The equation for adding different levels of chemical fertilizer and its effect on strawberry productivity under organic groundcovers

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Abstract

The experiment was carried out with the aim of rationing the use of manufactured chemical fertilizers through the application of some terrestrial organic additives in the production of Rubygem strawberries grown in greenhouses. The first factor included the addition of two types of organic materials (palm fiber and Nile flower compost) and its code H1 and H2, as well as the comparison treatment H0, while the second factor included the addition of chemical fertilizer with three levels (100%, 50% and 25% of the recommendation for NPK fertilizer) and its code F1, F2 and F3, respectively, after taking measurements and analyzing data statistically showing significant differences of the organic addition factor in most the use of palm fiber surpassed the percentage of vegetable and root dry matter, and the treatment of adding Nile flower compost surpassed the percentage of phosphorus and potassium, the number of fruits of the plant, the size of the fruit cm3 and the total yield kg bet-1. As for chemical composting, both the F1 and F2 treatments were superior in the plastic House quotient. The H2F3 interference treatment was significantly superior in the percentage of nitrogen, phosphorus and potassium, and the H2F2 treatment was significantly superior in the number of fruits, one and the yield of the plastic House. Therefore, we conclude that terrestrial organic additives play a role in the possibility of rationing the amounts of chemical additives and improving the production of strawberry plants.

Keywords: Rubygem strawberry, Nile compost, plant fiber, organic additives, chemical fertilization.

Introduction

The strawberry (Fragaria × ananassa Dutch.) is one of the plants of the Rosaceae family, with delicious, soft, and nutritious fruits that are small in size and have great economic importance [42]. South America is the original homeland of the plant, then its cultivation spread in France and it became one of its important crops [29]. and is now widely grown in Korea, China, Europe, the United States, Japan, Poland, Mexico, Egypt, Turkey, and Spain [14]. Its cultivation has developed in the last two decades due to its good production as well as its economic value, as global production has reached 7.7 million tons annually [19]. The plant is characterized by high nutritional importance, as it is used in many food industries such as yogurt, jams, jellies, juices, sweets, pastries, and ice cream [33]. The fruits contain vitamins, minerals, and organic acids, as well as antioxidants [20], and their red color is due to their content of anthocyanin compounds, pelarogonidin, and 3-monoglucoside [42], and it has anti-cancer and anti-disease activity. Cardiovascular [23.[
Despite the nutritional, medicinal, and economic importance of the strawberry plant, its cultivation requires the provision of large amounts of inputs related to environmental

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pollution, represented by soil and water pollution, such as chemical fertilizers and the use of pesticides [13], because the plant's growth and development is affected by several factors, including factors related to the environment and others. Physiological and nutritional factors, as well as genetic factors [27]. Therefore, one of the most important main goals existing is to encourage research that aims to employ fertilizers and organic additives to reduce the addition of chemical fertilizers. This produces a health-safe result while reducing production costs and reducing the risk of pollution. environmental [43.[

The trend to use natural organic waste is one of the environmentally safe applications in agricultural crop production [2]. And their use as fertilizer can improve and increase the nutrients of crop plant parts [7, 26]. It also improves the physical and chemical properties of the soil and enhances the ability to absorb and transfer nutrients through the roots [22 , 3], and contains a percentage of carbon, nitrogen, and phosphorus [48, 26], and works to increase The microbial activity of the soil, which transforms the elements into a ready-made formula that enables the plant to absorb them easily [24]. In addition, it contains many important substances in plant nutrition, such as humic acid, amino and organic acids, and activates microorganisms, making the soil porous. It has good water retention and keeps nutrients from being lost in washing [37, 47.[

Chemical fertilizers have an important role in agricultural production, and in recent years the global use of these fertilizers has increased [36], as farmers relied on them to provide nutritional requirements for cultivated plants with the aim of maintaining high crop production [28]. However, The increase in their use causes problems and pollution to the environment, such as increased emission of nitrogen oxides, which leads to global warming [38, 46]. In addition to problems related to resources and the environment, such as soil degradation and decreased land production [32], and in order to avoid their problems, their use must be reduced or added in reasonable quantities, because the problem related to agricultural production is not the problem of chemical fertilizers per se, but rather stems from unreasonable use. and unscientific use of chemical fertilizers [9]. In addition, this can be achieved within the framework of organic agriculture programs that rely on the use of organic fertilizers under the legalization of chemical fertilizers, and this technology protects the environment and supports plants [3, 4.[

Due to the importance of the strawberry plant and the increased demand for it and reducing the harmful effects of the accumulation of toxic compounds in plants, in addition to the problems of environmental pollution, the experiment aimed to employ organic fertilizers in plant production and obtain the active substance for the fruits within the minimum limits of chemical fertilizers.

Material and Method

The experiment was carried out in one of the greenhouses affiliated with the horticultural facility at the College of Agriculture/Tikrit University during the fall agricultural season 2023-2024 with the aim of evaluating the efficiency of organic materials in the quantity and quality of strawberry yield of the Rubygem variety under limited fertilization, as the soil of the greenhouse was prepared on 1/10/ 2023, carrying out agricultural operations, including cleaning and removing bushes and weeds, adding soil, then plowing,

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solar sterilization, smoothing and modification operations. The chemical and physical properties of the soil were analyzed in the Ministry of Agriculture-Horticulture Department as shown in Table 1.

Table 1. Shows the physical and chemical characteristics of greenhouse soil.

Soil texture	Soil separations%			Ready N mg kg-1	Ready P mg kg-1	Ready K mg kg-^{1}	pH	EC ds.m-^{1}	Organic matter gm kg-^{1}
	sand	Alluvial	Clay						
	Mixed sandy soil								
Clay loam	64	19	17	27.5	8.3	117.6	7.2	3.2	1.24

*Chemical analysis of the soil was conducted at the Ministry of Agriculture, Horticulture Department.

R.C.B.D. was applied in implementing the experiment within three sectors (replicates). The experiment included a study of two overlapping factors. The first is organic additives of two types, as well as the comparison treatment (without addition) and its symbol is H0. The first type is the addition of palm fiber mesh, It is obtained from the fiber surrounding the head of the date palm tree (H1). The experimental unit was removed and its bottom was dug to a depth of 5 cm. The fiber was placed in two layers along the length of the experimental unit, then the experimental unit was reshaped on it. The second type of organic applications is adding Nile flower compost (H2) at a rate of 15% (V/V), with the same formula as adding The above treatment and Table 2 show some properties of organic materials.

Table 2. Shows the chemical analysis of Nile flower compost

features	pH	Zn	Fe	Cu	OM	Ca	K	P	N
Values	7.8	129 g kg-1	39.5 g kg-1	30.9 g kg-1	%39.7	3.1 g kg-1	%3.1	%1.3	%1.4

*The chemical analysis of Nile Flower compost was conducted at the Ministry of Agriculture - Department of Agricultural Protection.

The second factor represents the use of chemical fertilizer (NPK) at three levels. The first level is adding the complete fertilizer recommendation, code F1 (according to the recommendation of the prepared company, amounting to 150 kg dunam-1). The second level is adding half (0.5) of the recommendation (F2), and the third level is Add a quarter (0.25) of recommendation (F3.(They were added by digging a slit 5 cm deep, for the experimental units included in the addition according to the design used. Then the seedlings were planted on 17/10/2023, with eight plants in each treatment, alternately, with a distance of 20 cm between one plant

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and another. The seedlings were irrigated after planting, then followed up and agricultural necessary. Early flowers were removed for a month for the purpose of encouraging vegetative and root growth of the seedlings. On May 1, 2024, the following characteristics were measured:

-The percentage of dry matter in the total vegetables and roots by taking five plants from each experimental unit and measuring their weight. Then they were placed in an electric oven at a temperature of 70°C until the weight was stable. Their dry weight was measured and the equation % of dry matter = (dry weight/wet weight) × 100 [6.[

-The total yield of fruits is calculated on the basis of the greenhouse (kg per greenhouse) according to the production of the greenhouse based on the production of one plant and the number of plants in the greenhouse according to the following equation:

The total yield of the house = the yield of one seedling x the number of plants in the house

-The number of fruits per plant (plant-1 fruit). Data were taken from the start of harvesting the fruits until the last harvest of the plants of the experimental unit, after which the average number of fruits per plant was according to the following equation:

Number of fruits per plant = total number of fruits per experimental unit plants / number of plants per experimental unit.

-Fruit size (mm) The average fruit size was calculated using the method of water displaced from a graduated glass cylinder.

-Measuring the percentage of nitrogen in the leaves (%): using a Microkaldahl device based operations were carried out whenever

on the method mentioned by van Dijk and Houba [44.[

-Measurement of the percentage of phosphorus in leaves (%): The plant's phosphorus content was measured based on the method presented (Chapman and Pratt, 1961). Using a spectrophotometer.

-Measuring the percentage of potassium in the leaves (%): Potassium was measured based on APHA [8] using an atomic absorption device (SHEMADZU AA 7000.(

Results and Discussion

-1Percentage of dry matter in the shoot(%)

The results of the statistical analysis listed in Figure 1 showed that there were significant differences between the levels of the first factor (organic addition), as the H1 treatment was significantly superior, with the highest value amounting to 35.07% compared to the H2 treatment, which recorded the lowest value amounting to 32.04%. The figure data showed significant differences for the treatments of the second factor (chemical fertilization), as the addition treatments F2 and F3 were significantly superior, with the highest values reaching 33.93 and 33.44% compared to the F1 treatment, which recorded the lowest value reaching 32.63%. It was also observed from the same figure that there were significant differences between the binary interference treatments, as the binary interference treatment H1F1 and H1F3 recorded the highest value of 35.33 and 35.89% compared to the H0F1 treatment, which gave the lowest value of 30.67%.

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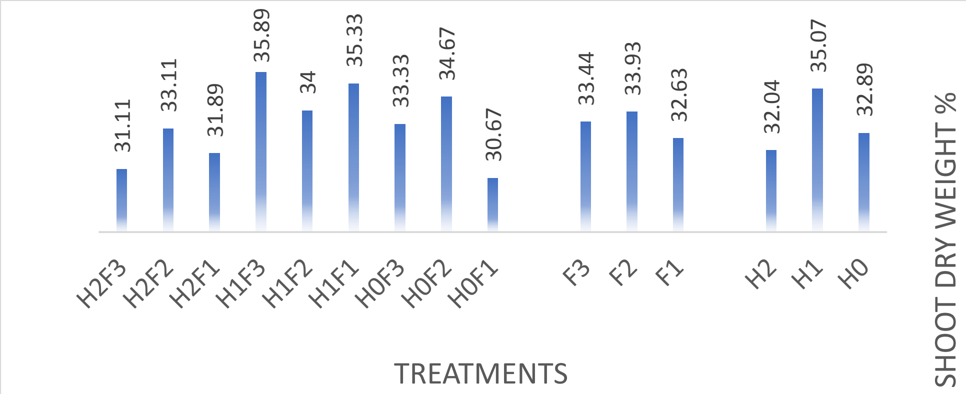

Figure 1. The role of organic additions and chemical fertilizers in the percentage of dry matter of the shoots%

-2Percentage of dry matter in the root system(%)

The results of the statistical analysis are shown in Figure 2. There are significant differences between the treatments of the first factor (organic addition). The H0 and H1 treatments were significantly superior, with the highest values reaching 41.32 and 41.32%, respectively, compared to the H2 treatment, which recorded the lowest value of 40.25%. The coefficients of the same figure showed significant differences for the coefficients of the second factor, as the addition treatment F3 was significantly superior with the highest value amounting to 41.44% compared to the treatment F1 which recorded the lowest value amounting to 39.73%. It was also noted from the same figure that there were significant differences between the binary interference treatments at H and F, as treatment H0F2 recorded the highest value of 42.83% compared to treatment H1F1, which gave the lowest value of 38.86%.

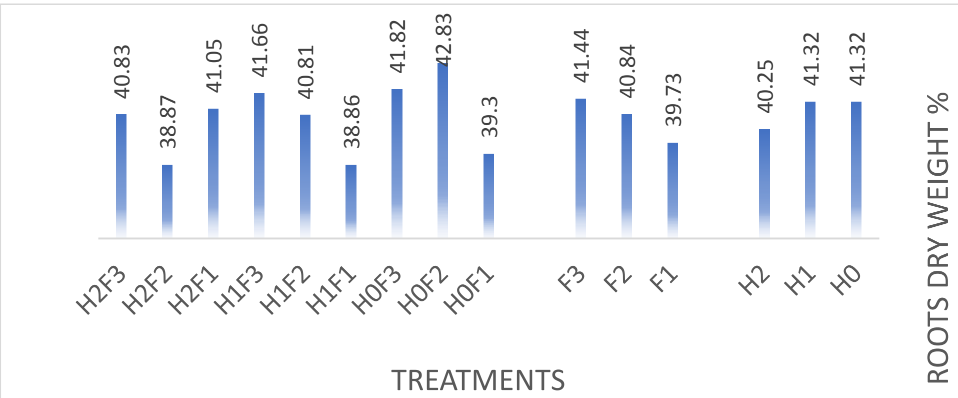

Figure 2. The role of organic additions and chemical fertilizers in the percentage of dry matter in the root system%

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The results of Figures 1 and 2 show a significant improvement in vegetative traits as a result of additions of organic matter, which plays an important role in providing nitrogen [5], as it affects and changes many enzymatic activities in plants that enhance cell elongation, root and shoot development, and glucose metabolism [41], thus leading to an increase in the leaf area and number of leaves, which results in a larger size and thus a higher dry matter percentage in the leaves and roots. The results were consistent with the findings of Sharma and Negi [40] in a study they conducted on the strawberry plant, Shimla cultivar. The results were consistent with the findings of Sharma et al. [41] in a study they conducted on the kiwi plant, Actinidia deliciosa, Allison cultivar. The results of Figures (1 and 2) show a significant improvement in vegetative traits as a result of the use of NPK chemical fertilizers to increase the total area of leaves, because the use of fertilizers mainly increases the size of leaves, while phosphorus fertilizers mainly increases the number of leaves [41]. . The increase in leaf area is also due to an increase in the average number and size of cells, and a faster rate of cell growth due to increased .
availability of nitrogen [16]. The increase in the available nitrogen content resulting from the addition of chemical fertilizers may be attributed to the increased proliferation of microbes in the soil during mineralization, as it thus changes the nitrogen bound to organic molecules to nitrogen bound to inorganic molecules. This makes access to nitrogen in the soil easier, and different sources of nitrogen and carbon are used. Organic fertilizers, as well as compost, build up nitrogen and organic carbon in the soil [41]. The results agreed with the findings of Choi et al. [15] in an experiment they conducted on strawberry cultivar Kuemsil.

-3Total fruit yield calculated on the basis of the greenhouse (kg per greenhouse-1.(

The results of the statistical analysis, whose data is listed in Figure 3, showed that there were no significant differences for the levels of workers, first and second. While the same figure shows that there are significant differences between the binary interference treatments, as the H2F2 treatment was significantly superior and gave the highest value of 1268 kg B-1 compared to the H1F2 treatment which gave the lowest value of 1059 kg B-1

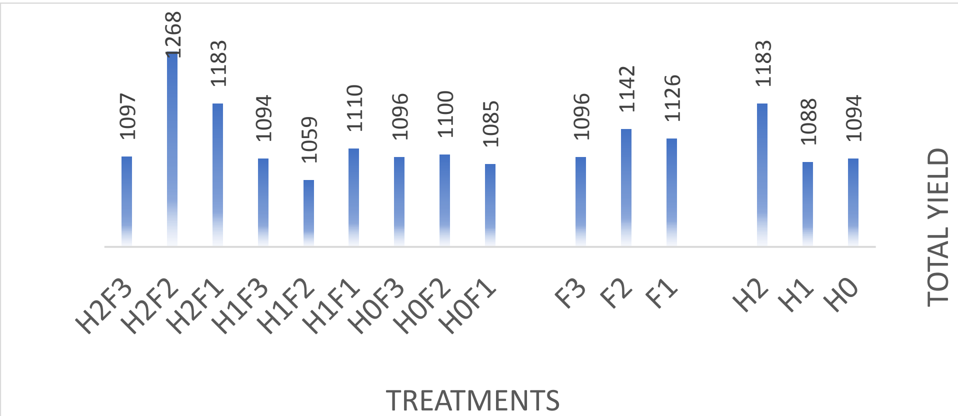

Figure 3. The role of organic additives and chemical fertilizers in the yield of the greenhouse, kg Pet-1.

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-4Number of fruits per plant (fruit per plant - 1.(

The results shown in Figure 4 show that there are significant differences between the treatments of the first factor (organic addition). The H2 treatment was significantly superior, with the highest value reaching 28.89 fruits per plant, compared to the comparison treatment H0, which recorded the lowest values, reaching 26.96 fruits per plant. While the shape parameters showed no significant differences for the second factor treatments. We find in the same figure that there are significant differences between the binary interference treatments, as the treatments H0F3, H1F1 and H2F2 recorded the highest values (29.00, 29.33 , 30.33 plant fruit-1) respectively compared to the treatment H0F1, which gave the lowest value of 24.89 plant fruits-1

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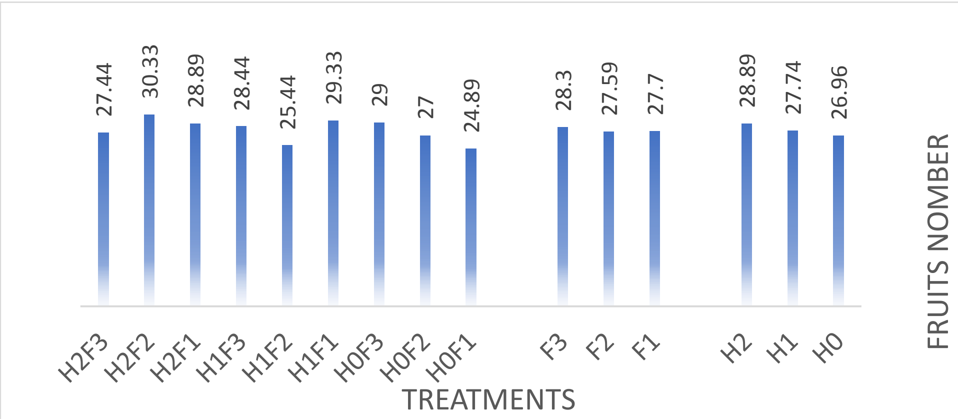

Figure 4. The role of organic additives and chemical fertilizers in the number of fruits. Plant-1

-5Fruit size (cm3(

The results are shown in Figure 5. There are no significant differences between the levels of the individual factors. As for the interaction, it was significant, as treatments H0F1, H1F2, and H2F3 recorded the highest averages, reaching 18.22, 17.56, and 17.33 mm, respectively, compared to treatment H1F3, which gave the lowest value of 16.22 mm

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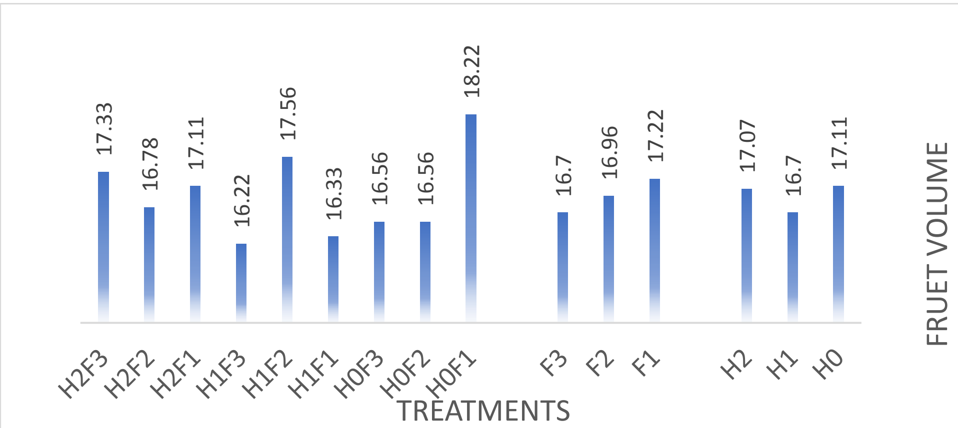

Figure 5. The role of organic additives and chemical fertilizer on fruit volume cm3

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The results of Figures (3, 4 , 5) show a significant superiority in the characteristics obtained as a result of additions of organic matter. They play an important role in improving the soil of the earth by increasing the content of organic matter in it. This enhances the structure of the soil and enhances the soil's ability to retain water and nutrients. Organic additives in the soil also have an important role, as they are the source of nutrients and energy necessary for the work of microorganisms in the soil [21], and when they decompose, the microorganisms produce enzymes, thus determining the level of soil productivity [25]. And this indicator of the activity level of microorganisms in the soil is soil respiration [35]. The results are consistent with the findings of Sharma and Negi [40] in a study they conducted on strawberry cultivar Shimla. The results were consistent with the findings of Balci and others [12], a study they conducted on four strawberry varieties (Camarosa, Sweet Charlie, Redlands Hope and Fern) during two seasons 2010 and 2011. The results of Figures (3, 4 , 5) show a significant superiority in yield characteristics as a result of The role of organic matter in organic additions that improve the rate of use of chemical fertilizers by improving the soil's ability to retain water and moisture in high areas, which leads to improved absorption of macro- and micro-nutrients in the soil [10].
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The results were consistent with the findings of EL-Gioushy and others [17] in a study they conducted on 13-year-old Fagri Kalan mango trees during the 2016 and 2017 seasons, and were consistent with the findings of EL-Khwaga and others [18] in a study they conducted on the navel orange plant. A restaurant based on Naranj origins for 9 years and for two consecutive seasons, 2018 and 2019.

-6Percentage of nitrogen in leaves(%)

The results of the statistical analysis showed in Figure 6. There are significant differences between the treatments of the first factor (organic addition). The H2 treatment was significantly superior, with the highest value amounting to 1.38%, compared to the comparison treatment H0, which recorded the lowest value amounting to 1.14%. While the coefficients of the same form showed significant differences for the coefficients of the second factor, as the F1 treatment was significantly superior with the highest value amounting to 1.38% compared to the F3 treatment which recorded the lowest value amounting to 1.19%. It was also observed from the same figure that there were significant differences between treatments H and F, as treatment H2F1 recorded the highest value of 1.44% compared to treatment H0F3, which gave the lowest value of 1.07%

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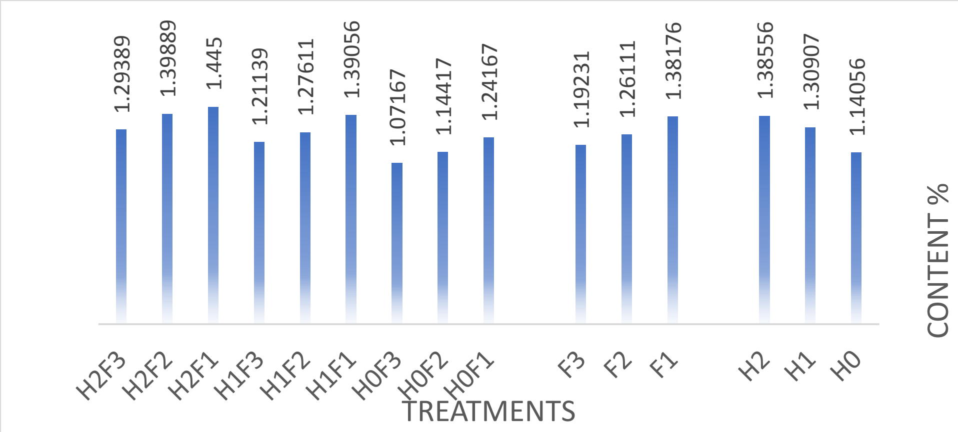

Figure 6. The role of organic additives and chemical fertilizer in the percentage of nitrogen%

-7Percentage of phosphorus in leaves(%)

The results of the statistical analysis are shown in Figure 7. There are significant differences between the factor treatments (organic addition). The H2 treatment was significantly superior, with the highest value amounting to 0.04%, compared to the comparison treatment H0, which recorded the lowest value amounting to 0.03%. While the shape parameters showed significant differences for the second factor treatments, as treatment F1 was significantly superior with the highest value amounting to 0.04% compared to treatment F3 which recorded the lowest value amounting to 0.03%. It was also noted from the same figure that there were significant differences between the H and F parameters, as the H1F1 and H2F1 parameters recorded the highest values, amounting to 0.046 and 0.047%, respectively, compared to the parameters H0F2 and H0F3, which gave the lowest values, amounting to 0.033 and 0.032%, respectively.

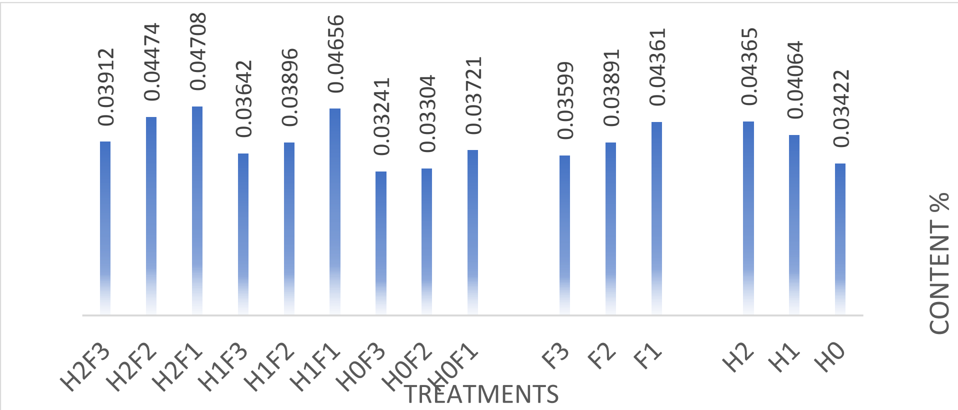

Figure 7. The role of organic additives and chemical fertilizer in the percentage of phosphorus %

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-8Percentage of potassium in leaves(%)

The results are shown in Figure 8. There are significant differences between the factor treatments (organic addition). The H2 treatment was significantly superior, with the highest value amounting to 1.58%, compared to the comparison treatment H0, which recorded the lowest value amounting to 1.26%. While the shape parameters showed significant differences for the second factor treatments, as the F1 treatment was significantly superior, with the highest value amounting to 1.58%, compared to the F3 treatment, which recorded the lowest value amounting to 1.33%. It was also observed from the figure that there were significant differences between the H and F treatments, as the H2F1 treatment recorded the highest value of 1.69% compared to the H0F3 treatment, which gave the lowest value of 1.20%.

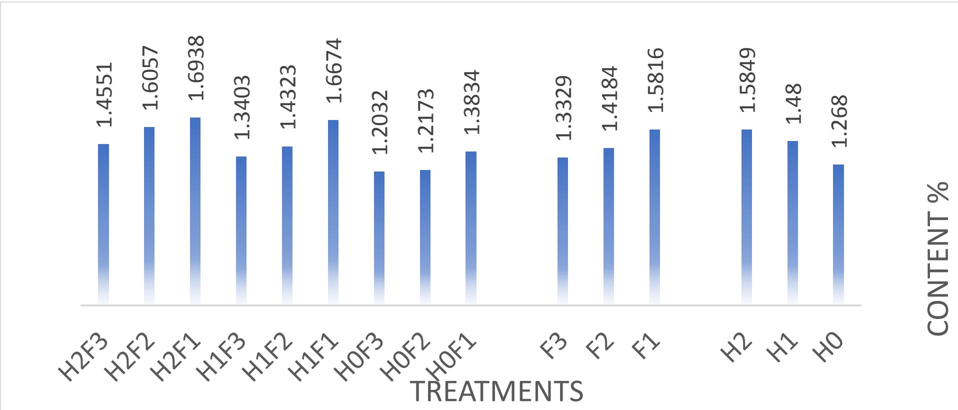

Figure 8. The role of organic additives and chemical fertilizer in the percentage of potassium %

The results of Figures (6, 7 , 8) show a significant improvement in the chemical characteristics of the organic additions. They work to increase the availability of macro- and micro-nutrients in the leaves resulting from the organic addition and thus improve the physical condition of the soil and the development of the roots by increasing moisture retention and thus increasing the absorption of water and nutrients. Enhancing the activities of microorganisms with organic addition, thus, nitrogen uptake is increased and organically bound nitrogen is changed to inorganic form in plants [31]. It also improves the chemical properties of the soil and enhances the ability to absorb and transfer nutrients through the roots [22]. The role of organic additions may be attributed to their higher carbon, nitrogen, phosphorus, and microbial biomass content in the soil, leading to a more intense nitrogen cycle in the soil [26], and increased soil microbial activity, converting already available nitrogen, phosphorus, and potassium into forms It can be easily absorbed by plants, thus improving soil productivity [24]. The high phosphorus content observed in the leaves can be attributed to what organic additives cause in plants through the generation of oxalic acid, thus leading to the provision of free phosphorus and helping in increasing phosphorus uptake by plants [41]. The results were consistent with the findings of Ye et al. [49] in a study they conducted on dwarf jujube pear trees. I also agreed with the findings of

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Sayğı [39] in a study she conducted on the Albion strawberry plant.
The results of Figures (6, 7 , 8) show a significant improvement in the chemical characteristics as a result of additions of organic matter, which plays an important role in increasing the nitrogen content available in soil treatment to the residual effect of chemical fertilizers, as the organic acids that are formed during the decomposition of organic fertilizer interact to convert non-phosphorus. Available in the soil into readily available forms, which accelerates the decomposition of organic matter in the original soil, thereby increasing mineralization and release of nutrients, which increases the NPK content in the soil [34, 45]. Thus, chemical fertilizers stand out as they deliver nutrients to the plant easily, which helps increase growth and production [11]. It agreed with the findings of Laita et al. [30] in an experiment they conducted on the peach plant, Prunus domestica, variety Angelino. The results were consistent with the findings of Abdulkadhim and Hussein [1] that adding chemical fertilizers to strawberry plants of the Rubygem variety.

Conclusion

Through the results of the study, it was found that there is a possibility of reducing the addition of chemical fertilizer based on organic additives (Nile flower compost) . because of their impact on achieving good productivity and close to the recommended levels

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