



# Effect of Surface Soil Removal and Organic Amendments on Growth, Yield and Nutrient Content and Uptake of Pea (*Pisum sativum* L.)

Haiguipung<sup>1</sup>, K. Hapemo Ngullie<sup>1</sup>, Sewak Ram<sup>1</sup>, Manoj Dutta<sup>1</sup>

10.18805/IJArE.A-6407

## ABSTRACT

**Background:** Pea (*Pisum sativum* L.) an important *rabi* season legume crop from the *fabaceae* family is cultivated in over 95 countries for both fresh and processed forms. It contains about 20-25% protein and ranks as the fourth most significant grain legume and is considered as one of the major green vegetables globally. Pea is native to the mediterranean region of Southern Europe and Western Asia. Peas are a versatile and resilient crop that thrives in various agricultural systems, adapting to different soil types and temperatures. Peas offer a sustainable solution for farmers aiming to balance environmental care with productivity.

**Methods:** An experiment entitled "Effect of surface soil removal and organic amendments on growth, yield and nutrient content and uptake of pea (*Pisum sativum* L.)" was conducted during the *rabi* season of 2023 at the experimental field of the Department of Soil and Water Conservation, School of Agricultural Sciences, Nagaland University, Medziphema campus. The study was conducted using a split-plot design. Surface soil removal was applied at the depths of 0, 5 and 10 cm designated as D<sub>0</sub>, D<sub>1</sub> and D<sub>2</sub>, respectively and various organic amendments were added including control (O<sub>0</sub>), FYM @ 5 t ha<sup>-1</sup> (O<sub>1</sub>), vermicompost @ 2 t ha<sup>-1</sup> (O<sub>2</sub>) and poultry litter @ 2.5 t ha<sup>-1</sup> (O<sub>3</sub>).

**Result:** The results of the experiment showed that the surface soil removal of 5 cm (D<sub>1</sub>) and 10 cm (D<sub>2</sub>) underperformed considerably as compared to 0 cm (D<sub>0</sub>) in all aspects of growth, yield and N, P and K content and uptake. Additionally, the interaction between surface soil removal and organic amendments revealed that D<sub>0</sub>O<sub>1</sub> i.e. 0 cm soil removal combined with FYM @ 5 t ha<sup>-1</sup> performed significantly better than most of the interaction.

**Key words:** Fertility, Nutrients, Organic amendments, Productivity, Soil removal.

## INTRODUCTION

Peas (*Pisum sativum* L.) play a vital role in global agriculture due to their rich nutritional value and significant economic and ecological benefits. As a leguminous crop, they possess a unique ability to fix atmospheric nitrogen through a symbiotic relationship with *Rhizobium* bacteria. This natural process significantly reduces the need for synthetic nitrogen fertilizers, which are costly and environmentally damaging, DeVilleneuve *et al.* (2023). Their contribution to soil fertility makes pea cultivation crucial for small landholders and commercial farming systems, promoting sustainable agricultural practices. Their low input requirements and ability to improve soil fertility and structure makes them a sustainable choice for farmers seeking to balance productivity with environmental responsibility.

The hilly terrain of Nagaland is highly susceptible to soil erosion due to its steep slopes, heavy rainfall and deforestation due to shifting cultivation practices, Bhan, (2009). The lack of vegetation, particularly in areas with agricultural expansion, weakens soil structure, making it prone to landslides and surface runoff, resulting in significant soil loss, fertility and environmental degradation, Jagannath *et al.* (2025). This study attempts to imitate natural surface soil loss to help to understand the impact of removal of topsoil which is the most fertile layer of soil and its influence on

<sup>1</sup>Department of Soil and Water Conservation, School of Agricultural Sciences, Nagaland University, Medziphema Campus, Dimapur-797 106, Nagaland, India.

**Corresponding Author:** Manoj Dutta, Department of Soil and Water Conservation, School of Agricultural Sciences, Nagaland University, Medziphema Campus, Dimapur-797 106, Nagaland, India.

Email: manojdutta@nagalanduniversity.ac.in

ORCID: 0009-0001-4967-7130

**How to cite this article:** Haiguipung, Hapemo, N.K., Ram, S. and Dutta, M. (2025). Effect of Surface Soil Removal and Organic Amendments on Growth, Yield and Nutrient Content and Uptake of Pea (*Pisum sativum* L.). *Indian Journal of Agricultural Research*. **59(10)**: 1590-1595. doi: 10.18805/IJArE.A-6407.

**Submitted:** 05-05-2025 **Accepted:** 04-07-2025 **Online:** 19-07-2025

crop growth and yield and how the addition of organic amendments helps to mitigate the loss of top soil by supplying the required nutrients to the depleted soil.

Surface soil removal negatively impacts crop growth by stripping away the nutrient rich topsoil essential for crop development. This layer contains organic matter, microorganisms and key nutrients like nitrogen, phosphorus and potassium that crops depend on, without it soil fertility declines, hindering nutrient uptake and root

growth. Additionally, the loss of surface soil increases erosion, further depleting soil health and causing water retention issues. Whereas, the addition of organic amendments like farmyard manure, vermicompost and poultry litter significantly enhances soil health, promoting better crop growth and productivity. These organic materials improve soil structure, making it more porous and better at retaining water and air, which supports healthy root development. They also add essential nutrients such as nitrogen, phosphorus and potassium, boosting soil fertility. Furthermore, organic amendments encourage beneficial microbial activity, which helps break down organic matter and release nutrients. Over time, these amendments improve soil's long-term sustainability, increasing crop yields, enhancing disease resistance and promoting environmental sustainability in farming.

## MATERIALS AND METHODS

The experiment was carried out during *rabi* season in the year 2023 at the experimental farm of School of Agricultural Sciences (SAS), Nagaland University. The experimental field is located at 310 meters above mean sea level. Its coordinates are 25°45'43"N latitude and 93°53'04"E longitude. The humid subtropical climate of Medziphema, where the experimental site is located, has moderate temperature, high relative humidity and an average rainfall of 2000-2500 mm. Owing to elevated atmospheric humidity, the average summer temperature fluctuates between 21°C and 30°C, with uncommon dips below 8°C during the winter months. Prior to sowing of seeds, soil samples were collected from various locations of the experimental field at 15 cm depth to evaluate various initial soil properties (Table 1). The various soil properties were evaluated following standard procedures. The experimental farm was rich in organic carbon, cation exchange capacity and medium range of available nitrogen. The pH of the soil was acidic having low amount of available phosphorus and potassium.

The experiment was conducted in split-plot design. The experiment consists of 2 factors- surface soil removal (D) as the main plot with 3 different types of surface soil removal *i.e.* 0 cm ( $D_0$ ), 5 cm ( $D_1$ ) and 10 cm ( $D_2$ ) and the sub plots consists of 4 different organic amendments (O) *i.e.* control ( $O_0$ ), FYM @ 5 t ha<sup>-1</sup> ( $O_1$ ), vermicompost @ 2 t ha<sup>-1</sup>

( $O_2$ ) and poultry litter @ 2.5 t ha<sup>-1</sup> ( $O_3$ ). The experiment was replicated 3 times with 12 treatment combinations. Sub-plots were separated by a bund of 30 cm and the size of each sub-plot was 3 m × 2 m. Recommended dose of fertilizer for pea crop was applied before sowing of crop. The crop was grown in accordance with regional recommendations of the crop. Five randomly selected plants per plot were used to assess growth parameters at various stages. Grains were taken from individual plots at harvest, weighed and the findings were expressed in kg ha<sup>-1</sup>. Gomez and Gomez (2004) technique was followed in the data analysis and significance was determined at  $p < 0.05$ . To compare mean differences, critical difference (CD) and standard error of the mean (SEM ±) values were provided.

## RESULTS AND DISCUSSION

### Growth and yield attributes

The data associated to growth and yield attributes is presented in Table 2. The highest plant height (45.51 cm), number of pods/plant (21.25), seed yield (447.64 kg ha<sup>-1</sup>) and biological yield (1127.07 kg ha<sup>-1</sup>) was observed in 0 cm removal of surface soil ( $D_0$ ) and the least was in 10 cm removal of surface soil ( $D_2$ ) in all the growth and yield parameters recorded. Removal of 10 cm surface soil resulted in the decrease of plant height by 17.09%, number of pods/plant by 28.61%, seed yield by 12.01% and biological yield by 1.21% respectively as compared to 0 cm of surface soil removal. Kamboj *et al.* (2016) revealed that the removal of surface soil, especially through mouldboard plough tillage, substantially affected the yield and yield attributes in field pea. This decline was more pronounced in sub-surface tillage or no-tillage systems likely due to disrupted soil structure, reduced moisture retention and nutrient loss. With reference to the addition of organic amendments, the application of FYM @ 5 t ha<sup>-1</sup> ( $O_1$ ) was found to be superior over control ( $O_0$ ), vermicompost @ 2 t ha<sup>-1</sup> ( $O_2$ ) and poultry manures @ 2 t ha<sup>-1</sup> ( $O_3$ ) in all the growth parameters like plant height, number of pods/plant, seed yield and biological yield. Compost and farmyard manure together greatly increased plant biomass and height. Plant growth was best achieved using the ideal mixture of 33% compost, 33% NPK and 33% FYM, Aziz *et al.* (2024). Similar

**Table 1:** Initial soil properties and methods employed for determination.

| Soil parameters                                                     | Value  | Methods employed                                         | Reference                |
|---------------------------------------------------------------------|--------|----------------------------------------------------------|--------------------------|
| pH                                                                  | 5.41   | Glass electrode pH meter<br>(1:2.5 soil and water ratio) | Jackson, 1973            |
| Organic carbon (%)                                                  | 1.15   | Walkley and Black, rapid titration                       | Jackson, 1973            |
| Cation exchange capacity {cmol (p <sup>+</sup> ) kg <sup>-1</sup> } | 11.03  | NH <sub>3</sub> distillation method                      | Jackson, 1973            |
| Available N (kg ha <sup>-1</sup> )                                  | 376.32 | Alkaline potassium permanganate method                   | Subbaiah and Asija, 1956 |
| Available P (kg ha <sup>-1</sup> )                                  | 17.24  | Bray's No.1 method                                       | Bray and Kurtz, 1945     |
| Available K (kg ha <sup>-1</sup> )                                  | 112.50 | Ammonium acetate method                                  | Hanway and Heidel, 1952  |

findings were also observed by Rathor *et al.* (2024) and Koireng *et al.* (2018).

The interaction between surface soil removal and organic amendments (Table 3) substantiated that when no surface soil was removed *i.e.*, 0 cm removal of surface soil ( $D_0$ ) and FYM @ 5 t ha<sup>-1</sup> was added ( $D_0O_1$ ), the plant height was increased by 16.19%, seed yield by 26.46% and biological yield by 2.10% as compared to the lowest that was found in ( $D_2O_0$ ) *i.e.*, 10 cm removal of surface soil ( $D_2$ ) of surface soil removed and control ( $O_0$ ). Whereas for the number of pods/plant was found to be highest in the interaction between 0cm removal of surface soil ( $D_0$ ) and FYM @ 5 t ha<sup>-1</sup> was added ( $D_0O_1$ ) and the lowest ( $D_2O_2$ ) *i.e.*, 10 cm ( $D_2$ ) of surface soil removed and vermicompost @ 2 t ha<sup>-1</sup> ( $O_2$ ) presenting an increase of about 87.78%. Mosavi-Azandehi *et al.* (2023) in their studies have shown that addition of organic amendments, particularly vermicompost, significantly enhance soil microbial activity. This increased microbial activity improves nutrient absorption, which in turn supports healthier plant growth.

Due to this, legumes exhibit higher pod yields, demonstrating the positive impact of vermicompost on both soil health and agricultural productivity. Similar results were also reported by Hossain *et al.* (2021) and Rangasami *et al.* (2024).

#### Nutrient content

The data related to nutrient content in seed and stover is presented in the Table 4. The N, P and K content in seed was found to be highest in 0 cm surface soil removal ( $D_0$ ) whereas the lowest was in 10 cm of surface soil removal ( $D_2$ ), resulting in a decrease of 8.63% in N, 6.86% in P and 7.55% in K content in seed respectively. The addition of organic amendments like FYM @ 5 t ha<sup>-1</sup>, vermicompost @ 2 t ha<sup>-1</sup> and poultry litter @ 2.5 t ha<sup>-1</sup> significantly increased the N, P and K content in seed as compared to control. Tusher (2022) who also reported that organic amendments improve soil N, P and K bio-availability by promoting microbial activity and enhancing mineralization. This increased NPK availability facilitates better plant uptake, ultimately leading to higher NPK content in seeds and improved crop nutrition. Similar findings were also reported

**Table 2:** Effect of surface soil removal and organic amendments on growth and yield attributes of pea.

| Treatments                  | Plant height<br>(cm) | Number of<br>pods/plant | Seed yield<br>(kg ha <sup>-1</sup> ) | Biological yield<br>(kg ha <sup>-1</sup> ) |
|-----------------------------|----------------------|-------------------------|--------------------------------------|--------------------------------------------|
| <b>Surface soil removal</b> |                      |                         |                                      |                                            |
| $D_0$                       | 45.51                | 21.25                   | 447.64                               | 1127.08                                    |
| $D_1$                       | 42.37                | 17.50                   | 428.43                               | 1123.75                                    |
| $D_2$                       | 37.73                | 15.17                   | 393.86                               | 1113.33                                    |
| SEm ±                       | 0.350                | 0.681                   | 0.930                                | 0.770                                      |
| CD @ 5%                     | 1.378                | 2.675                   | 3.650                                | 3.023                                      |
| <b>Organic amendments</b>   |                      |                         |                                      |                                            |
| $O_0$                       | 38.40                | 16.33                   | 409.54                               | 1117.11                                    |
| $O_1$                       | 47.49                | 20.56                   | 452.03                               | 1126.22                                    |
| $O_2$                       | 41.13                | 17.56                   | 420.34                               | 1122.89                                    |
| $O_3$                       | 40.44                | 14.44                   | 411.35                               | 1119.33                                    |
| SEm ±                       | 0.589                | 0.542                   | 1.272                                | 0.520                                      |
| CD @ 5%                     | 1.750                | 1.612                   | 3.780                                | 1.546                                      |

**Table 3:** Interaction effect of surface soil removal and organic amendments on growth and yield attributes of pea.

| Interaction | Plant height (cm) | Number of pods/plant | Seed yield (kg ha <sup>-1</sup> ) | Biological yield (kg ha <sup>-1</sup> ) |
|-------------|-------------------|----------------------|-----------------------------------|-----------------------------------------|
| $D_0O_0$    | 41.83             | 19.00                | 435.78                            | 1122.33                                 |
| $D_0O_1$    | 51.43             | 25.67                | 476.02                            | 1134.00                                 |
| $D_0O_2$    | 45.93             | 20.67                | 442.87                            | 1128.67                                 |
| $D_0O_3$    | 42.83             | 19.67                | 435.90                            | 1122.33                                 |
| $D_1O_0$    | 37.37             | 15.33                | 416.43                            | 1117.33                                 |
| $D_1O_1$    | 50.23             | 19.00                | 454.16                            | 1130.67                                 |
| $D_1O_2$    | 40.63             | 16.67                | 427.70                            | 1126.67                                 |
| $D_1O_3$    | 41.23             | 19.00                | 415.44                            | 1120.33                                 |
| $D_2O_0$    | 36.00             | 14.67                | 376.40                            | 1110.67                                 |
| $D_2O_1$    | 40.80             | 17.00                | 425.90                            | 1114.00                                 |
| $D_2O_2$    | 36.83             | 15.33                | 390.44                            | 1113.33                                 |
| $D_2O_3$    | 37.27             | 13.67                | 382.70                            | 1115.33                                 |
| SEm ±       | 1.020             | 0.940                | 2.204                             | 0.901                                   |
| CD @ 5%     | 3.032             | NS                   | NS                                | 2.677                                   |

by Joshi *et al.* (2020) and Sukitprapanon *et al.* (2021). The interaction between surface soil removal and organic amendments (Table 3) revealed that when no surface soil was removed *i.e.*, 0 cm removal of surface soil ( $D_0$ ) and FYM @ 5 t ha<sup>-1</sup> was added ( $D_0O_1$ ) the N, P and K content in seed increased by 34.79%, 43.93% and 22.01% as compared to ( $D_2O_0$ ) *i.e.*, 10 cm removal of surface soil ( $D_2$ ) of surface soil removed and control ( $O_0$ ). As for the N (10.90 g kg<sup>-1</sup>), P (4.30 g kg<sup>-1</sup>) and K (6.89 g kg<sup>-1</sup>) content in stover was found to be highest with 0 cm ( $D_0$ ) removal and the least in 10 cm ( $D_0$ ) removal, resulting in a decrease of 3.39%, 5.34% and 3.33% respectively. The addition of FYM @ 5 t ha<sup>-1</sup> ( $O_1$ ) proved to be significantly better than control and all other treatments added.

The interaction between surface soil removal and organic amendments (Table 5) confirmed that when no surface soil was removed *i.e.*, 0 cm removal of surface soil

( $D_0$ ) and FYM @ 5 t ha<sup>-1</sup> was added ( $D_0O_1$ ), the N content in stover was increased by 13.88%, P by 25.06% and K by 50.29% as compared to 10 cm removal of surface soil ( $D_2$ ) of surface soil removed and control ( $O_0$ ) *i.e.*, ( $D_2O_0$ ). The results are consistent with those of Amadou *et al.* (2022) who found out those organic amendments, especially NPKS and NPKM, significantly improved soil available potassium levels by enriching nutrient reserves and enhancing soil structure, leading to increased N, P and K content, better plant growth and higher soybean yield. Similar findings were also reported by Kumari *et al.* (2024) and Yogananda *et al.* (2019).

#### Nutrient uptake

The data pertaining to nutrient uptake by plant is presented in Table 4. 0 cm ( $D_0$ ) surface soil removal was found to be significantly better than 5 cm ( $D_1$ ) and 10 cm removal of

**Table 4:** Effect of surface soil removal and organic amendments on nutrient content and uptake of pea.

| Treatments                  | Nitrogen<br>(g kg <sup>-1</sup> ) |        | Phosphorus<br>(g kg <sup>-1</sup> ) |        | Potassium<br>(g kg <sup>-1</sup> ) |        | N uptake<br>by plant   | P uptake<br>by plant   | K uptake<br>by plant   |
|-----------------------------|-----------------------------------|--------|-------------------------------------|--------|------------------------------------|--------|------------------------|------------------------|------------------------|
|                             | Seed                              | Stover | Seed                                | Stover | Seed                               | Stover | (kg ha <sup>-1</sup> ) | (kg ha <sup>-1</sup> ) | (kg ha <sup>-1</sup> ) |
| <b>Surface soil removal</b> |                                   |        |                                     |        |                                    |        |                        |                        |                        |
| $D_0$                       | 19.81                             | 10.90  | 4.37                                | 4.30   | 5.56                               | 6.89   | 19.88                  | 5.81                   | 9.19                   |
| $D_1$                       | 19.17                             | 10.74  | 4.26                                | 4.18   | 5.40                               | 6.78   | 18.92                  | 5.56                   | 8.97                   |
| $D_2$                       | 18.10                             | 10.53  | 4.04                                | 4.07   | 5.14                               | 6.66   | 17.80                  | 5.15                   | 8.25                   |
| SEm ±                       | 0.095                             | 0.015  | 0.009                               | 0.009  | 0.007                              | 0.010  | 0.005                  | 0.008                  | 0.051                  |
| CD @ 5%                     | 0.371                             | 0.060  | 0.036                               | 0.035  | 0.029                              | 0.038  | 0.019                  | 0.030                  | 0.202                  |
| <b>Organic amendments</b>   |                                   |        |                                     |        |                                    |        |                        |                        |                        |
| $O_0$                       | 16.67                             | 10.07  | 3.49                                | 3.75   | 5.06                               | 5.15   | 17.92                  | 4.11                   | 7.23                   |
| $O_1$                       | 21.32                             | 11.19  | 4.63                                | 4.44   | 5.66                               | 7.49   | 20.50                  | 6.45                   | 9.92                   |
| $O_2$                       | 19.72                             | 11.05  | 4.47                                | 4.32   | 5.49                               | 4.32   | 18.79                  | 6.05                   | 9.25                   |
| $O_3$                       | 18.39                             | 10.57  | 4.30                                | 4.22   | 5.32                               | 4.22   | 18.26                  | 5.43                   | 8.81                   |
| SEm ±                       | 0.100                             | 0.028  | 0.008                               | 0.011  | 0.016                              | 0.007  | 0.006                  | 0.004                  | 0.080                  |
| CD @ 5%                     | 0.299                             | 0.082  | 0.023                               | 0.032  | 0.046                              | 0.020  | 0.017                  | 0.011                  | 0.237                  |

**Table 5:** Interaction effect of surface soil removal and organic amendments on nutrient content and uptake of pea.

| Interaction | Nitrogen<br>(g kg <sup>-1</sup> ) |        | Phosphorus<br>(g kg <sup>-1</sup> ) |        | Potassium<br>(g kg <sup>-1</sup> ) |        | N uptake<br>by plant   | P uptake<br>by plant   | K uptake<br>by plant   |
|-------------|-----------------------------------|--------|-------------------------------------|--------|------------------------------------|--------|------------------------|------------------------|------------------------|
|             | Seed                              | Stover | Seed                                | Stover | Seed                               | Stover | (kg ha <sup>-1</sup> ) | (kg ha <sup>-1</sup> ) | (kg ha <sup>-1</sup> ) |
| $D_0O_0$    | 17.01                             | 10.23  | 3.64                                | 3.87   | 5.24                               | 5.22   | 15.32                  | 4.34                   | 7.33                   |
| $D_0O_1$    | 22.16                             | 11.32  | 4.75                                | 4.54   | 5.82                               | 7.65   | 21.54                  | 6.73                   | 10.14                  |
| $D_0O_2$    | 20.82                             | 11.21  | 4.66                                | 4.45   | 5.71                               | 7.43   | 20.43                  | 6.37                   | 9.84                   |
| $D_0O_3$    | 19.26                             | 10.84  | 4.41                                | 4.32   | 5.64                               | 7.25   | 18.22                  | 5.82                   | 9.44                   |
| $D_1O_0$    | 16.57                             | 10.06  | 3.53                                | 3.73   | 5.16                               | 5.15   | 14.21                  | 4.13                   | 7.20                   |
| $D_1O_1$    | 21.52                             | 11.19  | 4.67                                | 4.42   | 5.63                               | 7.48   | 20.53                  | 6.48                   | 9.91                   |
| $D_1O_2$    | 20.14                             | 11.11  | 4.52                                | 4.33   | 5.44                               | 7.32   | 18.52                  | 6.03                   | 9.64                   |
| $D_1O_3$    | 18.45                             | 10.59  | 4.34                                | 4.25   | 5.37                               | 7.15   | 17.44                  | 5.61                   | 9.15                   |
| $D_2O_0$    | 16.44                             | 9.94   | 3.30                                | 3.63   | 4.77                               | 5.09   | 13.23                  | 3.86                   | 7.16                   |
| $D_2O_1$    | 20.28                             | 11.06  | 4.46                                | 4.36   | 5.53                               | 7.34   | 19.43                  | 6.13                   | 9.73                   |
| $D_2O_2$    | 18.20                             | 10.84  | 4.25                                | 4.19   | 5.31                               | 7.15   | 17.43                  | 5.76                   | 8.26                   |
| $D_2O_3$    | 17.48                             | 10.28  | 4.15                                | 4.11   | 4.94                               | 7.05   | 16.12                  | 4.85                   | 7.85                   |
| SEm ±       | 0.174                             | 0.048  | 0.013                               | 0.019  | 0.027                              | 0.012  | 0.010                  | 0.006                  | 0.138                  |
| CD @ 5%     | 0.517                             | NS     | 0.039                               | NS     | 0.080                              | 0.035  | 0.029                  | 0.018                  | 0.410                  |

surface soil ( $D_2$ ) with respect to N, P and K uptake by plants. 10 cm ( $D_2$ ) surface soil removal decreased the N uptake by 10.46%, P by 11.35% and K by 10.22% as compared to 0 cm ( $D_0$ ) of surface soil removal. It was also ascertained that the addition of organic amendment of FYM @ 5 t ha<sup>-1</sup> increased the N (20.50 kg ha<sup>-1</sup>), P (6.45 kg ha<sup>-1</sup>) and K (9.92 kg ha<sup>-1</sup>) uptake by plants by 14.39%, 56.93% and 37.20% respectively as compared to control ( $O_0$ ). Chen *et al.* (2022) reported that organic amendments such as pig manure and biogas residue improve N, P and K uptake efficiency by enhancing microbial activity, soil structure and nutrient availability, leading to increased soil fertility and higher crop yields than chemical fertilizers. Similar findings were also reported by Phillips *et al.* (2022) and Behera *et al.* (2022). Hammad *et al.* (2024) also stated that a variety of soil amendments, such as bio fertilizers, considerably enhance *Pisum sativum* L. development indices, with appreciable rises in N, P and K content and uptake in soil and plant tissues. Similar findings were also reported by Matheus *et al.* (2023) and Kumar *et al.* (2024).

As for the interaction between surface soil removal and organic amendments added (Table 5) it was found that, 0 cm surface soil removal *i.e.*, ( $D_0$ ) and FYM @ 5 t ha<sup>-1</sup> ( $D_0O_1$ ) increased the N (21.54 kg ha<sup>-1</sup>), P (6.73 kg ha<sup>-1</sup>) and K (10.14 kg ha<sup>-1</sup>) uptake by plants by 62.81%, 74.35% and 41.62% respectively which had the highest N, P and K uptake by plant as compared to ( $D_2O_0$ ) *i.e.*, 10 cm( $D_2$ ) of surface soil removed and control ( $O_0$ ) with N (13.23 kg ha<sup>-1</sup>), P (3.86 kg ha<sup>-1</sup>) and K (7.16 kg ha<sup>-1</sup>) which resulted the lowest performance for N, P and K uptake by plant.

## CONCLUSION

In conclusion, the study clearly validates that the removal of 10 cm of surface soil significantly reduces plant growth, yield attributes and nutrient content and uptake. The decline in N, P and K levels in both seed and stover emphasizes the detrimental effect of topsoil removal on soil fertility. Conversely, the application of FYM @ 5 t ha<sup>-1</sup> markedly enhanced all measured parameters, outclassing other organic amendments. The interaction of no surface soil removal with FYM application ( $D_0O_1$ ) performed as the most effective treatment. Overall, conserving surface soil and integrating organic amendments are essential strategies for sustaining soil productivity and ensuring sustainable crop performance.

## ACKNOWLEDGEMENT

The present study was supported by the Department of Soil and Water Conservation, Nagaland University, School of Agricultural Sciences, Medziphema Campus.

## Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the

information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

## Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

## REFERENCES

- Amadou, I., Faucon, M.P. and Houben, D. (2022). Role of soil minerals on organic phosphorus availability and phosphorus uptake by plants. *Geoderma*. **428**: 116125.
- Aziz, A., Musharaf, A., Hussain, M., Azhar, M.F., Masood, S., Aon, M. and Mehboob, N. (2024). Organic and inorganic amendments enhance the growth and productivity of pea (*Pisum sativum* L.) by improving soil microbial biomass carbon. *Soil and Environment*. **43**(1): 45-52.
- Behera, S., Jyotirmayee, B., Mandal, U., Mishra, A., Mohanty, P. and Mahalik, G. (2022). Effect of organic fertilizer on growth, yield and quality of *Pisum sativum* L.: A review. *Ecology. Environment and Conservation*. **28**: S233-S241.
- Bhan, S. (2009). A case study on shifting cultivation practices in Mon district of Nagaland. *Journal of Soil and Water Conservation*. **8**(2): 8-13.
- Bray, R.H. and Kurtz, L.T. (1945). Determination of total, organic and available forms of phosphorus in soil. *Soil Science*. **9**: 39-45.
- Chen, L., Du, H., Liu, Q., Li, T., Sui, P., Gao, W. and Chen, Y. (2022). Different organic material amendments effects soil nitrogen utilization and crop yield in the North China Plain. *Agronomy Journal*. **114**(6): 3473-3486.
- DeVilleneuve, S., Kelly, A., Miyanaka, N., Shanmuhasundaram, T., Murphree, P. and Wyatt, B.M. (2023). Impacts of vegetation and topsoil removal on soil erosion, soil moisture and infiltration. *Agrosystems, Geosciences and Environment*. **6**: e20402.
- Gomez, K.A. and Gomez, A.A. (2004). Statistical Procedures for Agricultural Research. John Wiley and Sons.
- Hammad, A., Ghazal, M.F., Salem, G.M., Metwally, R.S. and Mahdy, M.G. (2024). Effect of different soil amendments and biofertilizers on *Pisum sativum* L. in sandy soil. *Asian Journal of Soil Science and Plant Nutrition*. **10**(4): 524-539.
- Hanway, J.J. and Heidel, H. (1952). Soil Analysis Methods as Used in Iowa State College Testing Laboratory Iowa. *Agriculture*. **57**(1): 187-193.
- Hossain, M.A., Islam, S.M.S. and Hasan, M.M. (2021). Sustainability of wheat (*Triticum aestivum* L.) yield and improvement of seed quality through probiotic and organic soil amendment. *Bangladesh Agronomy Journal*. **24**(1): 1-11.
- Jackson, M.L. (1973). Soil Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi.
- Jagannath, P., Dutta, S., Jamir, C. and Chatterjee, S. (2025). Drivers of shifting cultivation in Nagaland: Crop cycles, crop selection and management. *International Journal of Anthropology and Ethnology*. **9**: 9.



- Joshi, H.N., Varma, L.R. and More, S.G. (2020). Effects of organic nutrients in combination with bio-fertilizers on uptake N, P, K and yield of garden pea (*Pisum sativum* L.) CV. bonneville. *The Pharma Innovation Journal*. **9(3)**: 385-389.
- Kamboj, N., Kamboj, V., Bharti, M. and Sharma, S. (2016). Productive assessment of *Pisum sativum* L. by using organic fertilizers. *Environment Conservation Journal*. **17(3)**: 79-83.
- Koireng, R.J., Anal, P.S.R., Chanu, T.M., Devi, K.P. (2018). Residual effects of organic manure and micro nutrients on growth and yield parameters of green gram (*Vigna radiata*) in potato-green gram sequence. *Indian Journal of Agricultural Research*. **52(3)**: 333-335. doi: 10.18805/IJAR.A-4914.
- Kumar, N.V., Patil, M.B., Nadadouda, B.T. and Beerge, R. (2024). Effect of different organic sources on nutrient dynamics and microbial count of black gram [*Vigna mungo* (L.) Hepper]. *Legume Research*. **47(11)**: 1976-1980. doi: 10.18805/LR-4782.
- Kumari, S., Dogra, B. and Dhiman, S. (2024). Effect of organic nutrient sources on soil nutrient level in pea (*Pisum sativum* L.). *Journal of Advances in Biology and Biotechnology*. **27(11)**: 1086-1093.
- Matheus, R.L., Kantur, D. and Salli, M.K. (2023). Utilization of organic soil amendments and phosphorus fertilizer to improve chemical properties of degraded dry land vertisol and maize yield. *Journal of Degraded and Mining Lands Management*. **10(2)**: 4297.
- Mosavi-Azandehi, S.M., Ansari, M.H., Sharifi, P. and Hoor, S.S. (2023). The effect of organic amendments on soil microbial activity and yield of faba bean (*Vicia faba*) inoculated with *Rhizobium leguminosarum*. *Indian Journal of Agricultural Sciences*. **93(8)**: 893-898. doi:10.56093/ijas.v93i8.135554.
- Phillips, I., Lonhienne, C.P., Tahmasbian, I., Hunter, B., Smith, B., Mayer, D. and Redding, M. (2022). Combination of inorganic nitrogen and organic soil amendment improves nitrogen use efficiency while reducing nitrogen runoff. *Nitrogen*. **3**: 57-73.
- Rangasami, S.R.S., Rani, S., Sivakumar, S.D. and Ganesan, K.N. (2024). Forage nutritive quality, yield and quantitative analysis of leguminous fodder cowpea-maize system as influenced by integrated nutrient management in Southern Zone of India. *Legume Research*. **47(4)**: 565-573. doi: 10.18805/LR-5277.
- Rathor, P., Upadhyay, P., Ullah, A., Warkentin, T.D., Gorim, L.Y. and Thilakarathna, M.S. (2024). The bio-stimulatory effect of humic based soil amendment on plant growth, root nodulation, symbiotic nitrogen fixation and yield of field pea (*Pisum sativum* L.). *Journal of Sustainable Agriculture and Environment*. **3(3)**: e70001. <https://doi.org/10.1002/sae2>.
- Subbiah, B.V. and Asija, G.L. (1956). A rapid procedure for the determination of available nitrogen in soils. *Current Science*. **25**: 259-260.
- Sukitprapanon, T.S., Jantamenchai, M., Tulaphitak, D. and Prakongkep, N. (2021). Influence of application of organic residues of different biochemical quality on phosphorus fractions in a tropical sandy soil. *Agronomy*. **11(2)**: 248.
- Tusher, T.R. (2022). Organic amendments for crop production, phosphorus bioavailability and heavy metal immobilisation: A review. *Crop and Pasture Science*. **73(8)**: 896-916.
- Yogananda, S.B., Thimmegowda, P. and Shruthi, G.K. (2019). Performance of cowpea [*Vigna unguiculata* (L.) Walp] under organic production system in Southern dry zone of Karnataka. *Legume Research*. **43**: 229-234. doi: 10.18805/LR-4175.