*Horticulture Research Journal, 3 ( 4 ), 24 : 39 - June 2025, ISSN 2974/4474*

# Effect of Organic and Bio-Fertilization on Promoting Vegetative Growth of Pear Seedling Cv. (Basateen MKM) Under Intensive Cultivars Conditions

**O. S. Mokhtar[1], Alaa S. Abdel-Rahman[1] and Ramy M. El-Khayat[2 *]**

1- Deciduous Fruits Research Department, Horticulture Research Institute, Agricultural Research Center (ARC), Giza, Egypt.

2- Agricultural Microbiology Researches Department, Soils, Water and Environment Research Institute (SWERI), Agricultural Research Center (ARC), Giza, Egypt.

[*] Researcher of Agricultural Microbiology Research Department.

## ABSTRACT

The experiment was conducted over two successive seasons (2023/2025) on 72 pear seedlings (*Pyrus communis*) grafted on *Pyrus betulaefolia* rootstock its two-year-old at the experimental orchard of the Horticulture Research Institute (ARC), Egypt. The seedlings were planted in clay soil with 1.5 × 2.0 m spacing and subjected to eight fertilization treatments combining compost, mineral fertilizers (NPK), and microbial inoculants including *Azospirillum brasilense*, *Bacillus circulans*, *Trichoderma harzianum*, and arbuscular mycorrhizal fungi (AMF). The study aimed to optimize fertilization strategies by replacing 50% of chemical fertilizers with sustainable biological alternatives under local conditions. Treatments involved combinations of two levels of NPK (50% and 100% of the recommended dose), two levels of compost (also equivalent to 50% and 100% NPK), and three levels of biofertilizers to assess their effects on vegetative growth. The most effective treatment (T8: 50% compost + 50% NPK + 200 ml/tree of microbial mixture + 200 g/tree of AMF) significantly improved seedling height, stem diameter, shoot number, leaf area, and total chlorophyll content. Leaf nutrient levels of N, P, K, and Ca increased accordingly. T8 also enhanced rhizosphere microbial activity, with bacterial counts reaching $95 \times 10^5$ cfu/g, actinomycetes $141 \times 10^3$ cfu/g, fungi $97 \times 10^3$ cfu/g, and enzyme activities of 106.55 µg TPF/g/day (dehydrogenase) and 0.57 mg PNP/g/day (phosphatase). Macronutrient concentrations in the soil also rose. In conclusion, integrating organic and biofertilizers with reduced mineral input effectively enhances pear seedling growth and soil health, supporting sustainable orchard management.

**Keywords**: Pear, bio-fertilization, microbial inoculants, compost.

## INTRODUCTION

Pears (*Pyrus* spp.) are among the most renowned deciduous fruits in the *Rosaceae* family, produced in temperate zones. It started in the southwest Chinese mountains and has since spread throughout (Katayama et al., 2016). On recently reclaimed fields in Egypt, the “Le-Conte” pear cultivar (*Pyrus communis*, Red) is grown and propagated using *Pyrus betulaefolia* (*P. Betulifolia*) rootstock (Abd-El-Latif et al., 2017). Techniques for management are essential for lowering the cooling requirements of buds. These include defoliation, fertilization, training, controlling tree vigor, and delaying winter pruning (Westwood, 1978; Lang *et al.*, 1987). Pear flower buds emerge on the tips of stems and short spurs that are at least two years old. The growth of flower buds can be altered by a variety of factors and techniques. According to Isaac (1986), Wei (1987), Edwards and Notodimedjo (1987), and others, shoot bending may increase the production of pear trees, improve the flowering of juvenile trees, and encourage the growth of flower buds. The cultivated area reached 13870 feddan with productivity of 80993 tons (Food and Agriculture Organization of the United Nations, 2023).

A lack of nitrogen will result in smaller leaves since there will be less normal and functional leaf surface (Khan et al., 2015). Nitrogen is crucial for increasing tree vitality. The chemical fertilizers are expensive, and the small farmers cannot afford to use these fertilizers in a suitable amount and balanced proportion, which results in low production (Ahmad, 2000).

Organic nutrient sources contribute to the preservation of soil health by preserving the balance between organic matter and soil micro-flora, which in turn enhances the soil's physical, chemical, and biological characteristics (Walia and Kler, 2009). Organic biofertilizers enriched with microorganisms play an effective role in enhancing microbial activity in the soil and increasing the availability of essential nutrients such as nitrogen, phosphorus, and potassium. They also improve the physical and chemical properties of the soil and maintain the productivity of fruit trees such as grapes, oranges, apples, and pears (Kang et al., 2022; Butcaru et al., 2024). Use of beneficial microorganisms is an effective strategy for enhancing nutrient availability in plants. Also, inoculating plants with *Azospirillum brasilense* increases nitrate reductase activity, resulting in reduced nitrate levels in plant tissues and improved nitrogen use efficiency and reducing fertilizer dependency by up to 25%. Furthermore, the fungus *Trichoderma harzianum* is widely used in the biocontrol of plant pathogens and modifies root system architecture by stimulating auxin signaling pathways. This fungus also increases enzyme activity and produces secondary metabolites, enhancing nutrient uptake from the soil and nutrient utilization efficiency in plants. The use of these microorganisms has been shown to improve fertilizer use efficiency and reduce fertilizer consumption in agriculture. In addition, both *Azospirillum brasilense* and *Trichoderma harzianum* act as growth promoters, contributing to a reduction in the need for fertilizer inputs in conventional agricultural systems (Galindo et al., 2020; Moreira *et al.,* 2022). *Bacillus circulans* bacteria provided potassium to the soil by secreting an organic acid, which facilitates the presence of potassium in the soil and its absorption by the plant (Abd El-Rahman and Al-Sharnouby, 2021). Arbuscular mycorrhizal fungi (AMF) constitute a group of soil microorganisms that establish symbiotic relationships with a wide spectrum of plant species. These fungi actively contribute to the enhancement of plant phosphorus (P) nutrition, in addition to improving the nutritional status of other poorly mobile nutrients in the soil. This is through the secretion of organic acids that function to solubilize less soluble phosphate compounds, thereby rendering them available for uptake by plant roots (Ahmed and Al-Sharnouby, 2021).

This study aimed to evaluate the effectiveness of integrating organic and biofertilizers with reduced mineral NPK application on the vegetative growth, nutrient status, and rhizosphere microbial activity of pear seedlings (*Pyrus communis* L. cv. MKM). The goal was to identify sustainable fertilization strategies that reduce dependence on chemical inputs while enhancing soil biological health and supporting the successful establishment of pear orchards in nutrient-deficient or reclaimed soils.

# MATERIALS AND METHODS

**Experimental site and plant material:**

The field experiment was conducted during two successive growing seasons (2023/2024 and 2024/2025) at the experimental orchard of the Horticulture Research Institute, Agricultural Research Center (ARC), Giza Governorate, Egypt (30°01′N, 31°12′E). The aim of the study was to evaluate the potential of replacing mineral fertilizers with organic and biofertilizer alternatives to enhance the vegetative performance of pear seedlings under open-field conditions. A total of 72 healthy and uniform pear seedlings (*Pyrus communis* L. cv. MKM), grafted onto *Pyrus betulaefolia* rootstock, were planted in clay soil at a spacing of 1.5 × 2.0 meters. Prior to transplanting, composite soil samples were collected from three depths (0–30, 30–60, and 60–90 cm) and subjected to physicochemical and microbiological analysis following standard procedures (Horneck et al., 2011). The soil was classified as clay with a pH of 8.0, electrical conductivity (EC) of 1.26 dS/m, and moderate nutrient content (Table, 1). Microbiological activity in the baseline soil included total bacterial counts of 25 × $10^3$ cfu/g, actinomycetes 36 × $10^3$ cfu/g, and fungi 19 × $10^3$ cfu/g.

Two rates of chemical fertilizers NPK were employed in this study. The first rate was 100% of recommended dose from NPK (286, 190 and 286 g of N, P and K pure units per tree, respectively (≈ 50–70 N, 30–50 P, and 50–70 K units/feddan/year)). The second rate was 50% of recommended dose from NPK (143, 95 and 143 g of N, P and K pure units per tree, respectively). Monocalcium phosphate (15.5%) was used as a phosphorus source and added to the soil in a single application around the seedlings at the end of winter. Ammonium nitrate (33.5%) was used as a nitrogen source and potassium sulfate (50%) was used as a potassium source. They were added to the soil around the seedlings in three equal applications during March, May, and June.

Organic fertilization was supplied as compost. The physicochemical and biological characteristics of the compost were determined outlined in APHA (1989). Total nitrogen, phosphorus, and potassium contents were determined according to described by Black (1965). Microbiological analyses, encompassing the enumeration of total and fecal coliform bacteria, Salmonellae & Shigella, were according to Difco (1985). The weed seeds were assessed by Yu et al. (2010), and nematode populations were examined according to Rice et al. (2017). It showed high organic matter content (40.23%), with a C/N ratio of 17:1 and no detectable coliforms, pathogens, nematodes, or weed seeds (Table, 2).

Two application rates were used:

- **100% compost** (20.429 kg/tree) ≈ equivalent to 286 g N, 194 g P, and 284 g K per tree.
- **50% compost** (10.214 kg/tree) ≈ equivalent to 143 g N, 97 g P, and 142 g K per tree.

All compost was applied around the trees once during the winter soil preparation period.

The bio fertilizers used included *Azospirillum brasilense*, *Bacillus circulans*, *Trichoderma harzianum*, and *Arbuscular Mycorrhizal* fungi (AMF). These microbial inoculants were sourced from Agric. Microbiology Dept., SWERI, ARC, Giza, Egypt. AMF was applied to the soil once during the winter service, while the bacterial and fungal inoculants were applied twice: the first during winter soil service (second week of December), and the second 35 days later after the first application.

**Table (1).** Physical, chemical and biological properties of the experimental soil.

| **Type of analysis** | **Unit** | **Soil** |
|---|---|---|
| **Particle size distribution** | | |
| **Clay** | % | 46.20 |
| **Silt** | % | 28.60 |
| **Sand** | % | 25.20 |
| **Textural class** | | Clay |
| **Chemical analysis** | | |
| **pH (1:2.5) soil – water suspension** | | 8 |
| **EC (saturation paste extract)** | dS/m | 1.26 |
| **Organic matter** | % | 1.25 |
| **Organic carbon** | % | 0.73 |
| **N** | mg/kg | 41.91 |
| **P** | mg/kg | 7.93 |
| **K** | mg/kg | 211.31 |
| **Soluble cations and anions** | | |
| **$Ca^{++}$** | $mmol_cL^{-1}$ | 6.06 |
| **$Mg^{++}$** | $mmol_cL^{-1}$ | 3.03 |
| **$Na^{+}$** | $mmol_cL^{-1}$ | 2.79 |
| **$K^{+}$** | $mmol_cL^{-1}$ | 0.68 |
| **$CO_3^{=}$** | $mmol_cL^{-1}$ | - |
| **$HCO_3^{-}$** | $mmol_cL^{-1}$ | 3.30 |
| **$Cl^{-}$** | $mmol_cL^{-1}$ | 6.78 |
| **$SO_4^{=}$** | $mmol_cL^{-1}$ | 2.48 |
| **Microbiological analysis** | | |
| **Total bacterial count** | cfu/g × $10^5$ | 25 |
| **Total actinomycetes** | cfu/g × $10^3$ | 36 |
| **Total fungi** | cfu/g × $10^3$ | 19 |

cfu/g: Colony forming unit/gram

**Table (2).** Physicochemical and biological characteristics of compost.

| Composition | Units | Compost |
|---|---|---|
| **Density** | **kg/m** | 660.00 |
| **Moisture content** | **%** | 32.00 |
| **pH (1:10)** | | 7.20 |
| **EC (1:10)** | **$dSm^{-1}$** | 1.89 |
| **$N\text{-}NH_4$** | **$mg\ kg^{-1}$** | 19.00 |
| **$N\text{-}NO_3$** | **$mg\ kg^{-1}$** | 283.00 |
| **Total nitrogen** | **%** | 1.40 |
| **Organic matter** | **%** | 40.23 |
| **Organic carbon** | **%** | 23.33 |
| **Ash** | **%** | 59.77 |
| **C/N ratio** | | 17: 1 |
| **Total phosphorus ($P_2O_5$)** | **%** | 0.95 |
| **Total potassium ($K_2O$)** | **%** | 1.39 |
| **Weed seeds** | | Nill |
| **Nematode** | **Larava/200g** | Nill |
| **Total bacterial count** | **$cfu/g \times 10^5$** | 31.10 |
| **Total actinomycetes** | **$cfu/g \times 10^4$** | 185.00 |
| **Total fungi** | **$cfu/g \times 10^4$** | 96.00 |
| **Total coliform** | **cfu/g** | Not detected |
| **Faecal coliform** | **cfu/g** | Not detected |
| ***Salmonella* and *Shigella*** | **cfu/g** | Not detected |

Cfu/g: Colony forming unit/gram

**Layout of the experimental treatments:**

The experiment was conducted using a complete randomized design with three replicates, which carried out on 72 seedlings of pear with 8 treatments as follows:

$T_1$: 100% NPK Control (286 g of N, 190 g of P and 286 g of K per tree).

$T_2$: 100% Compost (20.429 Kg/tree).

$T_3$: 100% Compost + 100 ml/tree of mixture of *Azospirillum brasilense*, *Bacillus circulans* and *Trichoderma harzianum* + 100 g/tree Arbuscular mycorrhizal fungi (AMF).

$T_4$: 100% Compost + 150 ml/tree of mixture of *Azospirillum brasilense*, *Bacillus circulans* and *Trichoderma harzianum* + 150 g/tree AMF.

$T_5$: 100% Compost + 200 ml/tree of mixture of *Azospirillum brasilense*, *Bacillus circulans* and *Trichoderma harzianum* + 200 g/tree AMF.

$T_6$: 50% Compost (10.214 Kg/tree) + 50% NPK (143 g of N, 95 g of P and 143 g of K per tree) + 100 ml/tree of mixture of *Azospirillum brasilense*, *Bacillus circulans* and *Trichoderma harzianum* + 100 g/tree AMF.

$T_7$: 50% Compost + 50% NPK + 150 ml/tree of mixture of *Azospirillum brasilense*, *Bacillus circulans* and *Trichoderma harzianum* + 150 g/tree AMF.

$T_8$: 50% Compost + 50% NPK + 200 ml/tree of mixture of *Azospirillum brasilense*, *Bacillus circulans* and *Trichoderma harzianum* + 200 g/tree AMF.

The considered treatments were evaluated through the following determinations:

**1. Vegetative growth parameters:**

**a. Stem diameter rate (cm/year):** was measured at the end of each season as the increment in stem diameter (above 3 cm from the grafting point, according to Soliman, (2020). Then, it was calculated as a difference between stem diameter at the end season and initial stem diameter at the beginning of the season.

**b. Trunk circumference:** it was calculated as a difference between the end season and the beginning of the season.

**c. Leaves number /shoot:** were counted at the end of each season of study.

**d. Leaf area ($cm^2$):** six mature leaves were taken at the third node from the base of the main stem of the seedlings for estimating leaf area meter (model 1203, CID, Inc., USA).

**e. Seedlings highest (cm):** tree seedlings were randomly chosen the mean value of each treatment was estimated.

f. **Number of shoots / seedling:** The new shoot number that formed was counted for each seedling.
g. **New shoot length (cm):** three shoots were randomly chosen on each seedling for counting the newly formed shoots. The mean value of each treatment was estimated.
h. **Shoot diameter:** Average shoot diameter measured by using a vernier caliper
i. **Main number of roots.**
j. **Root dry weight.**

2. **Endogenous leaf chemical contents:** Leaf nutrient contents (macro and micro elements) were determined in the oven-dried leaf samples (5- $7^{th}$ leaf from the base) collected at the first week of July of both seasons. Leaves were taken as previously described, dried at 70° for three days, and used for the following analysis:

a. **Leaf nitrogen content percentages:** sample of 5 grams dry weight from each replicate were used to estimate the leaf nitrogen content. Then, it was estimated by Micro-Kjeldahl according to A.O.A.C (2005).
b. **Leaf phosphorus content (%):** was estimated as described by Chapman and Parker (1961).
c. **Leaf potassium content (%):** was estimated according to Lilleland and Brown (1946).
d. **Chlorophyll analysis:**
   1. Weight 100 mg of leaf tissue in fractions into the vial containing 7 mL Dimethyl sulphoxide.
   2. Chlorophyll will extract into the fluid without grinding at 65 °C by incubating for various times, depending on the degree of cutinization and thickness of the leaf.
   3. Transfer the extract liquid to a graduated tube and make up to a total volume of 10 ml with Dimethyl sulphoxide, assay immediately, or transfer to vials and store between 0-4 °C until required for analysis.
   4. Take 3 ml of chlorophyll extract and transfer to cuvette, 5. Measure the extract's optical density (OD) at the following wavelengths, 645 and 663 nm, using Dimethyl sulphoxide as a blank after 30 min and 1 hr, incubation.

- Chlorophyll A (mg/g) =12.7 (OD663) – 2.69 (OD645) x (V/ (1000 x wt.)).
- Chlorophyll B (mg/g) =22.9 (OD645) – 4.68 (OD663) x (V/ (1000 x wt.)).
- Total Chlorophyll (mg/g) =20.2 (OD645) + 8.02 (OD663) x (V/ (1000 x wt.)).

OD: optical density at certain wave length (645 or 663 nm).
V: Final volume (10 ml).
Wt.: weight of sample (100 mg).

e. **Leaf Calcium content (ppm):** It was determined by using Atomic absorption spectrophotometer as described by Lindsay and Norvell (1978).
f. **Leaf content of total carbohydrates (mg/100g):** It was determined in dry leaf samples collected at the $2^{nd}$ week of July of each season according to A.O.A.C. (2005) as mg/100 g D.W.
g. **C/N ratio**: It was calculated according the following equation:

$$\text{C/N ratio} = \frac{\text{Total carbohydrates}}{\text{Total Nitrogen}}$$

**3. Soil Microbial Properties:**

Total bacterial counts (Allen, 1959), actinomycetes (Williams and Davis, 1965), and fungal counts (Martin, 1950) were determined. The dehydrogenase activity (μg/g dry soil/day) (Skujins, 1976) and total phosphatase (mg/ PNP/g dry soil) (Tabatabai, 1982), were determined.

**Statistical Analysis:**

Each season was subjected to a completely randomized design using the analysis of variance (ANOVA) as described by Gomez and Gomez (1984). The LSD test, which compares differences between treatment mean values at the 0.05 level of probability, was used to compare the discrepancies. ANOVA was used in the MSTAT-C software program to evaluate the data **(Freed *et al.*, 1989)**.

## RESULTS AND DISCUSSION

### 1. Vegetative growth parameters:

**Stem diameter rate (cm/year) and trunk circumference:** Data in Table (3) showed that the stem diameter rate (cm/year) and trunk circumference of pear seedlings during the two seasons significantly differ among all treatments under study. Also, the stem diameter rate and the trunk circumference were recorded as the highest results with the combinations of 50 % compost + 50% NPK + 200 ml/tree of mixture of *Azospirillum brasilense, Bacillus circulans* and *Trichoderma harzianum* and 200g/tree Arbuscular Mycorrhizal fungi in both seasons compared to the other treatments in the study.

This supports findings by Prasad et al., (2017) found that Bio-fertilization is of great importance in alleviating the deterioration of natural resources and environmental pollution. Bio-fertilizers combined with organic manure influence plant growth by enhancing root biomass, and an increase in all vegetative growth parameters by reducing consumption of natural sources of energy. Also, Wang et al., (2022) recorded that they recorded that when using the organic or bio-fertilizers on alter soil physical and chemical properties, thus manipulating specific microbial taxa and functions within the rhizosphere microbiome of pear plants to promote all of the vegetative growth characteristics, and they affected to increase the yield, which may help in the design of more efficient biofertilizers to promote the growth of fruit and production.

**Table (3).** Effect of organic and bio-fertilizers on stem diameter rate (cm/year) and trunk circumference of pear seedlings during two seasons (2023-2024/2024-2025).

| Treatments | Stem diameter rate (cm/year) | Trunk circumference | Stem diameter rate (cm/year) | Trunk circumference |
|---|---|---|---|---|
| | (2023-2024) | | (2024-2025) | |
| $T_1$ | 73.00 CD | 1.550 F | 87.00 C | 1.930 F |
| $T_2$ | 70.00 D | 1.630 F | 81.00 C | 2.007 F |
| $T_3$ | 73.00 CD | 2.330 E | 87.00 C | 2.710 E |
| $T_4$ | 76.00 C | 3.470 D | 85.33 C | 3.853 D |
| $T_5$ | 90.33 A | 3.700 C | 96.00 B | 4.080 C |
| $T_6$ | 82.00 B | 3.590 CD | 96.00 B | 4.000 C |
| $T_7$ | 90.00 A | 3.950 B | 104.0 A | 4.373 B |
| $T_8$ | 93.00 A | 4.233 A | 108.0 A | 4.580 A |

Means in a column followed by the same letter do not differ significantly according to Duncan`s New Multiple Range t-Test at 5 % level.

a. **Leaves number/shoot and leaf area ($cm^2$):** Leaves number/shoot and leaf areas were significantly different during the two seasons under study in Table (4). The number/shoots were recorded as the highest data with $T_8$ and $T_7$ treatments, respectively, in both seasons compared to the other treatments under the study. In the same Table, the leaf area in the first season was recorded as the maximum average with treatments $T_8$ and $T_7$. On the other hand, the treatments of $T_8$, $T_7$, $T_6$, and $T_5$, respectively, gave the highest data of leaf area as followed by $T_4$, $T_3$, $T_2$, and $T_1$ in the second season. Data harmony with Kai et al., (2013), they study different organic fertilizers on the growth of the Huangguan pear tree. They found that the applications of organic fertilizer enhance the leaf area and increase the number of leaves per shoot. Also, Yu et al., (2025) studied the effects of organic fertilizers and the rhizosphere microbiome on plant growth. They found that the plant fertilizers maintained the stability of the soil microbial community, beneficial to plant root development, increased carbon cycle pathways, and affected the area of the canopy trees under study.

**Table (4).** Effect of organic and bio-fertilizers on leaves number/shoot, and leaf area ($cm^2$) of pear seedlings during two seasons (2023-2024/2024-2025).

| Treatments | Leaves number /shoot | Leaf area ($cm^2$) | Leaves number/shoot | Leaf area ($cm^2$) |
|---|---|---|---|---|
| | (2023-2024) | | (2024-2025) | |
| $T_1$ | 9.000 E | 25.40 D | 10.32 D | 30.12 D |
| $T_2$ | 9.270 DE | 25.70 CD | 10.50 D | 30.28 CD |
| $T_3$ | 9.607 D | 26.18 BC | 11.15 C | 31.00 C |
| $T_4$ | 10.44 C | 26.30 BC | 11.46 C | 32.27 B |
| $T_5$ | 11.23 B | 26.82 B | 11.90 B | 33.17 A |
| $T_6$ | 11.52 B | 27.63 A | 12.16 B | 33.30 A |
| $T_7$ | 12.20 A | 27.80 A | 13.24 A | 33.50 A |
| $T_8$ | 12.32 A | 27.85 A | 13.65 A | 33.62 A |

Means in a column followed by the same letter do not differ significantly according to Duncan`s New Multiple Range t-Test at 5 % level.

**b. Seedlings highest (cm), number of shoots /seedling, new shoot length (cm) and shoot diameter:** The highest seedlings (cm), number of shoots /seedling, new shoot length (cm), and shoot diameter in Table (5) showed that all treatments significantly affected the highest seedlings (cm), number of shoots /seedling, new shoot length (cm), and shoot diameter in both seasons. Also, using treatments $T_8$ or $T_7$, respectively, increased all growth parameters in Table 6 compared to the other treatments in the same seasons under study. The results harmony with Haska et al., (2022) found that the vegetative growth parameters speed with the peat moss medium and the biofertilizer applications and biofertilizer application can improve the seedling quality in the production of organic seedlings. Also, Yu et al., (2025) recorded that the Plant fertilizers were enhancing the all growth parameters of plants in the long term, and a guide for organic fertilizer selection from the perspective of soil microecology and promoting sustainable development of organic agriculture.

**c. Main number of roots and Root dry weight:** Table (6) showed that the main number of roots and root dry weight were significantly affected by all treatments under the two seasons in the study. Data of the main roots and dry weight showed that the treatment of $T_8$ gave the maximum average of main roots and dry weight as followed by $T_7$, $T_6$, $T_5$, $T_4$, $T_3$, $T_2$, and $T_1$ in both seasons. Data confirmed that Haska et al., (2022) studied the effect of different organic growing mediums and biofertilizer in organic seedling production. They received that Biofertilizer application improved the root growth rate, such as weight, number, and length, in all seedlings under study. Also, the heaviest roots were obtained from seedlings inoculated with biofertilizer and grown in medium Peat moss for all species. Yu et al., (2025) studied the Effects of organic fertilizers on plant growth and the rhizosphere microbiome they found that animal fertilizers enhanced nitrogen cycle pathways, while plant fertilizers boosted carbon cycle pathways and promoted plant root development.

**Table (5).** Effect of organic and bio-fertilizers on shoot highest, number of shoots/seedling, new shoot length (cm) and shoot diameter of pear seedlings during two seasons (2023-2024/ 2024-2025).

| Treatments | (2023-2024) | | | | (2024-2025) | | | |
|---|---|---|---|---|---|---|---|---|
| | Shoot highest (cm) | Number of shoots/seedling | New shoot length (cm) | Shoot diameter (cm) | Shoot highest (cm) | Number of shoots/ seedling | New shoot length (cm) | Shoot diameter (cm) |
| $T_1$ | 116.0 F | 7.000 E | 38.00 D | 0.7467 C | 134.0 E | 8.000 D | 43.70 E | 0.880 C |
| $T_2$ | 118.0 EF | 7.193 E | 38.67 D | 0.8533 BC | 136.3 E | 8.233 D | 43.80 E | 0.983 C |
| $T_3$ | 122.0 DE | 8.700 D | 40.43 C | 0.8633 BC | 156.7 D | 9.747 C | 46.13 D | 0.950 C |
| $T_4$ | 125.0 CD | 8.950 D | 40.72 C | 0.9200 B | 161.3 CD | 9.700 C | 46.39 D | 0.973 C |
| $T_5$ | 135.0 B | 10.13 B | 45.30 B | 1.200 A | 171.7 BC | 10.47 B | 51.00 B | 1.367 B |
| $T_6$ | 130.0 BC | 9.293 C | 45.36 B | 0.9567 B | 176.7 B | 10.42 B | 48.81 C | 1.217 B |
| $T_7$ | 143.0 A | 12.52 A | 48.88 A | 1.220 A | 194.7 A | 13.58 A | 54.58 A | 1.530 A |
| $T_8$ | 147.0 A | 12.43 A | 48.50 A | 1.317 A | 196.3 A | 13.30 A | 54.20 A | 1.597 A |

Means in a column followed by the same letter do not differ significantly according to Duncan`s New Multiple Range t-Test at 5 % level.

**Table (6).** Effect of organic and bio-fertilizers on main number of roots and Root dry weight of pear seedlings during two seasons (2023-2024/2024-2025).

| Treatments | Main number of roots (2023-2024) | Root dry weight (2023-2024) | Main number of roots (2024-2025) | Root dry weight (2024-2025) |
|---|---|---|---|---|
| $T_1$ | 7.790 C | 19.50 D | 8.740 B | 20.00 F |
| $T_2$ | 8.007 BC | 19.52 D | 8.000 BC | 20.85 E |
| $T_3$ | 8.120 BC | 21.17 C | 7.233 C | 22.50 D |
| $T_4$ | 8.153 B | 21.50 C | 8.243 BC | 23.29 D |
| $T_5$ | 8.333 B | 21.50 C | 8.780 B | 25.51 C |
| $T_6$ | 8.347 B | 24.18 B | 8.853 AB | 25.79 BC |
| $T_7$ | 8.757 A | 24.70 B | 9.333 AB | 26.66 AB |
| $T_8$ | 8.890 A | 25.75 A | 10.17 A | 27.15 A |

Means in a column followed by the same letter do not differ significantly according to Duncan`s New Multiple Range t-Test at 5 % level.

**2. Endogenous leaf chemical contents:**

**a. Chlorophyll A, chlorophyll B, and total chlorophyll (mg/g):** Data in Table (7) cleaned that the chlorophyll A, chlorophyll B, and total Chlorophyll (mg/g) of pear seedlings during the two seasons significantly differ among all treatments under study. Also, the data of chlorophyll A, chlorophyll B, and total chlorophyll recorded as the highest results with the combinations of $T_8$ (50% Compost + 50% NPK + 200 ml/tree of mixture of *Azospirillum brasilense, Bacillus circulans* and *Trichoderma harzianum* + 200g/tree Arbuscular Mycorrhizal fungi) as followed by $T_7$, $T_6$, $T_5$, $T_4$, $T_3$, $T_2$, and $T_1$ in both seasons. This supports findings by Ritchie, (2008) stated that the different sources of organic fertilizer in the study affected all leaf chemical content, and changed the physiological interactions in plants over a long period, as followed by the growth characteristics and the crop yield.

**Table (7).** Effect of organic and bio- fertilizers on chlorophyll (A), chlorophyll (B), and total Chlorophyll of pear seedlings during two seasons (2023-2024/ 2024-2025).

| Treatments | Chlorophyll (A) (2023-2024) | Chlorophyll (B) (2023-2024) | Total chlorophyll (2023-2024) | Chlorophyll (A) (2024-2025) | Chlorophyll (B) (2024-2025) | Total chlorophyll (2024-2025) |
|---|---|---|---|---|---|---|
| $T_1$ | 0.761 B | 0.277 E | 1.037 F | 0.917 B | 0.327 E | 1.244 E |
| $T_2$ | 0.819 B | 0.611 D | 1.430 E | 1.100 B | 0.758 D | 1.858 D |
| $T_3$ | 0.854 B | 0.627 CD | 1.484 DE | 1.108 B | 0.843 D | 1.951 D |
| $T_4$ | 0.878 B | 0.672 C | 1.562 D | 1.220 AB | 0.802 D | 2.022 D |
| $T_5$ | 0.790 B | 0.660 CD | 1.545 D | 1.233 AB | 0.800 D | 2.033 D |
| $T_6$ | 0.862 B | 0.750 B | 1.777 C | 1.427 AB | 1.160 C | 2.587 C |
| $T_7$ | 1.155 A | 1.015 A | 2.170 B | 1.882 AB | 1.358 B | 3.080 B |
| $T_8$ | 1.265 A | 1.030 A | 2.262 A | 1.919 A | 1.600 A | 3.519 A |

Means in a column followed by the same letter do not differ significantly according to Duncan`s New Multiple Range t-Test at 5 % level.

**b. Leaf nitrogen content (%), leaf content of total carbohydrates (mg/100g) and C/N ratio:** Table (8) showed that the nitrogen content, total carbohydrates, and C/N of pear seedlings during the two seasons significantly differ among all treatments under study. Also, the combination of $T_8$ (50% Compost + 50% NPK + 200 ml/tree of mixture of *Azospirillum brasilense, Bacillus circulans* and *Trichoderma harzianum* + 200g/tree Arbuscular Mycorrhizal fungi) recorded the highest results of N%, carbohydrates, and C/N ratio in both seasons as compared to the other combination treatments under study. **Haska *et al.* (2022)** reported that biofertilizer application can improve the seedling quality and increased the leaf mineral content. **Abdel-Rahman *et al.* (2024)** The maximum N%, total carbohydrates, and C/N ratio were recorded with Cyanobacteria + B. subtilis + B. amylo compared to the other applications under study.

**c. Leaf phosphorus content (%), leaf potassium content (%) and leaf calcium content (ppm):** Table (9) showed that the P, K and Ca of pear seedlings during the two seasons significantly differ among all treatments under study. Also, the combination of $T_8$ (50% compost + 50% NPK + 200 ml/tree of mixture of *Azospirillum brasilense, Bacillus circulans* and *Trichoderma harzianum* + 200g/tree Arbuscular Mycorrhizal fungi) recorded the highest results of P, K, and Ca contents in both seasons as compared to the other combination treatments under study. Ritchie, (2008) found that the various organic fertilizer sources used in the study altered the physiological interactions in plants and had an impact on all leaf chemical composition. Also, El-Banna and Fouda (2018) found that 30 % of mineral fertilizer combined with farmyard manure at 30 $m^3$/fed., in the presence of bio-fertilizer and sprayed with humic acid increased the leaf mineral on plants compared control.

**Table (8).** Effect of organic and bio-fertilizers on leaf nitrogen content (%), leaf content of total carbohydrates (mg/100g) and C/N ratio of pear seedlings during two seasons (2023-2024/2024-2025).

| Treatments | Leaf nitrogen content (%) | Total carbohydrates (mg/100g) | C/N ratio | Leaf nitrogen content (%) | Total carbohydrates (mg/100g) | C/N ratio |
|---|---|---|---|---|---|---|
| | | (2023-2024) | | | (2024-2025) | |
| $T_1$ | 1.723 E | 9.180 E | 0.188 B | 1.800 D | 9.683 D | 0.185 B |
| $T_2$ | 1.800 E | 9.520 DE | 0.189 B | 1.910 D | 9.760 D | 0.195 B |
| $T_3$ | 2.130 D | 9.540 DE | 0.223 AB | 2.250 C | 9.680 D | 0.232 AB |
| $T_4$ | 2.237 CD | 9.803 CD | 0.228 AB | 2.327 C | 9.870 D | 0.235 AB |
| $T_5$ | 2.657 AB | 10.60 AB | 0.251 A | 2.800 AB | 10.75 B | 0.260 A |
| $T_6$ | 2.473 BC | 10.18 BC | 0.243 A | 2.760 B | 10.53 C | 0.262 A |
| $T_7$ | 2.700 AB | 10.62 AB | 0.254 A | 2.810 AB | 11.13 A | 0.252 A |
| $T_8$ | 2.900 A | 10.95 A | 0.265 A | 2.953 A | 11.22 A | 0.263 A |

Means in a column followed by the same letter do not differ significantly according to Duncan`s New Multiple Range t-Test at 5 % level.

**Table (9).** Effect of organic and bio- fertilizers on Leaf phosphorus content (%), leaf potassium content (%), and leaf calcium content (ppm) of pear seedlings during two seasons (2023-2024/ 2024-2025).

| Treatments | Leaf phosphorus content (%) | Leaf potassium content (%) | Leaf calcium content (ppm) | Leaf phosphorus content (%) | Leaf potassium content (%) | Leaf calcium content (ppm) |
|---|---|---|---|---|---|---|
| | | (2023-2024) | | | (2024-2025) | |
| $T_1$ | 0.110 D | 0.460 C | 1.300 B | 0.264 D | 0.615 C | 1.320 C |
| $T_2$ | 0.180 CD | 0.581 BC | 1.300 B | 0.340 CD | 0.725 BC | 1.320 C |
| $T_3$ | 0.221 B-D | 0.550 BC | 1.320 B | 0.342 CD | 0.863 B | 1.340 BC |
| $T_4$ | 0.232 A-D | 0.580 BC | 1.357 B | 0.362 C | 0.727 BC | 1.370 BC |
| $T_5$ | 0.307 AB | 0.579 BC | 1.400 B | 0.640 B | 0.889 B | 1.420 A-C |
| $T_6$ | 0.301 A-C | 0.731 AB | 1.440 A-C | 0.631 B | 0.920 B | 1.450 AB |
| $T_7$ | 0.330 AB | 0.653 A-C | 1.470 AB | 0.704 B | 0.880 B | 1.500 AB |
| $T_8$ | 0.350 A | 0.832 A | 1.530 A | 0.867 A | 1.369 A | 1.657 A |

Means in a column followed by the same letter do not differ significantly according to Duncan`s New Multiple Range t-Test at 5 % level.

**3. Soil microbial properties:**

**a. Effect of different treatments on total counts of bacteria, actinomycetes and fungi in soil rhizosphere:**

The results in Table (10) showed that the numbers of total bacterial counts, total actinomycetes, and total fungi in the rhizosphere of pear tree roots zone during the two seasons were increased. The results showed that organic and biofertilizers played an effective role in increasing the number of microbes in the pear tree root zone. So, the numbers of total bacterial, actinomycetes, and fungi in the tree root zone were higher in the second season than to the first season in all treatments. Also, the total number of bacteria was higher than the numbers of both actinomycetes and fungi in the tree root zone for all treatments. The results also showed that $T_8$ (50% compost + 50% NPK + 200 ml/tree of mixture of *Azospirillum brasilense, Bacillus circulans* and *Trichoderma harzianum* + 200g/tree Arbuscular Mycorrhizal fungi) gave the highest counts of total bacteria (59 and 95 × $10^5$ cfu/g soil), total actinomycetes (125 and 141 × $10^3$ cfu/g soil) and total fungi (84 and 97 × $10^3$ cfu/g soil) during two seasons, respectively. This is due to the presence of compost and its content of microorganisms and nutrients that increase the reproduction of microorganisms (*Azospirillum brasilense, Bacillus circulans, Trichoderma harzianum* and Arbuscular mycorrhizal fungi). In contrast, the results showed that using only chemical fertilizers, as in $T_1$ (control), resulted in a significant decrease in the numbers of total bacteria, actinomycetes, and fungi, as it was recorded (27 and 36 × $10^5$ cfu/g soil), (41 and 63 × $10^3$ cfu/g soil) and (25 and 31 × $10^3$ cfu/g soil) through the two seasons, respectively. These results are similar to those obtained by Talwar et al., (2017), Mohamed and Massoud (2017) and Khamis et al., (2018), they found that adding organic and biofertilizer to agriculture increases the activity of microbes in the soil and thus increases their numbers in the soil. Also, inoculating the soil with microorganisms increases the biological diversity in the soil and thus increases the concentration of nutrients available to the plant, thus increasing the yield (Ahmed and Ibrahim, 2023). Mohamed and Massoud (2017) found that the increased microbial population in the root zone of trees inoculated with biofertilizers was due to integrated between Azotobacter and Arbuscular mycorrhiza fungi, with the fungi providing tubes for nutrient transport. In addition, Azotobacter symbiotically fixes nitrogen within cell plant, leading to increased numbers of total bacteria, actinomycetes, and total mycorrhizae in soil inoculated with organic and biofertilizers. Using of biofertilizers and organic fertilizers increases the total number of bacteria, fungi, and actinomycetes in the soil in the root zone of plants. Where, microbes use carbon from organic matter as an energy source, increasing their reproduction and thus increasing the number of microbes. In addition, mixed biofertilizers integrated with chemical fertilizers increased the number of microbes in the soil rhizosphere (Sinha et al., 2024).

**Table (10): Changes of total bacterial, actinomycetes and fungi counts in the rhizosphere of pear seedlings during two seasons (2023-2024/ 2024-2025).**

| Treatments | Total bacterial counts ($10^5$ cfu/g soil) | | | Total actinomycetes ($10^3$ cfu/g soil) | | | Total fungi ($10^3$ cfu/g soil) | | |
|---|---|---|---|---|---|---|---|---|---|
| | (2023-2024) | (2024-2025) | Mean | (2023-2024) | (2024-2025) | Mean | (2023-2024) | (2024-2025) | Mean |
| **T1** | 27.00 | 36.00 | **31.50** | 41.00 | 63.00 | **52.00** | 25.00 | 31.00 | **28.00** |
| **T2** | 31.00 | 40.00 | **35.50** | 56.00 | 79.00 | **67.50** | 32.00 | 42.00 | **37.00** |
| **T3** | 37.00 | 51.00 | **44.00** | 62.00 | 88.00 | **75.00** | 39.00 | 49.00 | **44.00** |
| **T4** | 40.00 | 62.00 | **51.00** | 75.00 | 97.00 | **86.00** | 49.00 | 55.00 | **52.00** |
| **T5** | 42.00 | 66.00 | **54.00** | 86.00 | 105.00 | **95.50** | 58.00 | 69.00 | **63.50** |
| **T6** | 46.00 | 72.00 | **59.00** | 97.00 | 120.00 | **108.50** | 64.00 | 77.00 | **70.50** |
| **T7** | 51.00 | 84.00 | **67.50** | 111.00 | 129.00 | **120.00** | 78.00 | 85.00 | **81.50** |
| **T8** | 59.00 | 95.00 | **77.00** | 125.00 | 141.00 | **133.00** | 84.00 | 97.00 | **90.50** |
| **Mean** | **41.63** | **63.25** | - | **81.63** | **102.75** | - | **53.63** | **63.13** | - |

Means in a column followed by the same letter do not differ significantly according to Duncan`s New Multiple Range t-Test at 5 % level.

**b. Effect of organic and biofertilizers treatments on dehydrogenase and phosphatase enzyme activities in tested soil:**

The data presented in Fig. (1 and 2) illustrate the biological activity of dehydrogenase and phosphatase enzymes in the rhizosphere of pear root zone during the two study seasons 2023-2024. In both seasons, it was observed that the treatments that were fertilized with organic and biofertilizers had higher enzyme activity than the treatments that were not fertilized. Microorganisms in the soil play an effective role in increasing the activity of dehydrogenase and phosphatase enzymes. Data showed that $T_8$ (50% Compost + 50% NPK + 200 ml/tree of mixture of *Azospirillum brasilense, Bacillus circulans* and *Trichoderma harzianum* + 200g/tree Arbuscular Mycorrhizal fungi) gave the highest enzyme activity for both enzymes during the two study seasons, recording 79.11 and 106.55 µg TPF/g dry rhizosphere/day for dehydrogenase, also it recorded 0.54 and 0.57 mg PNP/g dry soil for phosphatase during the 2023 and 2024 study seasons, respectively. On the other hand, the results showed that $T_1$ (control) gave the lowest enzyme activity (dehydrogenase and phosphatase) in the soil of the tree root zone during both seasons. In addition to, the results showed that the activity of dehydrogenase and phosphatase enzymes in the tree root zone were higher during the 2024 season compared to the 2023 season. These results are agreement consistent conforming to present by Khamis et al., (2018), Ahmed et al., (2024), Abdel-Rahman et al., (2024) and Okba et al., (2025). The enzyme dehydrogenase is found in living cells and is an indicator of soil health and the number of microbes present. The increased activity of this enzyme when small amounts of mineral fertilizer are added to fruit trees is due to the increased microbial population (Mohamed and Massoud, 2017). Abd El-Rahman and Al-Sharnouby (2021) found that the increase in enzyme activity is due to the increase in soil acidity, which leads to an increase in the mineralization of organic compounds. The increase in the phosphatase enzyme is due to the use of *Arbuscular mycorrhiza* fungi and *Bacillus megatherium* in combination with a small amount of mineral fertilizer. This leads to an increase in the concentration of this enzyme in the soil, which increases the conversion of phosphorus from the unavailable form to the available form for absorption by tree roots, thus increasing tree growth (Ahmed and Al-Sharnouby, 2021). Soil enzyme activity was linked to the availability of nutrients in the soil. Adding biofertilizers integrated with organic fertilizers increases enzyme activity in the soil. The presence of *Trichoderma harzianum* also increases the decomposition of organic matter in the soil, which leads to an increase in the organic carbon required for microbial activity (Sinha et al., 2024).

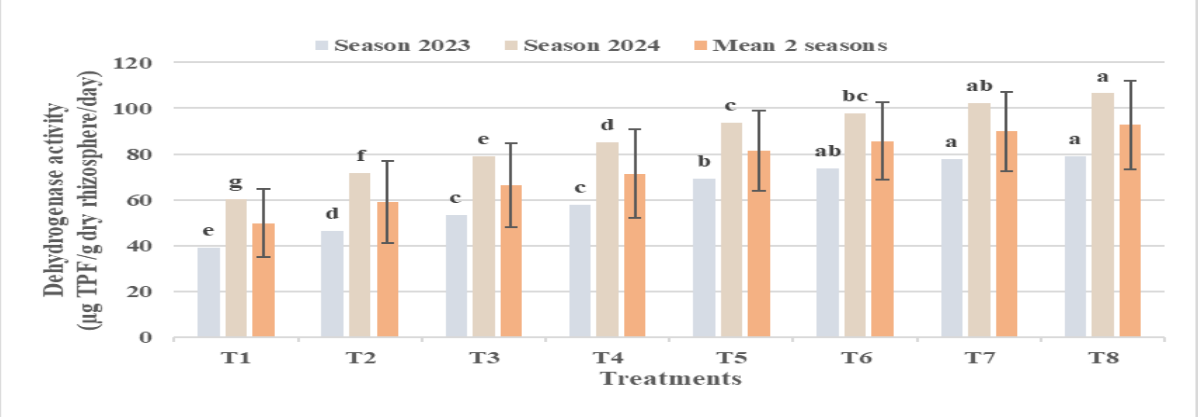


**Fig. (1):** Effect of mineral, organic and bio fertilizers on dehydrogenase activity in tested soil of pear seedlings in 2023 and 2024 seasons. Values are means of three replicates ± standard deviation. Histograms sharing the same letter are not statistically different using Duncan's multiple range test ($p \leq 0.05$).

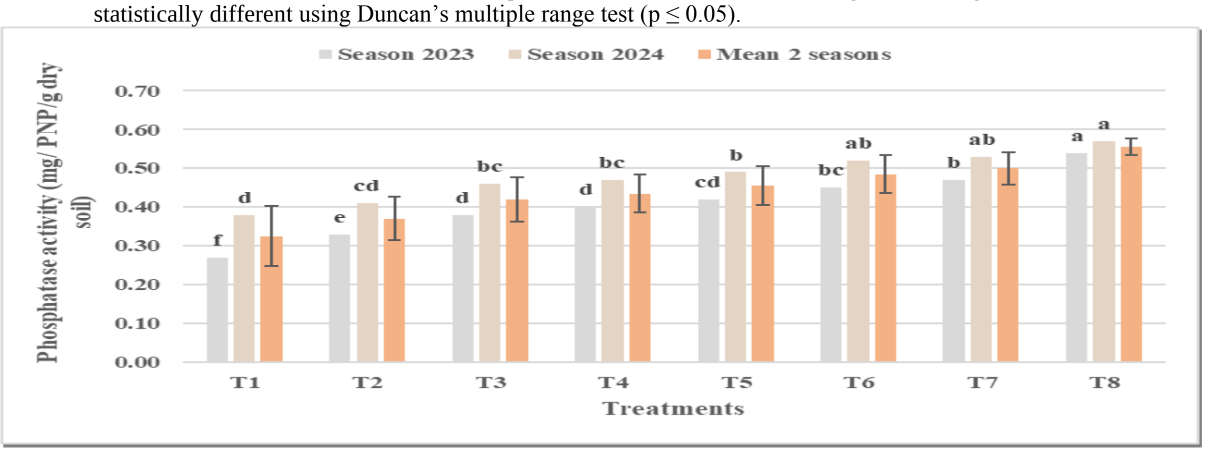


**Fig. (2):** Effect of mineral, organic and bio fertilizers on phosphatase activity in tested soil of pear seedlings in 2023 and 2024 seasons. Values are means of three replicates ± standard deviation. Histograms sharing the same letter are not statistically different using Duncan's multiple range test ($p \leq 0.05$).

**c. Effect of organic and biofertilizers treatments on macronutrients contents in tested soil:**

The results in Table (11) indicated that the use of organic fertilizers (compost) and biofertilizers (*Azospirillum brasilense, Bacillus circulans, Trichoderma harzianum* and Arbuscular Mycorrhizal fungi) had a positive impact on increasing the availability of major nutrients in the soil. The results showed that $T_8$ (50% compost + 50% NPK + 200 ml/tree of mixture of *Azospirillum brasilense*, *Bacillus circulans* and *Trichoderma harzianum* + 200g/tree Arbuscular Mycorrhizal fungi) recorded a clear increase in N, P, and K, where N was recorded 58.76 and 63.11 mg $kg^{-1}$, P was recorded 13.07 and 21.91 mg $kg^{-1}$, and K was recorded 220.13 and 263.18 mg $kg^{-1}$ in both seasons, respectively, compared to the control treatment ($T_1$). This is due to the presence of *Azospirillum brasilense*, which works to fix nitrogen symbiotically in the soil, and the presence of *Bacillus circulans*, which works to increase the availability of K in the soil, in addition to the presence of Arbuscular Mycorrhizal fungi, which secretes external enzymes that work to increase the solubility of phosphorus in the soil, and *Trichoderma harzianum*, which works to increase the decomposition of organic matter in the soil, thus increasing soil acidity and increasing the availability of elements in the soil. All these factors played an effective role in increasing the availability of major elements in the treatments. It was clear that that treatment content compost 100% (T2) gave results higher than control (T1) 100% NPK where compost was very mature so, all elements were released and they were available for seedlings in addition to, it contents other factors (humic substances, organic matter, enzymes, vitamins, antibiotics, growth regulators, nitrogen-fixing, phosphorus-solubilizing and potassium facilitating microorganisms). These results are agreement consistent conforming to present by Ahmed et al., (2024) and Sinha et al., (2024). They found that adding organic and biofertilizers to the soil increases the availability of major elements in the soil.

**Table (11):** Effect of different treatments on available macronutrients contents in the rhizosphere of pear seedlings during two seasons (2023-2024/ 2024-2025).

| Treatments | N (mg $Kg^{-1}$) | | P (mg $Kg^{-1}$) | | K (mg $Kg^{-1}$) | |
|---|---|---|---|---|---|---|
| | (2023-2024) | (2024-2025) | (2023-2024) | (2024-2025) | (2023-2024) | (2024-2025) |
| T1 | 43.28 E | 45.69 D | 8.41 B | 8.91 E | 212.01 E | 213.91 F |
| T2 | 46.03 DE | 48.33 CD | 9.64 AB | 10.21 E | 212.65 DE | 215.63 F |
| T3 | 47.66 C-E | 50.09 B-D | 10.11 AB | 11.53 DE | 213.17 C-E | 219.03 F |
| T4 | 48.25 B-E | 51.03 B-D | 10.63 AB | 13.03 DE | 214.61 B-E | 225.63 E |
| T5 | 51.88 A-D | 55.63 A-C | 11.81 AB | 15.23 CD | 216.63 A-D | 241.13 D |
| T6 | 54.63 A-C | 57.88 AB | 11.98 AB | 17.66 BC | 217.19 A-C | 247.11 C |
| T7 | 56.26 AB | 59.09 AB | 12.51 AB | 19.71 AB | 218.13 AB | 252.91 B |
| T8 | 58.76 A | 63.11 A | 13.07 A | 21.91 A | 220.13 A | 263.18 A |

Means in a column followed by the same letter do not differ significantly according to Duncan`s New Multiple Range t-Test at 5 % level.

**Conclusion:**

The study demonstrated that combining 50% mineral NPK with 50% compost and 200 ml/tree of mixture of *Azospirillum brasilense, Bacillus circulans* and *Trichoderma harzianum* beside to 200 g/tree Arbuscular Mycorrhizal fungi (AMF) significantly improved pear seedling growth, nutrient uptake, and rhizosphere microbial activity. This treatment ($T_8$) resulted in the highest seedling height (196.3 cm), shoot diameter (1.597 cm), leaf chlorophyll content (3.52 mg/g), soil microbial (total bacterial counts: $95 \times 10^5$ cfu/g; actinomycetes: $141 \times 10^3$ cfu/g; fungi $97 \times 10^3$ cfu/g), enzyme activity (dehydrogenase: 106.55 µg TPF/g/day; phosphatase: 0.57 mg PNP/g/day) and soil macronutrients (N: 63.11 mg $kg^{-1}$; P: 21.91 mg $kg^{-1}$; K: 263.18 mg $kg^{-1}$). These findings highlight the effectiveness of integrated organic and biofertilization in reducing chemical inputs while enhancing seedling vigor and soil health.

**Recommendation:**

Therefore, applying 50% NPK + 50% compost and 200 ml/tree of mixture of *Azospirillum brasilense*, *Bacillus circulans* and *Trichoderma harzianum* beside to 200 g/tree Arbuscular Mycorrhizal fungi are recommended for optimal best growth of young pear trees under conditions of this trail.

# REFERENCES


**Abd-El-Latif, F.M.; El-Gioushy, S.F.; Ismail, A.F. and Mohamed, M.S. (2017).** The impact of bio-fertilization, plant extracts and potassium silicate on some fruiting aspects and fruit quality of "Le-Conte" pear trees. Middle East J. of App. Sci.7 (2): 385-397.

**Abd El-Rahman, A.S. and Al-Sharnouby, S.F.S. (2021).** Possibility of Reducing the Amount of Mineral Potassium Fertilizers for Flame Seedless Grapevines by Using Rock-Feldspar. Hort. Sci. & Ornamen. Plants, 13(3): 249-258.

**Abdel-Rahman, A.S.; Ghazal, M.F. and Salem, G.M. (2024)**. Using Some Sources of Biofertilizers to Improve Growth, Productivity and Fruit Quality of Le-Conte Pear Trees. Journal of Horticultural Science & Ornamental Plants 16 (1): 55-64.

**Ahmed, A.E. and Ibrahim, H.A.K. (2023).** Evaluating the effect of biofertilization in improving growth and productivity of soya bean under Qantra Sharq conditions. Egyptian J. Desert Res., 73(2): 367-394.

**Ahmad, N. (2000).** Fertilizer scenario in Pakistan: Policies and development In: Proceeding of conference Agric. and fertilizer use. 2010. Feb. 15-16, NFDC, Islamabad.

**Ahmed, S.M.; El-Khayat, R.M.; El-Shahat, R.M and Badawi, M.A. (2024).** Effect of Bio and Organic Fertilizers on Yield and Quality of Date palm (Phoenix dactylifera, cv Sakkoti) fruit grown in Aswan Governorate and their Contents of Iron and Zinc. Afr. J. Bio. Sc. 6(2): 2552-2568.

**Ahmed, O.A. and Al-Sharnouby, S.F.S. (2021).** Role of Arbuscular Mycorrhizal Fungi and Phosphate-Solubilizing Bacteria in Improve Rock-Phosphate Availability for Superior Grapevines. Am-Euras. J. Agric. & Environ. Sci., 21(2): 126-139.

**A.O.A.C. (2005).** Official Methods of Analysis. Published by the A.O.A.C. Box540.

**Allen, O.N. (1959).** Experiments in Soil Bacteriology.1st ed. Burges Publ. co. Minnesota USA, 117 p.

**APHA. (1989).** Standard Methods for Examination of Water and Wastewater. 17th Edition. American Public Health Association, Washington, DC. USA, 2000 p.

**Black, C.A. (1965).** Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties. American Society of Agronomy, Inc., Madison, Wisconsin, USA, 926 p.

**Butcaru, A.C.; Mihai, C.A.; Mot, A.; Gogot, R.; Hoza, D. and Stănică, F. (2024).** Circular Pear Production Using Compost Fertilization: Influence on Tree Growth and Nitrogen Leaf Concentration. Horticulturae, 10, 1209. https://doi.org/10. 3390/horticulturae 10111209.

**Chapman, H.D. and F. Parker (1961).** Methods of analysis for soil, plants and waters. Agricultural Publications, University of California, U.S.A, 309 pp.

**Difico, Manual (1985).** Manual of Dehydrated Culture Media and Reagents of Microbiology. 10th Ed. Difico Laboratories, Detroit, MI, USA, 621 p.

**Edwards, G.R. and Notodimedjo (1987).** Defoliation, bending and tip pruning of apple under tropical conditions. Acta Horticultural, 199: 125 – 127.

**El-Banna, H.Y. and Fouda, K.F. (2018).** Effect of Mineral, Organic, Biofertilizers and Humic Acid on Vegetative Growth and Fruit Yield Quality of Caraway Plants (Carum carvi L.). J. Soil Sci. and Agric. Eng., Mansoura Univ. 9 (5): 237 - 241.

**Food and Agriculture Organization of the United Nations (2023). Harshad A.; Prajapati; Khushboo, Y.; , Yamuna, H.; Margam, B. K. ;Tanzeel, K.; Ningaraj, B. ; , Vimala T.; Afshan, J.;, Gomadh, G. and Malathi, G. (2024).** Impact of Climate Change on Global Agriculture: Challenges and Adaptation. International Journal of Environment and Climate Change.14 (4):372-379

**Freed, R.; Einensmith, S.P.; Gutez, S.; Reicosky, D.; Smail, V.W. and Wolberg, P. (1989).** Users guide to Mstat-c analysis of agronomic research experiments. Michigan State University, East Lansing, U.S.A., 25-77.

**Galindo, F.S.; Buzetti, S.; Rodrigues, W.L.; Boleta, E.H.M.; Silva, V.M.; Tavanti, R.F.R.; Fernandes, G.C.; Biagini, A.L.C.; Rosa, P.A.L.; and Teixeira Filho, M.C.M. (2020).** Inoculation of *Azospirillum brasilense* associated with silicon as a liming source to improve nitrogen fertilization in wheat crops. Sci. Reports 10: 6160.

**Gomez, K.A. and Gomez, A.A. (1984).** Statistical Procedures For Agricultural Research. 2nd Ed. (New York: John Wiley & Sons, Inc.), 680 P.

**Haska, O. J. A.; Söylemez, S and Sarhan, T. Z. (2022).** Effect of different organic growing mediums and application of biofertilizer in organic seedling production. World Journal of Advanced Research and Reviews., 13(02), 252–263.

**Horneck, D.A.; Sullivan, D.M.; Owen, J.S. and Hart, J.M. (2011)**. Soil Test Interpretation Guide. Technical report. Oregon State University. See discussions, stats, and author profiles for this publication at: https://www.researchgate. net/publication/ 265097991.

**Isac, I. (1986)**. Some aspects of the changes in growth and cropping as aresult of some pruning and training operations in high density apple orchards. Acta Horticulturae, 160 : 129 – 137.

**Kai, X.; Xiao-Hui, S.; Cai-Xia, D. and Yang-Chun, X. (2013).** Effects of different organic fertilizers on tree growth and soil property in Huangguan pear orchard. Journal of Plant Nutrition and Fertilizers. 19(1): 221-230.

**Kang, Y.; Ma, Y.; An, X.; Kan, L.; Xie, C.; Mei, X.; Wang, Z.; Xu, Y. and Dong, C. (2022).** Effects on the root morphology and mircostructure of young pear (Pyrus pyrifolia) tree by split-root supply of bioorganic and chemical fertilizer. Rhizosphere, 22, https://doi.org/10.1016/j.rhisph.2022.100504.

**Khamis M.A.; Sharaf, M.M.; Ali, M.M. and Mokhtar, O.S. (2018).** The impact of NPK mineral, bio-organic fertilizers and some stimulants on flowering and fruiting of Le-Conte pear trees. Middle East J. Agric. Res., 7(2): 315-330.

**Khan Esakkiammal, B.; Lakshmibai, L. and Sornalatha, S. (2015).** Studies on the combined effect of vermicompost and vermiwash prepared from organic wastes by earthworms on the growth and yield parameters of delicious lab. Asian Journal of Pharmaceutical Science & Technology, 5 (4): 246-252.

**Katayama, H.; Amo, H.; Wuyun, T.; Uematsu, C. and Iketani, H. (2016).** Genetic Structure and Diversity of the Wild Ussurian Pear East Asia. Breeding Sci., 66: 90-99.

**Lang, G.A.; Early, J.D.; Martin G.C. and Darnell, R.L. (1987)**. Endo, para and ecodormancy. Hort. Sci., 22: 371 – 377.

**Lilleland, M.K. and Brown, J.D. (1946).** Rapid determination of potassium and sodium in plant materal and soil extracted by flam photometer. Proc. Amer. Soc. Hort. Sci., 48: 341- 346.

**Lindsay, W.L. and Norvell, W.A. (1978).** Development of a Dtpa Soil Test for Zinc, Iron, Manganese, and Copper. Soil Science Society of America Journal, 42: 421-428.

**Martin, J.P. (1950).** Use of acid Rose Bengal and Streptomycin in the plate method for estimating soil fungi. Soil Sci., 69: 715-732.

**Mohamed, S.A. and Massoud, O.N. (2017).** Impact of Inoculation with Mycorrhiza and Azotobacter under Different N and P Rates on Growth, Nutrient status, Yield and Some Soil Characteristics of Washington Navel Orange Trees. Middle East J. Agric. Res., 6(3): 617-638.

**Moreira, A.V.; Oliveira, C.E.S.; Jalal, A.; Gato, I.M.B.; Oliveira, T.J.S.S.; Boleta, G.H.M.; Giolo, V.M.; Vitória, L.S.; Tamburi, K.V. and Filho, M.C.M.T. (2022).** Inoculation with Trichoderma harzianum and Azospirillum brasilense increases nutrition and yield of hydroponic lettuce. Archives of Microbiology, 204:440 https://doi.org/10.1007/s00203-022-03047-w.

**Okba, S.K.; Abo Ogiela, H.M.; Mehesen, A.; Mikhael, G.B.; Alam-Eldein, S.M. and Tubeileh, A.M.S. (2025).** Influence of Compost and Biological Fertilization with Reducing the Rates of Mineral Fertilizers on Vegetative Growth, Nutritional Status, Yield and Fruit Quality of ‘Anna’ Apples. Agronomy 2025, 15, 662. https://doi.org/10.3390/agronomy 15030662.

**Prasad, H.; Sajwan, P.; Kumari, M. and Solanki, S. (2017).** Effect of Organic Manures and Biofertilizer on Plant Growth, Yield and Quality of Horticultural Crop: A Review. Inter. J. of Chemical Studies, 5 (1): 217-221.

**Rice, E.W.; Baird, R.B. and Eaton, A.D. (2017).** Standard Methods for Examination of Water and Wastewater, 23rd Edition. American Public Health Association (APHA), American Water Works Association (AWWA), Water Environment Federation (WEF), USA, 1796 p.

**Ritchie, R.J. (2008).** Universal chlorophyll equations for estimating chlorophylls a, b, c, and d and total chlorophylls in natural assemblages of photosynthetic organisms using acetone, methanol, or ethanol solvents. Photosynthetica. 46 (1): 115-126.

**Sinha, S.K.; Kumar, A.; Kumari, A. and Singh, A.K. (2024).** The Integrated Effect of Organic Manure, Biofertilizer and Inorganic Fertilizer on Soil Properties, Yield and Quality in Sugarcane Plant-ratoon System under Calcareous Soil of Indo-gangetic Plains of India. J. Sci. Res. Rep., (30)5: 193-206, Article no. JSRR.114404.

**Skujins, J. (1976).** Extracellular enzymes in soil-CRC. Crit. Rev. Microbiol., 4: 383-421.

**Soliman, G.M. (2020).** Graft compatibility between Florida prince peach cultivar and new Almond X Peach Hybrid rootstocks. journal of horticultural science & ornamental plants 12 (2): 77-85.

**Tabatabai, M.A. (1982)**. Soil Enzymes. In: Page, A.L., R.H. Miller and D.R. Keeney (eds.), Methods of soil Analysis (part 2). Chemical and microbiological properties. Am. Soc. For Agronomy, Madison, PP. 903-947.

**Talwar, D.; Singh, K. and Singh, J. (2017).** Effect of biofertilizers on soil microbial count, nutrient availability and uptake under November sown onion. J. Appl. & Nat. Sci. 9 (1): 55 – 59.

**Walia S.S and Kler D.S. (2009)**. Organic versus chemical review farming- A. Journal of Research Punjab Agric. Univ 46 (3& 4): 114-26.

**Wang, Z.; Yang, T.; Mei, X.; Wang, N.; Li, X.; Yang, Q.; Dong, C.; Jiang , G.; Lin, Y. Xu, J.; Shen, Q.; Jousset, A. and Banerjee, S. (2022).** Bio-Organic Fertilizer Promotes Pear Yield by Shaping the Rhizosphere Microbiome Composition and Functions. National Library of Medicine., doi:10.1128/ spectrum.03572-22.

**Wei, S. (1987).** The effect of shoot bending on flower bud formation in young apple trees and bio-chemical changes in the treated shoots. Act horticulture science, 14 (3): 161 – 168.

**Westwood, M.N. (1978).** Temperate-Zone-Pomology. W.H. Freeman Comp., San Francisco, USA.

**Williams, S.T. and Davis, F.L. (1965).** Use of antibiotics for selected isolation and enumeration of actinomycetes in soil. J. Gen. Microbiol., 38: 251-261.

**Yu, G., Luo, H.Y.H., Wu, M.J., Tang, Z., Liu, D.Y., Yang, X.M. and Shen, Q.R. (2010).** Parafac modeling of fluorescence excitation-emission spectra for rapid assessment of compost maturity. Bioresource. Technol., 101: 8244- 8251.

**Yu, Y.; Zhang, Q.; Kang, J.; Xu, N.; Zhang, Z.; Deng, Y.; Gillings, M.; Lu, T. and Qian, H. (2025).** Effects of organic fertilizers on plant growth and the rhizosphere microbiome. Applied and Environmental Microbiology., 90 (2):1-14.

# تأثير التسميد العضوى والحيوى فى تعزيز النمو الخضرى لشتلات الكمثرى صنف بساتين MKM تحت ظروف الزراعه الكثيفة

**أسامة سعد مختار[1]، ألاء سامى عبدالرحمن[1]، رامي مسعد الخياط[2]**

**1- قسم بحوث الفاكهة متساقطة الأوراق، معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر.**

**2- قسم بحوث الميكروبيولوجيا الزراعية، معهد بحوث الآراضى والمياه، مركز البحوث الزراعية، الجيزة، مصر.**

أُجـريت التجـربة خـلال موسـمين متتالـيين (2024/2023 و2025/2024) عـلى 72 شتلـة كـمثرى (*Pyrus communis*) مطعومة على أصل *Pyrus betulaefolia* بعمر سنتين، مزروعة في تربة طينية بمزرعة المعهد البحثي

للبساتين بمسافه 1.5 × 2.0 م . هدف التجربة هو تقييم تأثير بدائل التسميد الكيميائي على النمو الخضري والكفاءة الغذائية للشتلات، من خلال دمج السماد العضوي والمخصبات الحيوية مع مستويات مخفضة من الأسمدة المعدنية (NPK). شملت المعاملات ثمانية توليفات تجمع بين مستويين من NPK (50 % و 100 %) من الجرعة الموصى بها، (ومستويين من الكمبوست) مكافئين لنفس النسب، بالإضافة إلى ثلاث مستويات من التسميد الحيوي باستخدام *Azospirillum brasilense*، *Bacillus circulans*، *Trichoderma harzianum*، وفطريات المايكورايزا (AMF).

أظهرت النتائج أن المعاملة الثامنة "T8" NPK 50% + 50%كمبوست + 200 مل/شجرة من خليط *Azospirillum brasilensem* و*Bacillus circulans* و *Trichoderma harzianum* + 200 جم/شجرة من (AMF) كانت الأكثر كفاءة، حيث حسّنت بشكل معنوي جميع الصفات المدروسة مثل الطول، القطر، عدد الأفرع، مساحة الأوراق، والكلوروفيل الكلي. كما ارتفعت تراكيز العناصر الغذائية نيتورجين، فوسفور، بوتاسيوم وكالسيوم في الأوراق، وزادت الأنشطة الميكروبية في التربة المحيطة بالجذور، حيث وصلت أعداد البكتيريا إلى $95 \times 10^5$ CFU/g والأكتينوميسيتات إلى $141 \times 10^3$ CFU/g والفطريات إلى $97 \times 10^3$ CFU/g، وبلغت أنشطة إنزيمات الديهدروجينيز والفوسفاتيز 106.55 و 0.57 على التوالي.

تُظهر الدراسة أهمية دمج التسميد العضوي والحيوي في تحسين نمو شتلات الكمثرى وتقليل الاعتماد على الأسمدة الكيميائية، مما يدعم ممارسات الزراعة المستدامة تحت الظروف المصرية.