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Manufacturing of NPK nano fertilizer and its effect on growth and of cut flowers production in two types of Rosa spp

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NPK was made from the compound fertilizer ProSol (20: 20: 20) using an urgent mortar with 5 gm crushing for two hours until the conversion to nano size. nanoparticles size of the powder produced was measured by an X-ray diffraction meter XRD and the size of the produced was 54.13 nm. A field experiment was carried out using RCBD to study two factors, first type of fertilizer used with three levels of spraying with nutritious fertilizer ProSol at a concentration of 1.5 g. L-1 and spraying with NPK nano fertilizer at a concentration of 0.5 g. L-1 in addition to control treatment, second factor two types of rose damascene and Legend belongs to the Hybrid Tea Rose. results showed that the treatment of spraying with nanoparticles was superior in all the studied characters, and it gave the highest number of flowering plants at 14.24. It also gave the highest concentration of nutrients in the leaves of 2.6 % nitrogen and 1.97 % for potassium. Legend superior to R. Damascena in number of flowers and carbohydrate content, while Damascena was superior in weight and flower diameter. The highest vase life recorded at 13.82 days for the treatment of interaction between spraying with nano fertilizer and Legend cultivar.

Keywords: Nano fertilizer; XRD; Cut flowers; Rose.

1. INTRODUCTION

Plants need essential nutrients required for optimum growth; Nitrogen helps plants make the proteins they need to produce new tissues. Phosphorus stimulates root growth, helps the plant set buds and flowers, it does this by helping transfer energy from one part of the plant to another, to absorb phosphorus, most plants require a soil pH of 6.5 to 6.8. Potassium helps the plants make carbohydrates and provides disease resistance it also helps regulate metabolic activities [1]. Agricultural scientists are facing a wide spectrum of challenges such as stagnation in crop yields, low nutrient use efficiency, declining soil organic matter, multi-nutrient deficiencies, climate change, shrinking arable land and water availability and shortage of lab our besides exodus of people from farming. In spite of immense constraints faced, we need to attain a sustainable growth in agriculture at the rate of 4% to meet the food security challenges., To address these problems, there is a need to explore one of the frontier technologies such as 'Nanotechnology' to precisely detect and deliver the correct quantity of nutrients and pesticides that promote productivity while ensuring environmental safety and higher use efficiency. The nanotechnology can be exploited in the value chain of entire agriculture production system**,** Nanotechnology is a novel scientific approach that involves the use of materials and

equipment capable of manipulating physical as well as chemical properties of a substance at molecular levels [2]. Nanotechnology has the potential to revolutionize the agricultural and food industry with novel tools for the molecular management of diseases, rapid disease detection, enhancing the ability of plants to absorb nutrients, among others [3] Hence, only nanoparticles or nanoparticle aggregates with diameter less than the pore diameter of the cell wall could easily pass through and reach the plasma membrane [4]**.** accumulation of nanoparticles on photosynthetic surface cause foliar heating which results in alterations to gas exchange due to stomata obstruction that produce changes in cellular functions of plants [5] **.**The mechanism of formation of nanoparticles; whether they are formed outside in the media and then translocate to plants or whether they are formed by the reduction of metal salts within the plants itself still needs more clarification [6] .The uptake and translocation of nanoparticles across root cells depends on the type of metal ions and plant species. The amount of nanoparticle accumulation in plants also varies with reduction potential of ions and the reducing capacity of plants that depends on the presence of various polyphenols and other heterocyclic compounds present in plants [7] **.** The title of the rose is the queen of flowers by the Greek poet Safo. The rose plant is one of the most famous cut flowers and ornamental plants. The genus (Rosa) belongs to the pink family Rosaceae, Its cultivation is spread all over the world except in hot regions and in particular it is grown in the regions of Korea, Asia and the East. Middle East and North America, genus Rosa includes mostly deciduous shrubs, and the fruits are rich in vitamins such as A, B3, C, D and E, in addition to citric acid and dyes, among others, China was the first to produce hybrid tea. Rose contains 200 species and nearly 1800 varieties [8].

In view of the lack of studies in Iraq on the use of Nano-fertilizers in the field of producing ornamental plants, this study was conducted for the purpose of knowing the response of two varieties of roses and spraying with Nano fertilizer and comparing it with traditional fertilizers and the effect of these factors on the qualitative characteristics of the cut flowers production.

2. EXPERIMENTAL

The experiment was carried out in one of the greenhouses of the Horticultural Facilities Unit, Department of Horticulture and Landscape / College of Agriculture / Tikrit University during the 2018 agricultural season. The land of the plastic house was plowed with a tipping plow, and then smoothed with a digging plow, modifying the land and dividing it into three benches with a width of one meter and the distance between one floor and another one Meters. Seedlings were planted on 3/20/2018 by two lines on the bench, the distance between the lines is 60 cm and the distance between the plants is 20 cm, and the average is 8 plants for the experimental unit. The experiment included two factors.

A: The first factor, PRO. sol fertilizer NPK (20: 20: 20) using in two forms: basic form and Nano form (where the nanoparticle fertilizer was manufactured using ivory mortar in the College of Education for Pure Sciences in the Department of Physics, where the PRO.sol fertilizer was crushed with an amount of 5 gm. for two hours by hand until it was transformed into the Nanoscale:

1. Foliar spray basic form, at a concentration of 1.5 g L^{-1},
2. Foliar spray Nano from 0.5g L^{-1},
3. Control treatments (tap water)

The foliar spray was carried out after two weeks of pruning, at a rate of spraying 15 days throughout the study period.

B: The second factor: Rose Varieties: is using two rose varieties

1. Rosa damascena cultivar
2. legend variety of Italian origin.

The experiment was carried out with a randomized complete block design (RCBD) and with three replications

Measurements as follows: vegetative characteristics (percentage of dry matter, concentration of nitrogen, phosphorus and potassium and leaf content of total chlorophyll)., and flowering characteristics (number of flowers per plant, weight and diameter of flower, flowering age, flower content of carbohydrates). The results were analyzed statistically using the SAS program and the averages were compared according to the Duncan's polynomial test at a 5% probability.

size of nano composite was examined using a Diffract meter (XRD) device at College of Education, Ibn Al-Haytham / University of Baghdad. Crystallite size was calculated according to the Debye - Scherrer equation [9].

D= $K.\lambda \setminus B.cos\theta$

D = Crystallite size (nm)

K = shape factor (0.90)

λ = x-ray wavelength (mostly λ for Cu)

B = FWHM (full width at half max)

θ = Bragg Angle

No	Peak no.	2θ (deg)	Θ=2θ/2 (deg)	Θ (rad)	cosΘ (rad)	FWHM (deg)	B (rad)	B * cosΘ	D =0.1386504/B. cosΘ
1	4	22.56	11.28	0.1967	0.9807	0.157	0.0027	0.002647	51.62
2	2	16.93	8.465	0.1476	0.9891	0.117	0.0020	0.00198	68.68
3	7	24.04	12.02	0.2096	0.9781	0.193	0.0033	0.00322	42.10

Θ(rad) = Θ(deg)*3.14/180

B = FWHM(deg)*3.14/180

D = 0.90×0.15406 nm / B*cosθ = 0.1386504/B*cosθ

D_{av} (nm) = (D_1+D_2+D_3) / 3

D_{av} = (51.62 + 68.68+42.10) / 3 = 54.13 nm.

3. RESULTS AND DISCUSSION

From Table 1, we find that the treatment of spraying with Nano fertilizer caused a significant increase in most of the studied growth characteristics of the two rose cultivars (Legend-Damascene). The treatment of spraying with Nano NPK fertilizer gave the highest dry matter, reaching 9.79%, and it was significantly superior to the comparison treatment and spraying with NPK fertilizer basic form , as well as the highest concentration of nitrogen, phosphorous and potassium (2.60, 0.24 and 1.97%) respectively , and the highest chlorophyll content of 7.96 mg. GM-1. The Legend cultivar was identical to Damascene in most of the studied traits, and it gave the highest dry matter ratio of 9.54 g, and the highest nitrogen and potassium ratio of 2.62 and 1.80%. From the interaction coefficients, we find that the interaction treatment between the Nano fertilizer and the Legend variety gave the highest values in the leaf content of the dietary elements and gave 2.84% nitrogen and 0.24% phosphorus.

Table 1 Effect of foliar with Nano NPK fertilizer on growth of tow Rose variety.

Applications (PRO.sol)		Measurements(vegetative characteristics)				
		Dry matter %	N %	P %	K %	Chlorophyll Mg.gm^{-1}
Control		7.17 c	2.19 c	0.235 c	1.68 e	7.37 b
Basic form		8.65 b	2.39 b	0.241 b	1.83 b	7.57 b
Nano form		9.79 a	2.60 a	0.247 a	1.97 a	7.96 a
Variety						
Legend		9.54 a	2.62 a	0.241 a	1.80 a	8.47 a
Damascene		7.53 b	2.19 b	0.241 a	1.85 a	7.23 b
PRO.sol x variety						
Control	Legend	7.85 c	2.43 c	0.234 e	1.66 e	8.20 b
	Damascene	6.48 d	2.03 e	0.237de	1.71 d	6.53 d
Basic form	Legend	9.67 b	2.60 b	0.240cd	1.78 c	8.43 b
	Damascene	7.63 c	2.17 d	0.242bc	1.87 b	6.71 d
Nano form	Legend	11.09 a	2.84 a	0.250 a	1.97 a	8.76 a
	Damascene	8.49 c	2.36 c	0.245 b	1.98 a	7.16 c

*In a vertical column means having similar letters do not differ significantly according to Duncan's Multiples Range Test at 0.05 level of significance

Data in Table 2 showed that the superiority of the treatment of nano fertilizer in the flower growth characteristics of the rose and it gave the highest average number of flowers, which reached 14.24 flowers/ plant., 1, 91.56 mm flower diameter, 24.24 g flower fresh weight, 12.57 flowering days (rose life) and 2.23% carbohydrate content of flower. Legend cultivar outperformed Damascene cultivar in number of flowers and gave 15.35 flowers and flowering age and gave 13.34 days, while Damascene cultivar outperformed in the two characteristics of diameter and flower weight, reaching 90.38 mm and 22.47 gm for the two stems, respectively. From the double interference coefficients, we find the superiority of the interaction treatment between the nano fertilizer and the Legend variety in the number of flowers, flowering age and the carbohydrate content of the petals and gave (18.99 flowers: plant-1, 13.82 days and 2.43%) for the traits respectively and did not differ significantly from the treatment of the interaction between nano fertilizers and the variety Damascene is in the attributes of weight and diameter of flower.

Table 2 Effect of foliar with nano NPK fertilizer on flowering of tow Rose variety.

Applications (PRO.sol)		Measurements(flowering characteristics)				
		No flower Flower.plant^{-1}	**Flower diameter Mm**	**Flower weight gm**	**Vase life Day**	**Carbohydrate in flower %**
Control		10.35 c	78.93 b	20.06 c	11.49 b	2.08 b
Basic form		11.35 b	91.20 a	22.38 b	11.99 b	2.15 b
Nano form		14.24 a	91.56 a	24.24 a	12.57 a	2.23 a
Variety						
Legend		15.35 a	84.07 b	21.99 b	13.34 a	2.30 a
Damascene		8.43 b	90.38 a	22.47 a	10.60 b	2.01 b
PRO.sol x variety						
Control	Legend	13.55 b	72.21 c	19.99 d	12.82 b	2.19 b
	Damascene	7.16 d	85.64 b	20.14 d	10.16 d	1.97 c
Basic form	Legend	14.05 b	89.27 ab	21.77 b	13.66 a	2.27 b
	Damascene	8.66 c	93.13 a	23.00 b	10.32 d	2.03 c
Nono form	Legend	18.99 a	90.74 a	24.21 a	13.82 a	2.43 a
	Damascene	9.49 c	92.38 a	24.27 a	11.32 c	2.04 c

*In a vertical column means having similar letters do not differ significantly according to Duncan's Multiples Range Test at 0.05 level of significance

To find the superiority of the treatment of spraying with nano fertilizer in the characteristics of vegetative growth and flowering and the concentration of nutrients in the leaves over the two treatments of spraying with conventional fertilizer. And comparison, this superiority may be due to the fact that nanoparticles have a higher surface area than conventional fertilizers, according to what is proven in Figures (1 and 2) and measuring the size of minutes by the formula Debbie-Scherer, the synthetic fertilizer has a nano size, which facilitates its entry through the stomata, which means an increase in the rate of metabolism reactions inside the plant, which increases the dry matter of nutrients [10]. The use of nanotechnology in fertilizers has increased in recent times, aiming at a gradual and controlled release of nutrients into the soil. This helps a lot in avoiding the potential damage to the environment due to the use of traditional fertilizers and thus contributes to plant growth and the development of the yield [11]. The use of nano fertilizer compared with regular fertilizers improves the efficiency of fertilizer use and reduces the loss of elements by leaching into the soil. The results of the studies showed that the addition of the triple NPK fertilizer in the form of nano had a positive effect in improving the plant content of nitrogen elements N, phosphorus P, and potassium K in the plant ,As well as increasing plant height, leaf area, and dry matter [12] . As for the superiority of the Legend variety in increasing the dry matter and the chlorophyll content of the leaves, it may be due to the nature of the variety and its accumulation of nutrients, carbohydrates and leaf thickness more than in the Damascena variety, and this increase means an increase in the mesophyll and tissues containing chloroplasts and thus an increase in chlorophyll[13]. The superiority of the Legend variety in the number of flowers is due to the fact that this variety is perpetual, if the production conditions are available for it. Perhaps the superiority of the Legend variety over the Damascena variety in the characteristic of the flowering age, in the limits of the genotype, the survival period of many cut flowers is related to the diameter and stiffness of the flower stalk, so the thicker the less curvature and contains more nutrients and depends on the anatomical and physiological characteristics, flowering longevity is one of the important qualitative characteristics of cut flowers, and there is a contrast

between varieties for plants [14]. And that the flowering life depends on the strength of the flower carrier below the flower, and that the dissolution of this part causes the neck to curvature, which impedes the arrival of water to the flower, causing it to dry out due to the blockage of the wooden vessels carrying water and the cause of the blockage, either mechanical or bacterial [15].

4. CONCLUSIONS

In conclusion, it can be recommended the spraying with nano NPK fertilizer gave highest growth and flowering specialty flower number , diameter and vase life compared with normal fertilizer.

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