth: A Review. Biotica Research Today,2025:7(1):28–32. https://doi.org/10.54083/brt/7.1.2025/28-32
12. Kathbaruah S, Bhattacharyya B, Borkataki S, Gogoi B, Hatibarua P, Gogoi S, *et al*. Termite mound soil based potting media: a better approach towards sustainable agriculture. Frontiers in Microbiology, 2024, 15. https://doi.org/10.3389/fmicb.2024.1387434
13. Kruse J, Abraham M, Amelung W, Baum C, Bol R, Kühn O, *et al*. Innovative methods in soil phosphorus research: A review. In Journal of Plant Nutrition and Soil Science,2015:178(1):43–88. https://doi.org/10.1002/jpln.201400327
14. Lelisa Deke A. Soil Physic-chemical Properties in Termite Mounds and Adjacent Control Soil in Miyo and Yabello Districts of Borana Zone, Southern Ethiopia. American Journal of Agriculture and Forestry,2016:4(4):69. https://doi.org/10.11648/j.ajaf.20160404.11
15. Liu C, Aumont C, Mikhailova AA, Audisio T, Hellemans S, Weng YM, *et al*. Unravelling the evolution of wood-feeding in termites with 47 high-resolution genome assemblies. Nature Communications, 2025, 16(1). https://doi.org/10.1038/s41467-025-65969-5
16. Miyagawa S, Koyama Y, Kokubo M, Matsushita Y, Adachi Y, Sivilay S, *et al*. Indigenous utilization of termite mounds and their sustainability in a rice growing village of the central plain of Laos. Journal of Ethnobiology and Ethnomedicine, 2011, 7. https://doi.org/10.1186/1746-4269-7-24
17. Mukalay JB, Meersmans J, Wellens J, Useni Sikuzani Y, Mukonzo EKL, Colinet G. Restoring Functional Soil Depth in Plinthosols: Effects of Subsoiling and Termite Mound Amendments on Maize Yield. Environments,2026:13(1):52. https://doi.org/10.3390/environments13010052
18. Murano E. Termite Mound Soil As A Soil Amendment In Eastern Uganda., 2019.
19. Nelson DW, Sommers LE. Total Carbon, Organic Carbon, and Organic Matter., 1996.
20. Okweche SI, Matthew HP, Effa EB, Nwaogu C. Physico-Chemical Properties of Termitaria and their Surrounding Soils in Some Nigerian Ecozones. Agricultural Research,2024:13(3):509–518. https://doi.org/10.1007/s40003-024-00707-9
21. Robert Okalebo by J, Gathua KW, Woomer PL. Laboratory Methods Of Soil And Plant Analysis: A Working Manual The Second Edition The Sustainable Agriculture Centre for Research Extension and Development in Africa.
22. Shelke P, Waghmode M, Mene R, Gunjal A, Patil N, Bhujbal N, *et al*. Morphological and elemental analysis of termite mound and ant nest in agriculturally prominent area. Nepal Journal of Environmental

Science,2023:11(1):1–10.
https://doi.org/10.3126/njes.v11i1.49170
23. Tilahun A, Kebede F, Yamoah C, Erens H, Mujinya BB, Verdoodt A, *et al*. Quantifying the masses of Macrotermes subhyalinus mounds and evaluating their use as a soil amendment. Agriculture, Ecosystems and Environment,2012:157:54–59.
https://doi.org/10.1016/j.agee.2011.11.013
24. Zewdie I, Reta Y. Review on the role of soil macronutrient (NPK) on the improvement and yield and quality of agronomic crops. Official Publication of Direct Research Journal of Agriculture and Food Science,2021:9(1):7–11.
https://doi.org/10.26765/DRJAFS23284767