Effect of nutratin feeding with nano-iron oxide and potash fertilization on some growth and flowering Characteristics of Baby rose *Rosa pygmaea* L.

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Abstract

A factorial agricultural experiment with a randomized complete block design (RCBD) was carried out in the woody canopy / Department of Horticulture and Garden engineering / College of Agriculture / Tikrit University for the agricultural season 2022-2023, to determine the effect of foliar nutration with nano-iron oxide at three levels (0, 50, 100) mg L-1 and ground potash fertilization at four levels (0 1, 3, 5) gm L-1. The results showed that spraying with nano-iron oxide led to significant differences in the studied traits, and the level (100) mg L-1 gave the highest rates in the percentage of dry matter of the shoot (45.81) and root systems,(43.35) the number of flowers(3.67)flowers plant-1 and the concentration of potassium 2.52%, nitrogen 2.69%, phosphorus. and Iron in plant leaves was (97.74)ppm, The addition of potassium had a significant effect on the above traits, and the treatment (5) gm liter-1 gave the highest averages. The percentage of dry matter of the shoot and root systems reached (46.65, 43.69)%, the number of flowers was (3.53) flower per plant-1, and the concentration of potassium, nitrogen and phosphorus was (3.53, 2.56. 0.209)%, respectively, and the iron concentration (88.66) ppm. As for the interaction, the K4Fe3 treatment gave the highest rates of the studied traits, and the percentage of dry matter in the shoot reached 50.74%, the root part reached 47.89%, the number of flowers (4.45) flower plant, the percentage of potassium 3.18%, nitrogen 3.018%, phosphorus 0.23%, and the iron concentration (103.48) ppm in Baby rose leaves

Keywords: nanoiron oxide, potassium, Baby roseThe research is taken from the first researcher's master's thesis

introduction

The rose plant Rosa spp. It is one of the most famous medicinal and aromatic plants, which has an ancient history dating back to previous civilizations in Mesopotamia and the Nile. It was perhaps the first flower that humans cared about and cultivated, and considered it a symbol of love, loyalty, and beauty, as roses occupied their rightful place in palace gardens five thousand years ago (1). The baby rose plant is a perennial plant that grows either climbing or standing and belongs to the Rosaceae family. It belongs to the genus Rosa and is characterized by continuous flowering throughout the year. Its flowers live for a long time after being picked. A special exhibition is held in the month of April of each year in Iraq (2). The rose has many industrial uses, as its essential oil extracted by distillation from the petals is used in several fields, such as cosmetics, perfumes, soap production, and food flavorings, such as in tea (3). The rose plant has become famous as the king of flowers and has been described as one of nature's beautiful creations. It is the highest ranked cut flower, the largest traded flower in the world, and occupies 51% of the world's flowers. The value of the cut flowers marketed globally is estimated at about 11 billion US dollars (4) Roses constitute the soul of plants,

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with their many colors, shapes and different phases, which constitute the message about the nature that God calls it. Because it lives all year round and gives flowers with beautiful, bright colors, the species was produced by hybridization, preferring wild species (5). Foliar feeding is the spraying of liquid fertilizer on the plant's foliage in harmless concentrations, and it is not a substitute for root absorption. Nutrients are absorbed either through the stomata and interspaces, passing to the vessels transporting them to the parts of the plant, or through the bridges and cytoplasmic tubes located under the cuticle layer, passing to Cytoplasm (6)The atomic scale is 10-9 of a meter, because nanomaterials exhibit different material properties than when they have their conventional dimensions, which exceed 100 nanometers (7).Nanofertilizers are characterized by their small size and large surface area, which increases the absorption surface and this leads to an increase in the rate of photosynthesis, which in turn increases the production of active substances in the plant (8). Current developments have led to the manufacture of nanomaterials of different shapes and sizes, and their applications have been used in several fields such as engineering, medicine, science, and food preparation, in addition to their uses in the field of agriculture, especially in improving seed germination, plant growth, and prevention (9). Iron participates in many important processes in the plant as it is an activator of special enzymes. In the process of transferring electrons and respiration, it is also involved in the synthesis of chloroplast, and the most important of these enzymes are peroxidase and catalase. Secondary iron is a rich source for plants of effective divalent iron, which is considered to have properties that help the plant grow and develop (10). Explain (11). In a study on basil plants, spraying with nano-iron at a concentration of (0,1,2,3) gm L-1 led to a significant increase in all vegetative and flowering growth characteristics compared to the control treatment. A study conducted (12) showed. On the Aloe Vera plant, the study showed that when the plant was treated with nano-iron at a concentration of 50 gm liter-1, it gave the highest concentration of nutrients in the leaves for both nitrogen and potassium, which amounted to 1.28 and 1.77, respectively, and gave iron concentrations that reached 55.92 mg kg-1 Potassium is considered the big nutrient element, and is widely spread in nature as one of the components of silicate minerals and some types of mica. Potassium is considered one of the important and necessary elements for plants and cannot be dispensed with and replaced with another element because of its great benefits to the plant, such as controlling the process of opening and closing stomata and transporting nutrients. Manufactured and distributed to all parts of the plant through the bark, in addition to improving flowering and seed characteristics and other benefits (13). And between (14). When using two levels of potassium fertilizer, 516 and 774 gm L-1, on rose plants, it was found that the level of 774 gm L-1 gave the highest result in the number of leaves and flowers. It was also shown (15) that using potassium silicate at a concentration of 200 mg L-1 with three treatments (In addition to soil, foliar spraying, adding soil and foliar spraying) on the baby rose plant, and adding potassium to the soil and foliar spraying gave the highest values in the diameter of the stem, the number of branches, and the wet and dry weight of the shoots. He is considered a nano scientist who is interested in studying the

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processing of materials on the atomic scale. 10-9 of a meter, because nanomaterials exhibit different material properties than when they have their traditional dimensions, which exceed 100 nanometers (7). Due to the lack of studies on the effect of spraying with nano-iron oxide and adding potassium fertilizer on the baby rose plant and how it affects vegetative and flowering growth and mineral content, the idea of this research emerged.

Materials and working methods

The experiment was conducted in the wooden canopy of the Department of Horticulture and Landscape Engineering / College of Agriculture for the agricultural season 2022-2023 in anvils with a diameter of 18 cm and 15cm hight containing a sandy mixture. The seedlings were brought ready from the nursery in Baghdad Governorate. The seedlings were of a height not exceeding (20) cm and did not contain On pink bells or on flowers, and the experiment was started on 13/3/2023. The canopy panels were cleaned of the existing bushes and a layer of nylon was placed to prevent the growth of the bushes, as well as to ensure that the plant roots did not penetrate into the canopy soil. A layer of soil with a thickness of (3) cm was placed over the material. Nylon to ensure that the anvils do not heat up due to temperature and water evaporates from them. The experiment included a study of the following factors: the first factor, nano-iron oxide Fe3o4 20 nm mw 231.53 Assag 99.5 %,at three concentrations (0,50,100) mg L-1, and the second factor, potassium sulfate K2SO4 potassium oxide(K2O)water-soluble 51% Sulfur 18%, at four concentrations (0,1,2,3,4,5) g L-1, and the spraying and addition processes were in the form of In batches, spraying with nano-iron oxide was carried out two days after starting the experiment, 15/3/2023, then after five days, Add potassium fertilizer was carried out, meaning that between one spray and the addition of five days, until the completion of the spraying and fertilization process with potassium sulfate, the experiment was carried out in a RCBD. After development the vegetative and flowering growth of the plant After completing the foliar and ground fertilization operations, the following characteristics were studied: the percentage of dry matter in the shoot (%):After taking the weight of the fresh plant and then the dry plant, we extract the percentage of dry matter through the following equation(16).

Percentage of dry matter (%) = (dry weight)/(wet weight) x 100 the percentage of dry matter in the root system (%):The same method as the percentage of shoots

the number of flowers (plant flower - 1): The number of flowers per plant was calculated by counting the number in four anvils and then extracting the average.

the concentration of potassium (%):Potassium was determined in the digested plant sample using a flame photometer according to Page et al. (17).

nitrogen (%):Nitrogen was estimated using a Microkildahl device according to the method mentioned by (18).

phosphorus (%):Phosphorus was estimated in vegetable crops using a spectrophotometer (17)

iron (mg g-1): Iron in the eye was determined using an atomic absorption spectrophotometer according to the following (19).

in the leaves of the baby rose plant. The average results were statistically analyzed using the SAS statistical program according to the Least Significant Difference (L.S.D) test at the 5% probability level to test the significant

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differences between the arithmetic averages of the coefficients (20).

Results and discussion

Percentage of dry matter in the shoot (%): The results in Table (1) show that there is a significant difference between the levels of spraying with nano-iron oxide in the percentage of dry matter, as the Fe3 treatment excelled with the highest average of (45.811)% compared to the Fe1 treatment, which reached (40.343)%. The table indicates that adding potassium levels gave significant differences in the average percentage of dry matter, as the K4 treatment excelled by giving the highest rate and reached (46.652)% compared to the K1 treatment (no addition), which amounted to (39.730)%. It is clear from the results obtained that the K2 treatment and K3 There are no significant differences between them. The same table shows that the interaction treatment of spraying with nano-iron oxide and adding potassium gave significant differences in the percentage of dry matter , and the Fe3K4 treatment was superior (spraying with nano-iron oxide at a concentration of 100 mg L-1 + adding potassium at a concentration of 5 mg L-1). Given the highest rate, which amounted to (50.747)% compared to the Fe1K1 treatment (no treatment), which amounted to (37.480)%, and the percentage increase for the interference treatments was 35.397% compared to the comparison treatment .

Table (1) Effect of adding potassium and spraying with nano-iron oxide on the percentage of dry matter of the shoot

levels K / levels Fe	K1	K2	K3	K4	Fe
Fe1	37.480	39.873	41.320	42.700	40.343
Fe2	39.713	40.337	43.217	46.510	42.444
Fe3	41.997	44.363	46.137	50.747	45.811
Average K	39.730	41.524	43.558	46.652	
LSD	Fe	K		K×Fe	
	3.010	3.475		6.020	

K_1= Add distilled water only K_2= 1 gm L^{-1} K_3= 3 gm L^{-1} K_4= 5 gm L^{-1}

Fe_1= Spray with distilled water only Fe_2= 50 mg L^{-1} Fe_3= 100 mg L^{-1}

Percentage of dry matter in the root system (%): It is clear from the results obtained in Table (2) that spraying with nano-iron oxide gave significant differences in the percentage of dry matter, as the Fe_3 treatment with a concentration of (100) mg L^{-1} gave the highest percentage. For dry matter, which amounted to (43.350)%, while the Fe_1 treatment (spraying with distilled water) gave the lowest rate, amounting to (39.342)%. As for the potassium addition treatment, the K_4 treatment significantly exceeded the concentrations of (5) gm L^{-1}, which is a rate of (43.694)% compared to the lowest rate, which was the K_1 treatment (no addition), which is a rate of (38.020)%. We note from the double interaction treatment between spraying with nano-iron oxide and adding potassium in the percentage of dry matter in the roots that the Fe_3K_4 treatment gave the highest average, which amounted to (47.890)% compared to the lowest average, which was in the Fe_1K_1

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treatment, which amounted to (34.697)%, and the percentage of increase was Percentage: 38.02%.

Table (2) Effect of adding potassium and spraying with nano-iron oxide on the percentage of dry matter of the root system

levels K / levels Fe	K1	K2	K3	K4	Fe
Fe1	34.697	39.407	40.993	42.270	39.342
Fe2	38.283	38.727	42.390	40.923	40.081
Fe3	41.107	41.277	43.127	47.890	43.350
Average K	38.029	39.803	34.127	43.694	
LSD	Fe	K		K×Fe	
	3.107	3.588		6.214	

K_1= Add distilled water only K_2= 1 gm L^{-1} K_3= 3 gm L^{-1} K_4= 5 gm L^{-1}
Fe_1= Spray with distilled water only Fe_2= 50 mg L^{-1} Fe_3= 100 mg L^{-1}

Number of flowers (flower plant^{-1}): Table (3) shows that spraying with nano-iron oxide gave significant differences in the average number of flowers, as the Fe_3 treatment spraying with nano-iron oxide at a concentration of (100) mg L^{-1} gave the highest rate, which amounted to (3.672).) Plant^{-1} flower, and the comparison treatment Fe_1 was given, which amounted to the lowest number of flowers (2,054) Plant^{-1} flowers, with a percentage increase of 78.77%. The table shows that adding potassium levels gave significant differences in the average number of flowers, as it gave the K4 treatment at a concentration of (5) grams. The highest rate of liter^{-1} was (3.533) plant flowers^{-1}, while the comparison treatment K1 gave the lowest rate, which amounted to (1.993) plant flowers^{-1}, with a percentage increase of 77.27% compared to the comparison treatment. As for the interaction, there were significant differences between the interference treatments, and the Fe3K4 interaction gave the highest average, reaching (4.456) plant flowers^{-1}, while the lowest average was in the Fe_1K_1 treatment, which was (1.436) plant flowers^{-1}, with a percentage increase of 210.30%.

Table (3) Effect of adding potassium and spraying with nano-iron oxide on the number of flowers

levels K / levels Fe	K1	K2	K3	K4	Fe
Fe1	1.436	1.673	2.406	2.700	2.054
Fe2	1.530	2.663	2.773	3.443	2.602
Fe3	3.013	3.446	3.773	4.456	3.672
Average K	1.993	2.594	2.984	3.533	
LSD	Fe	K		K×Fe	

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	0.354	0.409	0.708

K_1= Add distilled water only K_2= 1 gm L^{-1} K_3= 3 gm L^{-1} K_4= 5 gm L^{-1}
Fe_1= Spray with distilled water only Fe_2= 50 mg L^{-1} Fe_3= 100 mg L^{-1}

Potassium concentraton in plant leaves (%): The results of Table (4) show that there are significant differences between the levels of spraying with nano-iron oxide in the percentage of potassium in the leaves, as the Fe3 treatment excelled in giving the highest percentage of potassium amounting to (2.525)% compared to the Fe1 treatment, which gave The lowest percentage of potassium was Fe_1, which gave the lowest percentage of potassium of (1.950)%. As for the potassium addition treatments, the table shows that treatment K_4 excelled by giving the highest percentage of potassium, amounting to (3.018)%, compared to treatment K_1, which gave the lowest percentage of potassium, amounting to (1.267)%. The results of the same table showed the superiority of the interference coefficients, which were in the Fe_3K_4 treatment with the highest percentage of potassium (3.300)% compared to the lowest percentage of potassium, which was in the Fe1K1 treatment and amounted to (1.160)%, with a percentage increase of 184.48% compared to the comparison treatment.

Table (4) Effect of adding potassium and spraying with nano-iron oxide on the concentration of potassium in plant leaves (%)

levels K / levels Fe	K1	K2	K3	K4	Average Fe
Fe1	1.160	1.690	2.250	2.703	1.950
Fe2	1.260	18.00	2.570	3.053	2.170
Fe3	1.383	2.236	3.183	3.300	2.525
Average K	1.267	1.908	2.667	3.018	
LSD	Fe	K		K×Fe	
	0.046	0.053		0.0923	

K_1= Add distilled water only K_2= 1 gm L^{-1} K_3= 3 gm L^{-1} K_4= 5 gm L^{-1}
Fe_1= Spray with distilled water only Fe_2= 50 mg L^{-1} Fe_3= 100 mg L^{-1}

Nitrogen content of leaves (%): Table (5) shows that there are significant differences between the levels of spraying with nano-iron oxide in the percentage of nitrogen in the leaves, where the highest rate of nitrogen was in the Fe_3 treatment, giving (2.699)% compared to the lowest rate of nitrogen, which was in the treatment. Fe_1 reached (1.689)%. As for the effect of adding potassium, the table shows that there are significant differences between the levels. The highest rate of nitrogen was in the K_4 treatment, giving (2.566)%, while the lowest rate was in the K_1 treatment, which amounted to (1.728)%. The results in the table showed that there were significant differences between the interactions, as the highest rate was given by The Fe_3K_4 treatment reached (3.183)%, and the lowest rate in the Fe_1K_1 treatment reached (1.553)%, with a percentage increase over the comparison treatment amounting to 104.958%.

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Table (5) Effect of adding potassium and spraying with nano-iron oxide on the concentration of nitrogen in plant leaves (%)

levels K / levels Fe	K1	K2	K3	K4	Average Fe
Fe1	1.553	1.683	1.736	1.783	1.689
Fe2	1.716	2.056	2.273	2.733	2.195
Fe3	1.916	2.720	2.976	3.183	1.699
Average K	1.728	2.153	2.328	2.566	
LSD	Fe	K		K×Fe	
	0.049	0.0576		0.099	

K_1= Add distilled water only K_2= 1 gm L^{-1} K_3= 3 gm L^{-1} K_4= 5 gm L^{-1}
Fe_1= Spray with distilled water only Fe_2= 50 mg L^{-1} Fe_3= 100 mg L^{-1}

Phosphorus content of leaves (%): The results of Table (6) indicate that there are significant differences in the levels of spraying with nano-iron oxide, as the results show the superiority of the Fe_3 treatment by giving the highest phosphorus percentage of (0.183)% compared to the Fe_1 treatment, which gave the lowest phosphorus percentage of (0.155).)%. As for the effect of potassium addition treatments, the results show that the K_4 treatment was superior, giving the highest percentage of phosphorus in the leaves, amounting to (0.204)%, compared to the K_1 treatment (no addition), which gave the lowest rate, amounting to (0.136)%. As for the effect of the interference treatments, the results show that the Fe_3K_4 treatment was superior by giving the highest percentage of phosphorus in the leaves, amounting to (0.233)% compared to the comparison treatment, Fe_1K_1 (no addition), which gave the lowest rate (0.130)%. The table shows that there are no significant differences between the comparison treatment and each of Fe_1K_2. And Fe_2K_1 and Fe_3K_1. The results show that there was a percentage increase between the interference treatments amounting to 79.230% compared to the comparison treatment.

Table (6) Effect of adding potassium and spraying with nano-iron oxide on the concentration of phosphorus in plant leaves (%)

levels K / levels Fe	K1	K2	K3	K4	Average Fe
Fe1	0.130	0.150	0.160	0.180	0.155
Fe2	0.140	0.160	0.180	0.200	0.170
Fe3	0.140	0.170	0.190	0.233	0.183
Average K	0.136	0.160	0.176	0.204	
LSD	Fe	K		K×Fe	
	0.011	0.012		0.022	

K_1= Add distilled water only K_2= 1 gm L^{-1} K_3= 3 gm L^{-1} K_4= 5 gm L^{-1}

Fe_1= Spray with distilled water only Fe_2= 50 mg L^{-1} Fe_3= 100 mg L^{-1}

Iron content of plant leaves (ppm): The results of Table (7) indicate that there are significant differences between the levels of spraying with nano-iron oxide in the iron content in the leaves, as the Fe_3 treatment excelled in giving the highest iron content in the leaves, amounting to (97.744) mg.kg^{-1} Compared to the Fe_1 treatment, which gave the lowest iron content, amounting to (70,015) mg.kg^{-1}, while the results showed the superiority of the K_4 addition treatment, which gave the highest iron content in the leaves, amounting to (88,662) mg.kg^{-1}, compared to the K_1 treatment (no addition), which It gave the lowest iron content, amounting to (78.338) mg.kg^{-1}. The results of the same table showed that there were significant differences in the interaction coefficients in the iron content of the leaves, as the Fe_3K_4 treatment gave the highest iron content, which amounted to (103,480) mg.kg^{-1}, compared to the lowest iron content, which was in the Fe_1K_1 treatment, which amounted to (66,253) mg.kg^{-1}, noting that There is no significant difference between the Fe_3K_4 and Fe_3K_3 treatments, as well as the Fe_1K_2 treatment and the comparison treatment, there are no significant differences between them. As for the percentage increase in the interference treatment, it was 56.189% compared to the no-addition treatment.

Table (7) Effect of adding potassium and spraying with nano-iron oxide on the concentration of iron in plant leaves (mg kg^{-1})

levels K / levels Fe	K1	K2	K3	K4	Average Fe
Fe1	66.253	68.520	70.507	74.783	70.015
Fe2	76.173	81.800	80.503	87.723	81.550
Fe3	92.590	94.287	100.620	103.480	97.744
Average K	78.338	81.535	83.876	88.662	
LSD	Fe	K		K×Fe	
	1.541	1.780		3.083	

K_1= Add distilled water only K_2= 1 gm L^{-1} K_3= 3 gm L^{-1} K_4= 5 gm L^{-1}

Fe_1= Spray with distilled water only Fe_2= 50 mg L^{-1} Fe_3= 100 mg L^{-1}

Through the results we reached, the plant responded to the treatment by spraying with nano-iron oxide, and the treatment had a positive effect on the percentage of dry matter of the shoot, the percentage of dry matter of the root system, the number of flowers, and the concentration of potassium, nitrogen, phosphorus, and iron in the plant leaves. The tables show that the reason for the increase in the studied traits is that The spraying method led to the rapid arrival of nutrients to manufacturing sites and their representation in metabolic sites. They entered either through stomata in the leaves or scratches and wounds in the cuticle layer, and then through cytoplasmic bridges to reach the cells in a shorter time, which helps in continuing the nutrient flow. Nanoscale iron oxide has unique properties. It is unique because of the small size of its particles and the increase in its surface area, which helps increase its absorption rate by the leaves(21).

The tables also show that adding potassium fertilizer had a significant effect on all the traits studied, whether vegetative, flowering, or mineral. Perhaps the reason is that

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potassium activates more than 80 enzymes, especially the enzymes involved in the synthesis of proteins, oxidation-reduction enzymes, ATP energy transfer, and the ATP cycle, which is important for efficiency. Metabolism and physiological processes such as protein transport. It also helps in increasing the plant's fat content and converting sugars into starches and cellulose. Potassium plays an important role in the processes of opening and closing stomata through its presence as a free ion in the guard cells. Potassium works to pull water into the root cells from During the increase in osmotic pressure, it also stimulates the plant to release CO_2 gas through the stomata in the leaves, and then produces ATP, which is important in filling the sieve tubes with carbon metabolism products (22). These results are in line with what was reported(23). Who indicated that treating the baby rose plant with different levels of potassium fertilizer showed an increase in vegetative and flowering growth indicators due to an increase in its readiness in the soil when the level of addition is increased, which leads to an increase in its absorption and also leads to an increase in the absorption of nitrogen as a result of cooperation in the absorption and balance between the nutrients in the plant. Thus Plant growth indicators increased. It also agrees with what (24) found on the Daoudi plant and what (25) pointed out. As for the interaction, the tables show that the combined effect of nano-iron oxide and potassium fertilization has led to a significant increase in the characteristics of vegetative and root growth, the number of flowers, and the concentration of nutrients such as nitrogen, phosphorus, potassium, and iron in the plant leaves. The reason is due to the role of nano-iron and potassium in the system of many enzymes that help In the process of respiration, including Cytrochrome Oxidase and Catalase, it encourages the processes of division, elongation, energy production, and increases growth and number of flowers. These results are consistent with what was reported by (24) and what (26) found on the baby rose plant.

Conclusions

Spraying with nano-iron oxide at a concentration of (100) mg L-1 increased the rate of vegetative growth characteristics and concentration of N , P , K , Fe in plant. And that adding potassium fertilizer at a concentration of (5) gm L-1 gave above rate in this characteristics. The intervention The intervention treatment (spraying with nano-iron oxide at a concentration of 100 mg L-1 + potassium fertilizer 5 g L-1) gave the highest rates of vegetative and flowering growth characteristics and element concentration.

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