The Effect of Different Levels of Nitrogen, Phosphorous and Potassium in Some Growth Properties of Rosa Damascena Mill L.

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Abstract

The experiment was conducted on cuttings of Rosa damascena mill L. During the period from mid-March of 2014 until the end of 2015 before the period of formation of flowers for picking at the College of Agriculture / University of Karbala. According to the design of complete random sectors, The research included a global experiment with three different factors of the first chemical fertilizer nitrogen fertilization and three levels (0, 0.5 and 1 gm N. Kg⁻¹ soil) and fertilization with the element phosphorus with three levels (0, 15 and 30 mg P₂O₅. Kg⁻¹ soil) and three levels of Potassium (0, 100 and 200 mg K₂O. Kg⁻¹ soil). The results showed that the single effect of the fertilization treatment with nitrogen, phosphorous, and potassium resulted in a significant increase in the characteristic of plant height and number of leaves, and the fertilization treatment with nitrogen and phosphorous component separately resulted in the production of seedlings that were characterized by a high dry green weight compared to the comparison treatment. The data of the bilateral overlap between nitrogen and phosphorous indicate the presence of significant differences, as the treatment with nitrogen component gave a concentration of (0.5 and 1 g. Kg⁻¹) overlapping with the component of phosphorus concentration (30 mg. Kg⁻¹) with the highest significant rate of (39.66 cm). The treatment of the triple interference between nitrogen, phosphorous, and potassium gave a significant effect on all the studied traits.

Word key: Nitrogen, Phosphorous, Potassium, Chemical fertilizer, Rosa damascene.

1. Introduction

Rose is a woody, dendritic plant that belongs to the family Rosaceae, genus Rosa and is comprised of 200 species worldwide [1]. Among the total genotypes of roses, only 20 are known for their high attractiveness in terms of flowers [2]. The Rosa damascena mill L. commonly known as Damask rose [3], has been occupying since ancient times and still has a prominent position among the various ornamental plants, and almost no public or private garden is devoid of this beautiful plant. It is characterized by many specifications in terms of beauty, environment, and economy. Roses are immensely important for landscaping and no garden is considered complete without roses [4].

The Rosa damascena mill L. is one of the most important species of Rosaceae family flowers. R. damascena is an ornamental plant and perfuming effect, several pharmacological properties including anti-HIV, antibacterial, antioxidant, antitussive, hypnotic, antidiabetic, and relaxing effects on tracheal chains have been reported for this plant. This article is a comprehensive review of the pharmacological effects of R. damascena [5]. Fertilization plays an important role in compensating the soil for what it has lost from the elements necessary for growth. Fertilization affects different effects commensurate with the type of soil, yield, growth factors, method of addition, and other factors. Therefore, the addition of fertilizers is a critical step for raising the productivity of soil from plants.

To improve the growth of the produce, it is necessary to pay attention to the optimum balanced use of nutrients through fertilizer application [6]. Fertilizers play a key role in the production of both quantity and quality of Rose. Rose plants should be provided with adequate fertilizer Nitrogen, Phosphorous and Potassium are these the main elements that affect the growth, yield, and quality of Rose plants. N is a part of the chlorophyll (the green pigment in leaves) and is an essential constituent of all proteins. It is responsible for the dark green color of stem and leaves, vigorous growth, branching, leaf production. P is essential for growth, cell division, root lengthening, seed and fruit development, and early ripening. It is a part of several compounds including oils and amino acids. The P compounds adenosine diphosphate (ADP) and adenosine triphosphate (ATP) acts as energy carriers within the plants. K is involved in the working of more than 60 enzymes, in photosynthesis and the movement of its products (photosynthates) to storage organs (seeds, tubers, roots, and fruits), water economy, and providing resistance against several pests, diseases, and stresses (frost and drought). It plays a role in regulating the stomatal
opening and, therefore, in the internal water relations of plants [7]. This study aims to use different levels of nitrogen, phosphorous, and potassium chemical fertilizers to find out the effect of the interaction between them on the growth of the shrub rose.

2. Materials and Methods

The study was conducted on Rosa damascena mill. bush roses during the period from mid-March of 2014 until the end of 2015 at the College of Agriculture / University of Karbala located in Al-Hussainiya district - Holy Karbala governorate at the intersection of longitude 44° 06’ 58” east and latitude 32° 32’ 17” N, at an altitude of 29 m above sea level. The cuttings its average length of (10 cm) approximately were taken from seedlings with an average age of three years from the newly formed soft branches.

The research included a factorial experiment with three different factors of the first chemical fertilizer, nitrogen fertilization (urea 46%), three levels (0, 0.5, and 1 g. kg⁻¹ soil), and three levels of phosphorous (tri-super phosphate 45%) are (0 and 15 and 30 mg P₂O₅. Kg⁻¹ soil) and three levels of potassium (potassium sulfate 41.5%) are (0, 100 and 200 mg K₂O. kg⁻¹ soil). The experiment was designed in a randomized complete block method (RCBD) with three replications, so the experiment is factorial with three factors (3 x 3 x 3), so the number of transactions is 27 treatments, and the number of experimental units is 81 experimental units, and each experimental unit consists of ten observations, and the data were analyzed statistically according to the design of the experiment Using the electronic calculator and SAS program for statistical analysis, the arithmetic means of the coefficients were compared statistically according to Duncan's Multiple Range Test. Ash content was determined by the procedure by [8]. Two grams of powdered leaves were taken from the studied species and placed in a ceramic vase and burned in the oven at a temperature of 600 º C until the sample color turned to the slanted gray to the white and then left until cold and then weighed. The percentage of ash in the leaves was estimated based on dry weight according to the following equation (3)

\[
\text{Weight of ash} \times 100
\]

\[
\text{Dry sample weight}
\]

The chemical and physical analysis of some soil properties used in the experiment before planting was carried out in the laboratories of Karbala Agriculture Directorate as shown in Table (1).

Table 1. Some physical and chemical properties of the soil sample.

| Clay | Silt | Sandy | N% | K⁺ ppm | Na⁺ ppm | Mg²⁺ Ppm | Ca²⁺ Ppm | E.C | pH | Sample number |
|------|------|-------|----|--------|---------|----------|----------|-----|----|----------------|
| 4%   | 6%   | 90%   |    |        |         |          |          |     |    |                |
| Soil Texture Sandy | 0   | 142   | 730 | 25.5   | 183.8   | 1.1      | 7.4      | 1   |    |                |

3. Results and Discussion

3.1. Effect of fertilization on seedling height

The data in Table (2) shows that there are significant differences, as the treatment with nitrogen element concentration (0.5 and 1 g. kg⁻¹) worked to produce seedlings characterized by the height of the plant at a rate of (33.88 and 35.77 cm), respectively, with a significant difference from the comparison treatment Which gave the lowest average (28.63 cm).

The reason for this is that nitrogen has the main role in the formation of various proteins and amino acids, which have an important and essential role in cell division and elongation, and thus led to giving distinct lengths to plants that were treated with this element [9]. The data of the binary interaction between nitrogen and phosphorous elements indicate significant differences, as the treatment with nitrogen element gave a concentration (0.5 and 1 g. kg⁻¹) overlapping with the phosphorous element (30 mg. kg⁻¹). The highest significant rate of (39.66 cm) compared to the comparison treatment gave the lowest average (28.00 cm). Whereas, the interaction treatment between nitrogen and potassium at a concentration of (1 g. kg⁻¹) and (100 mg. kg⁻¹), respectively, gave the highest significant rate of (39.66 cm) compared to the interaction treatment between nitrogen at a concentration of (0 g. kg⁻¹). The potassium element had a concentration of (100 mg. kg⁻¹), which gave the lowest rate of (28.00 cm). While the triple interaction treatment of nitrogen, phosphorous, and potassium at a concentration of (0.5 g. kg⁻¹), (15 mg. kg⁻¹) and (0 mg. kg⁻¹) respectively gave the highest significant rate of (41.33 cm) compared to the triple interaction treatment. The three nutrients with concentrations (0 g. kg⁻¹), (0 mg. kg⁻¹) and (200 mg. kg⁻¹), gave the lowest rate of (26.33 cm). The reason for this is that the fertilizer combination with the presence of nitrogen gave the best height for plant growth. However, in the absence of nitrogen, there was no distinct height for the vegetative total of the plant. Nitrogen has the main role in the formation of various proteins and amino acids that have an essential role in cell division and elongation. Thus, it leads to show distinct lengths for treated plants [10]. Phosphorous also gives the plant strength in growth and works...
to increase the number of branches and to strengthen the root group [11], and potassium has a role in the regulatory and catalytic action of more than 60 enzymes in the plant (6).

Table 2. Effect of different concentrations of nitrogen, phosphorous, and potassium, and the interaction factors on the height of the rose plant (cm).

| Nitrogen concentration (g. Kg⁻¹) | Phosphorous concentration (mg. Kg⁻¹) | Potassium concentration (mg. Kg⁻¹) | Average overlap between nutrient phosphorous | Average effect of nitrogen |
|---------------------------------|-------------------------------------|----------------------------------|--------------------------------------------|---------------------------|
| 0.0                             | 0.0                                 | 0.0                              | 28.00 c                                    |                           |
| 15                              | ab                                  | ab                               | 28.63 b                                    |                           |
| 30                              | 27.33                               | 30.00                            | 28.22 c                                    |                           |
| 0.0                             | 29.33                               | 30.00                            | 29.55 b                                    |                           |
| 0.5                             | 15                                  | 30.00                            | 32.44 bc                                   | 33.88 a                   |
| 1                               | 41.33                               | 37.33 ab                         | 39.66 a                                    |                           |
| 0.0                             | 37.00                               | 36.33 ab                         | 36.55 ab                                   |                           |
| 1                               | 34.00                               | 41.00 a ab                      | 38.22 a                                    | 35.77 a                   |
| 30                              | 31.33                               | 33.33 ab                         | 32.55 abc                                  |                           |
| The average effect of potassium | 32.48 a                             | 33.03 a                          | 32.77 a                                    |                           |
| 0.0                             | 29.11                               | 28.77 bc                         | 28.88 c                                    |                           |
| The overlap between nitrogen and potassium | 0.5                              | 34.22 abc                        | Average effect of phosphorous               |                           |
| 1                               | 34.11 abc                           | 36.88 a ab                       |                                            |                           |
| The overlap between phosphorus and potassium | 0.0                              | 32.11 a abc                      |                                            | 31.37 a                   |
| 15                              | 32.00 a abc                         | 33.44 a abc                      |                                            | 33.44 a                   |
| 30                              | 33.33 a abc                         | 34.00 a abc                      |                                            | 33.48 a                   |

3.2. Effect of fertilization on the number of leaves for seedlings

The results of Table (3) showed that the increase in nitrogen concentration led to a significant increase in the number of leaves/plants. The concentration (1 g. kg⁻¹) gave the highest significant rate of (20 leaves) compared to the comparison treatment (14 leaves). However, no significant differences were observed between all the used concentrations of potassium. But the data indicated the superiority of the concentration (30 mg. kg⁻¹) of the phosphorous element in this trait, with an average of (20 leaves) that reached the level of significance compared to the comparison treatment (14 leaves). This indicates that the phosphorous element has an important role in giving a distinct vegetative.

The data of the binary interaction between the studied factors indicate that some of the interaction coefficients between nitrogen and phosphorous led to a significant increase in the number of leaves/plants. The interaction treatment between nitrogen gave a concentration of (0.5 g. kg⁻¹) and a phosphorous element a concentration of (30 mg. kg⁻¹). The highest rate of (24 leaves) of the plant reached the level of significance compared to the treatment of the binary interaction between (0.5 g. kg⁻¹) of nitrogen element and a concentration (0 mg. kg⁻¹) of the phosphorous element (11 leaves). As for the results of the triple interaction of the studied treatments, the treatment with a concentration (0.5 and 1 g. kg⁻¹) of nitrogen overlapped with a phosphorous treatment with a concentration (30 mg. kg⁻¹) and a potassium treatment with a concentration (0.0 mg. kg⁻¹) that gave the highest rate in the trait. The number of papers reached (25 leaves), but it did not reach the level of significance with the rest of the overlap coefficients.

From these data, we can conclude that the plant benefited from the addition of nitrogen and phosphorous elements present in the fertilizer, and did not benefit from the addition of potassium, as it may have sufficed with the available potassium already ready in the soil before the addition.
The treatment-

concentration (0.5 and 1 g. kg⁻¹) phosphorous and potassium, and the interaction factors on the number of leaves for seedlings.

| Nitrogen concentration (g. Kg⁻¹) | Phosphorous concentration (mg. Kg⁻¹) | Potassium t concentration (mg. Kg⁻¹) | Average overlap between nitrogen and phosphorous | Average effect of nitrogen |
|----------------------------------|--------------------------------------|-------------------------------------|-----------------------------------------------|--------------------------|
| 0.0                              | 0.0                                  | 0.0                                 | 0.0                                           | 0.0                      |
| 15                               | 15                                   | 15                                  | 15 abc                                        | 15 b                     |
| 30                               | 30                                   | 30                                  | 14 ab                                         | 14 b                     |
| 0.5                              | 0.5                                  | 0.5                                 | 19 abc                                        | 18 a                     |
| 15                               | 0.5                                  | 0.5                                 | 19 abc                                        | 18 a                     |
| 30                               | 0.5                                  | 0.5                                 | 19 abc                                        | 18 a                     |
| 0.5                              | 1                                    | 1                                   | 20 ab                                         | 20 a                     |
| 15                               | 1                                    | 1                                   | 20 ab                                         | 20 a                     |
| 30                               | 1                                    | 1                                   | 20 ab                                         | 20 a                     |
| Average effect of potassium      | 0.0                                  | 1.0                                 | 17 a                                          | 17 a                     |
| The overlap between nitrogen and potassium | 0.5                                  | 1.0                                 | 14 a                                          | 14 a                     |
| The overlap between phosphorus and potassium | 15                                   | 1.0                                 | 20 a                                          | 20 a                     |

3.3. Effect of fertilization on the dry weight of the shoots of seedlings

Table 4. The effect of different concentrations of nitrogen, phosphorous, and potassium, and the interaction factors on the dry weight of the shoots of seedlings (g).

| Nitrogen concentration (g. Kg⁻¹) | Phosphorous concentration (mg. Kg⁻¹) | Potassium t concentration (mg. Kg⁻¹) | Average overlap between nitrogen and phosphorous | Average effect of nitrogen |
|----------------------------------|--------------------------------------|-------------------------------------|-----------------------------------------------|--------------------------|
| 0.0                              | 0.0                                  | 0.0                                 | 0.0                                           | 0.0                      |
| 0.5                              | 0.0                                  | 0.0                                 | 0.0                                           | 0.0                      |
| 15                               | 15                                   | 15                                  | 15 abc                                        | 15 b                     |
| 30                               | 30                                   | 30                                  | 15 abc                                        | 15 b                     |
| 0.5                              | 0.5                                  | 0.5                                 | 15 abc                                        | 15 b                     |
| 15                               | 0.5                                  | 0.5                                 | 15 abc                                        | 15 b                     |
| 30                               | 0.5                                  | 0.5                                 | 15 abc                                        | 15 b                     |
| Average effect of potassium      | 0.0                                  | 1.0                                 | 6.94 a                                        | 6.84 a                   |
| The overlap between nitrogen and potassium | 0.5                                  | 1.0                                 | 5.63 a                                        | 5.74 a                   |
| The overlap between phosphorus and potassium | 15                                   | 1.0                                 | 7.77 a                                        | 7.38 a                   |
| Average effect of phosphorus     | 0.0                                  | 0.5                                 | 7.77 a                                        | 7.38 a                   |
| The overlap between phosphorus and potassium | 15                                   | 1.0                                 | 7.77 a                                        | 7.38 a                   |
| Average effect of phosphorus     | 0.0                                  | 0.5                                 | 7.77 a                                        | 7.38 a                   |

The results of Table (4) indicate that there is a significant difference with nitrogen treatment, concentration (0.5 and 1 g. kg⁻¹), as this treatment led to the production of seedlings that had the highest weight of the dry vegetative at a rate of (7.62 and 7.45 g), respectively, with a significant difference from the control treatment that it gave the lowest rate (5.76 g). The treatment with the phosphorous element at a concentration of (30 mg. kg⁻¹) gave the highest dry weight average of (7.92 g), with a significant difference from the two treatments (0.0 and 15 mg. kg⁻¹) and at an average of (6.15 and 6.77 g), respectively. While Table (4) shows that there are minor differences that did not reach the significant level for the dry weights of the vegetative total when treated with potassium for all levels. The results of the binary interaction between nitrogen and phosphorous elements showed that there were significant differences, as the treatment with nitrogen element gave concentration (0.5 and 1 g. kg⁻¹) overlapping with element phosphorous concentration (30 mg. kg⁻¹) the highest significant rate reached (9.74 and 8.16 g), respectively, compared to the comparison treatment, which gave the lowest average of (5.20 g).
dry weight. While there were no significant differences for the bilateral interaction coefficients between phosphorous and potassium in relation to the vegetative dry weight rates.

It is noted from the results of the triple interaction of the studied treatments that the treatment with a concentration of (0.5 g. kg\(^{-1}\)) of the element nitrogen and (30 mg. kg\(^{-1}\)) of phosphorous, and the potassium treatment with a concentration (0.0 mg. kg\(^{-1}\)) gave the highest rate of the weight (10.10 g), with a significant difference from the comparison treatment, which gave an average weight of (5.10 g).

Here, too, it can be said that the plant has benefited from the fertilizer combination that contains nitrogen and phosphorous and was able to obtain the third element, which is potassium, through what is already in the soil, as in the table of chemical analysis of the soil, or it may be installed in the soil and when nitrogen and phosphorous are added in the form of urea and superphosphate. It caused the provision of an acidic medium, which led to the release of installed potassium, as most of the nutrients are ready for absorption by the plant, including potassium when acidic media is available in the soil (1).

3.4. Effect of fertilization on ash weight of seedlings

Table 5. The effect of different concentrations of nitrogen, phosphorous and potassium, and the interaction factors on ash weight of seedlings (g).

| Nitrogen concentration (g. Kg\(^{-1}\)) | Phosphorus concentration (mg. Kg\(^{-1}\)) | Potassium treatment concentration (mg. Kg\(^{-1}\)) | Average overlap between nitrogen and phosphorous | Average effect of nitrogen and phosphorous |
|--------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| 0.0                                  | 0.0                             | 0.030 e                        | 0.029 e                        | 0.031 e                        | 0.030 d                        | 0.039 c                        |
| 0.5                                  | 0.0                             | 0.056 bc                       | 0.040 cde                      | 0.082 a                        | 0.051 c                        | 0.082 b                        |
| 1                                     | 0.0                             | 0.067 ab                       | 0.072 ab                       | 0.076 ab                       | 0.070 ab                       | 0.071 a                        |
| Average effect of potassium           | 15                              | 0.070 ab                       | 0.074 ab                       | 0.067 ab                       | 0.070 ab                       | 0.071 a                        |
| The overlap between phosphorous and potassium | 15                              | 0.054 bcd                      | 0.068 ab                       | 0.069 ab                       | 0.064 ab                       | 0.062 b                        |
| Average effect of phosphorus          | 0.0                             | 0.054 b                        | 0.057 ab                       | 0.061 a                        | 0.054 c                        | 0.054 b                        |
| Average effect of nitrogen and phosphorous | 0.0                             | 0.034 c                        | 0.042 c                        | 0.040 c                        | 0.054 c                        | 0.054 b                        |

It is clear from the results of Table (5) that there are significant differences between the studied treatments in the ash weight, as the treatment of rose seedlings at a concentration of (0.5 and 1 g. kg\(^{-1}\)) led to the production of seedlings that had the highest ash weight of (0.062 and 0.071 mg) respectively, with a difference significant about the control treatment that produced seedlings with ash weight of (0.039 mg).

The treatment of seedlings with phosphorous element (30 mg. kg\(^{-1}\)) gave the highest rate of ash weight of (0.063 mg), with a significant difference from the other treatments.

Also, the treatment of rose seedlings with potassium (200 mg. kg\(^{-1}\)) caused the production of seedlings with a high ash weight of (0.61 mg), with a significant difference from the comparison treatment that gave a weight of (0.054 mg).

It is clear from Table (5) that the binary interaction between the elements nitrogen and phosphorous has caused significant differences in the ash weight. The seedlings treated with concentration (1g. kg\(^{-1}\)) of nitrogen and (30 mg.kg\(^{-1}\)) of phosphorous gave the highest weight. Ashes reached (0.073 g), with a significant difference from the comparison treatment, which gave ash weight (0.030 mg).

It is also evident from the same table that there are significant differences in the bilateral interaction coefficients between nitrogen and potassium and the binary interaction between phosphorous and potassium.

It is noted from the results of the triple interaction of the studied treatments that the treatment with a concentration (0.5 g. kg\(^{-1}\)) of nitrogen element and a concentration of (0 g. kg\(^{-1}\)) of phosphorous element and potassium treatment with a concentration of (0.0 mg. kg\(^{-1}\)) gave the highest rate of ash weight It reached (0.082 g), with a significant difference from the comparison treatment, which gave an average weight of (0.030 g).

Here, too, it can be said that the plant has benefited from the fertilizer combination that contains nitrogen and phosphorous and was able to obtain the third element, which is potassium, through what is already in the soil, as in the table of chemical analysis of the soil, or it may be installed in the soil and when nitrogen and phosphorous are added in the form of urea and
superphosphate. It caused the provision of an acidic medium, which led to the release of installed potassium, as most of the nutrients are ready for absorption by the plant, including potassium when acidic media is available in the soil [12].

4. Discussion

Nitrogen is important for protein production. It plays a pivotal role in many critical functions such as photosynthesis in the plant. It is a major component of amino acids. Nitrogen is necessary for enzymatic reactions in plants that have importance in cell division and elongation. Phosphorus has a pronounced effect on plants. it is essential for root development and good utilization of water and other nutrients by the plant and component of ATP and transfer energy. Potassium is very important for the regulation of 60 enzyme activities. Application of NPK might have accelerated the vigorous growth which leads to increase plant height and number of leaves per plant that lead to increase Dry weight of shoot and ash weight of seedling.

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