

ORIGINAL ARTICLE

Impact of Fumigation on Physicochemical Properties of *Jivanti* Cultivated Soil: A Comparative Soil Analysis Study

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ABSTRACT

The present study was conducted to assess the impact of fumigation treatment on the physicochemical properties of soil and to compare them with those of untreated control soil. Three soil samples were analysed, i.e., soil before plantation, soil from the control group, which was not fumigated, and soil from the trial group, which was fumigated. Important soil parameters, including pH, electrical conductivity, organic carbon, available nitrogen, available phosphorus (P2O5), and available potash (K2O), were estimated using standard soil analytical procedures. The pre-plantation soil was deficient in organic carbon and nitrogen, with low fertility. The soil of the control group also exhibited poor nutrient status and increased alkalinity. By contrast, in the fumigated trial group, organic carbon (1.20%), available nitrogen (329 kg/ha), and available potash (582 kg/ha) showed significant improvement. The electrical conductivity of all the samples was within the normal limits, indicating the absence of salinity stress. The results showed that fumigation had a positive effect on soil fertility through increased availability of nutrients and organic matter. The results support the use of fumigation as a potential eco-friendly agricultural practice for improving soil quality and sustainable crop management.

Keywords: *Jivanti*, *Leptedania reticulata* L., Soil fertility, fumigation, soil analysis, sustainable agriculture

Received 19.04.2026

Revised 18.06.2026

Accepted 21.07.2026

How to cite this article:

Bhavin V. D, Suwarna A. M and Vidhi B. Impact of Fumigation on Physicochemical Properties of *Jivanti* Cultivated Soil: A Comparative Soil Analysis Study. Adv. Biores. Vol 17 [7] July 2026. 114-118

INTRODUCTION

Soil is regarded as one of the most important natural resources that support agricultural productivity and ecological balance. The physicochemical properties of soil have a great effect on crop growth, the availability of nutrients, microbial activity, and the overall health of plants. Healthy soil has the capacity to retain water, aeration, and biological activity, necessary for sustainable agriculture [1,2], and also provides essential nutrients to plants. In recent years, continuous cultivation, excessive use of chemical fertilisers, environmental pollution, and loss of organic matter have deteriorated soil fertility to a great extent [3]. Modern agricultural practices have increased dependence on synthetic agrochemicals, which often lead to nutrient imbalance and gradual degradation of soil quality [4,5]. The situation has created an urgent need for eco-friendly and sustainable agricultural interventions that can restore soil health without damaging the environment. Ancient systems of farming, Traditional farming practices were associated with emphasis on the use of natural methods of maintaining soil fertility and ecological equilibrium [6]. Among these traditional practices, fumigation methods with herbal or organic materials have attracted much attention due to their potential positive impacts on environmental purification, microbial regulation, and soil quality enhancement. Fumigation is thought to influence the soil biological activity through modification of the microbial ecosystem and acceleration of the decomposition of organic matter. Those processes may lead to a better availability of nutrients and soil fertility status [7]. Assessment of soil physicochemical parameters is an important tool to understand soil fertility and to evaluate the effect of agricultural interventions. Soil pH, electrical conductivity (EC), organic carbon, available nitrogen, phosphorus, and potash are the major indicators of soil quality [8]. Soil pH influences

nutrient availability and biological activity. The electrical conductivity indicates the state of the soil salinity. Organic carbon is important to improve soil structure, water retention, and microbial growth. Nitrogen. Nitrogen is a macronutrient that is vital for vegetative growth and protein synthesis in plants. Phosphorus participates in root development and energy transfer. Potassium regulates enzymatic activity, osmotic regulation, and the resistance of plants to stress.

Although fumigation has been traditionally practised in various agricultural systems, scientific evidence on the effect of fumigation on soil physicochemical properties is still scarce. Therefore, the present study was undertaken to evaluate and compare the effect of fumigation on important soil fertility parameters by analysing soil samples before plantation, control soil without fumigation, and fumigated trial soil.

MATERIAL AND METHODS

Study design

This current study was a comparative soil analysis investigation carried out in March 2026 to assess the impact of fumigation on of *Jivanti* (*Leptidenia reticulata* L.) physicochemical properties.

Experimental Setup

Initially, the grow bags were prepared for experimenting with controlled conditions. To ensure consistency between treatment groups, equal amounts of soil were placed in separate grow bags of *Jivanti*. The soil-filled grow bags were then clustered for the comparative evaluation.

The groups were:

- Soil before planting.
- Soil of the control group (no fumigation).
- Soil fumigated in the trial group.

Different grow bags for the soil were used to ensure proper isolation of experimental conditions and prevent cross-contamination between the fumigated and non-fumigated soils.

Fumigating Procedure

The trial group grow bags were fumigated while the control group was left unfumigated. Fumigation was carried out under controlled environmental conditions during the experimental period.

Soil Sample Collection

At the end of the experimental period, soil samples from all grow bags were carefully collected for physicochemical analysis. The collected samples were sent to the soil analysis laboratory for evaluation.

Physicochemical Parameters Assessed

- The following soil parameters have been studied:
- Soil pH (1:2.5)
- Electrical conductivity (EC)
- Organic carbon (mg/kg)
- Nitrogen, available (kg/ha)
- Available phosphorus as P_2O_5 (kg/ha)
- Available potassium as K_2O (kg/ha)

Analysis Methodology

Soil pH

The pH of the soil suspension was measured in a 1:2.5 soil-water suspension using a digital pH meter. The soil is acidic or alkaline, depending on its pH level.

Electrical Conductivity (EC)

Electrical conductivity was measured by a conductivity meter and expressed in ds/m^{-1} . EC shows the soluble salt concentration and salinity status of the soil

Organic Carbon

The organic carbon was estimated by standard wet oxidation methods. Organic carbon is an important indicator of soil organic matter and soil fertility.

Available Nitrogen

Available nitrogen was estimated by the alkaline permanganate method and expressed in kg/ha.

Available Phosphorus

Available phosphorus was determined and expressed as P_2O_5 (kg/ha).

Available Potash

Available potash as K_2O (kg/ha) was analyzed and expressed.

RESULTS

The values obtained were interpreted into low, medium, and high fertility status based on standard soil fertility classifications.

As shown in Table 1, the soil sample collected before plantation of *Jivanti* was alkaline and had low fertility.

Table 1: Soil before *Jivanti* plantation

Sr. No.	Parameters of soil	Results	Critical limit		
			Low	Medium	High
1	pH (1:2.5)	8.32	< 6.5 (acidic)	6.5 to 7.5	> 7.5 (Alkaline)
2	EC (ds/m ⁻¹)	0.23	< 1.0 (Normal)	1.0 to 2.5 (slightly saline)	> 2.5 (Highly saline)
3	Organic Carbon (%)	0.13	< 0.5	0.5 to 0.75	>0.75
4	Available nitrogen (kg/ha)	157	< 250	250.0 to 500.0	>500.0
5	Available Phosphorus P ₂ O ₅ (kg/ha)	26.88	< 28.0	28.0 to 56.0	> 56.0
6	Available potash K ₂ O (kg/ha)	169	< 140.0	140.0 to 280.0	> 280.0

As presented in Table 2, the control group of *Jivanti* soil without fumigation showed limited improvement in soil fertility parameters.

Table 2: Soil of *Jivanti* cultivated control group (without fumigation group soil)

Sr. No.	Parameters of soil	Results	Critical limit		
			Low	Medium	High
1	pH (1:2.5)	9.10	< 6.5 (acidic)	6.5 to 7.5	> 7.5 (Alkaline)
2	EC (ds/m ⁻¹)	0.55	< 1.0 (Normal)	1.0 to 2.5 (slightly saline)	> 2.5 (Highly saline)
3	Organic Carbon (%)	0.17	< 0.5	0.5 to 0.75	>0.75
4	Available nitrogen (kg/ha)	172	< 250	250.0 to 500.0	>500.0
5	Available Phosphorus P ₂ O ₅ (kg/ha)	44.81	< 28.0	28.0 to 56.0	> 56.0
6	Available potash K ₂ O (kg/ha)	88	< 140.0	140.0 to 280.0	> 280.0

Table 3 shows the physicochemical properties of *Jivanti* oil from the fumigated trial group.

Table 3: Soil of *Jivanti* cultivated trial group (with fumigation group soil)

Sr. No.	Parameters of soil	Results	Critical limit		
			Low	Medium	High
1	pH (1:2.5)	9.21	< 6.5 (acidic)	6.5 to 7.5	> 7.5 (Alkaline)
2	EC (ds/m ⁻¹)	0.45	< 1.0 (Normal)	1.0 to 2.5 (slightly saline)	> 2.5 (Highly saline)
3	Organic Carbon (%)	1.20	< 0.5	0.5 to 0.75	>0.75
4	Available nitrogen (kg/ha)	329	< 250	250.0 to 500.0	>500.0
5	Available Phosphorus P ₂ O ₅ (kg/ha)	27.80	< 28.0	28.0 to 56.0	> 56.0
6	Available potash K ₂ O (kg/ha)	582	< 140.0	140.0 to 280.0	> 280.0

DISCUSSION

The present study was conducted to evaluate the effect of fumigation on soil of *Jivanti* physicochemical properties using a grow-bag-based experimental setup. Physicochemical parameters such as pH, electrical conductivity, organic carbon, nitrogen, phosphorus, and potash largely affect the soil fertility. These parameters directly impact nutrient availability, microbial activity, soil structure, and overall plant productivity [9,10]. The results of this study showed that fumigation had positive effects on important parameters of soil fertility. A very important observation of the present study was the significant increase

in the organic carbon content in the fumigated soil. The organic carbon increased from 0.13 per cent in the pre-plantation soil and 0.17 per cent in the control soil to 1.20 per cent in the fumigated soil. Organic carbon is one of the most important indicators of soil health, as it improves soil aggregation, aeration, moisture retention, microbial proliferation, and nutrient availability [11]. The increased organic matter improves the cation exchange capacity and enhances the long-term sustainability of the agricultural soil. The fumigated soil of *Jivanti* showed a significant increase in organic carbon content, indicating a higher rate of decomposition of organic matter and enhanced microbial activity [12]. Organic amendments and biologically active agricultural practices are known to stimulate soil microbial populations, thereby promoting nutrient mineralization and humus formation. Soil fertility in the fumigated group may have been improved by increased microbial activity [13]. The available nitrogen content also improved markedly in the fumigated soil. Nitrogen increased from 157kg/ha before plantation to 329kg/ha after fumigation treatment. Nitrogen is a required macronutrient and is needed for chlorophyll formation, amino acid synthesis, protein metabolism, and vegetative plant growth [14,15]. Nitrogen deficiency often results in poor growth, chlorosis, and low crop productivity. The increase in available nitrogen in the fumigated group may be attributed to an increase in organic matter mineralization and microbial transformation of nitrogenous compounds to plant-available forms. Increased nitrogen availability indicates fumigation may be beneficial for nutrient cycling processes within soil [16]. The study showed another interesting result, a marked increase in the available content of potash in the fumigated soil. In the trial group, the level of potash was increased to 582 kg/ha against 169 kg/ha in the pre-plantation soil and only 88 kg/ha in the control soil. Potassium is a vital plant nutrient involved in the activation of enzymes, osmotic regulation, photosynthesis, carbohydrate metabolism, protein synthesis, and resistance to environmental stress [17]. The greater availability of potash in fumigated soil might suggest enhanced nutrient mobilization and release of potassium from soil complexes. A higher potash content is good for the general vigor of the plant, its water balance regulation, and tolerance to stress. Electrical conductivity values were within the normal range in all soil samples, suggesting that fumigation did not cause harmful salt accumulation or salinity stress [18]. High salinity adversely affects seed germination, nutrient uptake, root development, and growth of the plant, so it is important to maintain normal EC values. The pH of all soil samples was alkaline. The pH of fumigated soil was still strongly alkaline, as in the control. Soil pH is important for nutrient solubility and microbial activity. Availability of some nutrients, especially phosphorus and micronutrients like zinc and iron, may decrease under alkaline conditions. In the fumigated soil, the available phosphorus content was still in the lower fertility range and did not improve much compared to other nutrients. This observation could be related to the decrease in the phosphorus solubility under alkaline soil conditions, in which phosphorus tends to be fixed into insoluble forms. Soil of the control group of *Jivanti* without fumigation showed little improvement in organic carbon and nitrogen content, and potash content decreased compared to the soil before planting. This suggests that the natural changes taking place in the absence of fumigation were not adequate to produce a significant improvement in soil fertility [19]. The comparative results of the present study, therefore, suggest that fumigation may have a positive effect on the soil nutrient dynamics, organic matter content, and overall soil fertility status. The observed increase in microbial activities, improved decomposition of organic matter, improved nutrient transformation, and release of nutrients in plant-available forms could be the reason for the increase in fertility parameters [20]. Previous studies on sustainable agriculture and soil management have also highlighted the importance of organic matter enrichment and biological methods for improving soil fertility. Higher soil organic carbon and nutrient availability are associated with increased crop yield, improved soil structure, and long-term sustainability of agriculture. Therefore, the use of eco-friendly agricultural interventions such as fumigation may be supportive in sustainable farming systems. Such practices may reduce the dependence on excessive chemical inputs and maintain the soil ecological balance.

However, the present study was restricted to the physicochemical evaluation of soil samples. Detailed microbiological evaluation, enzymatic activity assay, and crop yield studies were not done. Future studies that include long-term field trials, microbial profiling, and plant growth evaluation may provide a better understanding of the mechanisms and agricultural significance of fumigation. Overall findings of the present study support the beneficial role of fumigation in improving important soil fertility parameters, particularly organic carbon, nitrogen, and potash content.

CONCLUSION

The present study showed that fumigation of *Jivanti* had a positive effect on important properties of soil physicochemical, under the experimental conditions of the grow bag. Available nitrogen and available potash content were significantly increased compared to pre-plantation and control soil in fumigated soil

organic carbon. Electrical conductivity was within normal limits, indicating no harmful salinity effects. Although soil pH remained alkaline and phosphorus content was only slightly improved, overall findings support the positive role of fumigation in improving soil fertility and nutrient availability. The work implies that fumigation may be an environmentally friendly agricultural practice for sustainable soil management. Further long-term experiments are recommended to confirm its agricultural importance.

REFERENCES

1. Brady NC, Weil RR. (2016): *The Nature and Properties of Soils*. 15th ed. Pearson Education.
2. Food and Agriculture Organization (2015): Healthy soils are the basis for healthy food production. Rome: FAO.
3. Lal R. (2009): Soil degradation as a reason for inadequate human nutrition. *Food Security*;1(1):45–57.
4. Tilman D, Cassman KG, Matson PA, Naylor R, Polasky S. (2002): Agricultural sustainability and intensive production practices. *Nature*; 418(6898):671–677.
5. Pimentel D, Burgess M. (2013): Soil erosion threatens food production. *Agriculture*; 3(3):443–463.
6. Bhattacharyya R, Kundu S, Prakash V, Gupta HS. (2008): Sustainability under combined application of mineral and organic fertilizers in a rainfed soybean–wheat system of the Indian Himalayas. *European Journal of Agronomy*; 28(1):33–46.
7. Stevenson FJ. (1994): *Humus Chemistry: Genesis, Composition, Reactions*. 2nd ed. Wiley.
8. Havlin JL, Tisdale SL, Nelson WL, Beaton JD. (2014): *Soil Fertility and Fertilizers*. 8th ed. Pearson.
9. Brady NC, Weil RR. (2016): *The Nature and Properties of Soils*. 15th ed. Pearson Education.
10. Stevenson FJ. (1994): *Humus Chemistry: Genesis, Composition, Reactions*. 2nd ed. Wiley.
11. Lal R. (2004): Soil carbon sequestration impacts on global climate change and food security. *Science*;304(5677):1623–1627.
12. Smith P, Martino D, Cai Z, et al. (2008): Greenhouse gas mitigation in agriculture. *Philosophical Transactions of the Royal Society B*; 363(1492):789–813.
13. Marschner P. (2012): *Marschner's Mineral Nutrition of Higher Plants*. 3rd ed. Academic Press; 2012.
14. Mengel K, Kirkby EA. (2001): *Principles of Plant Nutrition*. 5th ed. Springer.
15. Rengel Z. (2003): *Handbook of Soil Acidity*. CRC Press.
16. Srinivasarao C, Venkateswarlu B, Lal R, et al. (2013): Soil carbon sequestration to mitigate climate change and advance food security. *Current Science*;105(11):1526–1535.
17. Bünemann EK, Bongiorno G, Bai Z, et al. (2018): Soil quality – A critical review. *Soil Biology and Biochemistry*; 120:105–125.
18. Karlen DL, Ditzler CA, Andrews SS. (2003): Soil quality: Why and how? *Geoderma*;114(3–4):145–156.
19. Gupta PK. (2007): *Soil, Plant, Water and Fertilizer Analysis*. 2nd ed. Agrobios.
20. Das DK. (2013): *Introductory Soil Science*. 3rd ed. Kalyani Publishers.

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