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The effect of nano-Macro elements (NPK) and Amino Spray on some Physical and Chemical Characteristics of date palm fruits (*Phoenix dactylifera* L.) Al-Sayer cultivar.

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Abstract

This experiment was carried out during the growing season (2023 AD) in one of the private orchards in Thi Qar Governorate, with the aim of studying the effect of spraying fruits with concentrations of the nano-macro elements NPK (0, 75, and 150) mg L^{-1} and Amino Spray with concentrations (0, 2, and 4) ml L^{-1} and their interactions in some physical and chemical characteristics of the fruits of the Al-Sayer cultivar at the Rutab stage.

The results showed the significant superiority of the nano-macro elements NPK at a concentration of (150 mg L^{-1}), recording the highest averages in both the weight of the fruit and the core (9.322 and 8.453) g, respectively , and the concentrations of nitrogen, phosphorus and potassium (2.60, 0.40 and 2.783).) % respectively .

The spraying treatment with Amino Spray at a concentration of(4 ml L^{-1}) was significantly superior in increasing the averages of both the weight of the fruit and the core (8.483 and 7.678) g , respectively, and the percentages of nitrogen, phosphorus and potassium (2.76, 0.43, and 963.3) % , respectively .

Keywords: Nano NPK - Amino spray - date palm – Core .

I. Introduction :

The date palm (*phoenix dactlifera* L.) is considered one of the most important plants belonging to the Arecaceae family, and it is considered one of the most important evergreen fruit trees known to human since ancient times , It is a monocot plant and its cultivation is widespread in tropical and subtropical regions between latitudes (10- 30) north and extends to latitude (20) south (Al-Bakr 1972).

The date palm is considered an important and essential part of the agricultural environment of Iraq because of its great nutritional and economic value, which makes it contribute to the national income (Al-Duri and Al-Rawi, 2000). The production of dates in Iraq for the season (2020) was estimated for all cultivars at a quantity of (735400) Tons , with an average production per palm tree of (68.2) kg (Dates production report (2020).

The Al-Sayer cultivar is considered one of the commercially important cultivars . It is one of the early ripening cultivars , and its fruits are eaten in the Rutab and Tamr stages due to their good quality, the color of the fruits in the khalal stage is dark yellow near the area of the cup , which is prominent on the surface of the fruit , Its fruits are characterized by a sweet taste with a slight sourness in the khalal stage due to tannins (Al-Zubaidi *et al*. 2020).

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Fertilization plays an important role in improving tree growth and production because it provides the nutrients necessary for complete fruit formation. There is a misconception that date palm trees have the ability to grow and bear fruit without the need for fertilization. Therefore, a distinction must be made between palm trees having the ability to grow and bear fruit. Without fertilization, it must be of high productivity and with specifications desired by the consumer as a result of performing the service operations for the provided date palms, primarily fertilization (Ibrahim, 2008).

The application of nanotechnology to produce fertilizers in the field of agriculture will reduce the loss of added nutrients, as well as speed up the plant's benefit from them, as they are environmentally friendly fertilizers and of great importance in promoting sustainable agricultural development, as this technology was able to provide nutrients and release them slowly to suit the plant's need, this is why it is called smart fertilizer , the use of nano-fertilizers, which are characterized by their small size and high surface area, leads to an increase in the absorption surface, as nano-fertilizer is one of the most widespread and widely used molecules due to its positive effect in improving plant growth. (Liu and Lai, 2015).

NPK compound fertilizer is one of the important and necessary nutrients that the plant needs in large quantities for the purpose of increasing growth, photosynthesis and other functions in the plant. Nanotechnology has helped regulate the release of nutrients from fertilizers, especially nitrogen and phosphate compounds, as nutrient loss is reduced by washing or stabilization and thus helping them to be absorbed slowly by the plant, as well as avoiding the interaction of nutrients with soil, organisms and water (Liu *et al*., 2006).

As a result of the negative impact of some chemical fertilizers when sprayed on plants and their indirect impact on human health, it was necessary to think of new methods that increase growth, and one of these methods is the use of spraying organic compounds because of their large and important role in most physiological processes in plants. Use Amino spray solution because it is a compound rich in free amino acids, nitrogen, organic matter and other compounds, Therefore, this study was conducted with the aim of knowing the effect of spraying Al-Sayer date palm fruits with concentrations of NPK and Amino Spray on some (physical and chemical) characteristics.

II. Materials and Methods :

This experiment was carried out during the 2023 growing season in one of the private orchards in Thi-Qar Governorate / Nasiriyah District / Muhammadiyah region adjacent to the Euphrates River. Where five trees of the Al-Sayer cultivar were selected, as similar as possible in terms of growth strength and at an age of (8 years), and they were planted with dimensions of (8 x 8) M and irrigated by pumps from the water of the Euphrates River. The same service operations were carried out for the selected trees in terms of irrigation, fertilization and pest control. The tree pollination process was carried out for the period from 21/3 to 5/4/2023 using Al- ghanami Al – aghadir pollen , the number of bunches was 9 on each tree, and marks were placed on them according to the study's treatments and replicates.

The experiment was designed as a factorial experiment according to a Randomized Completely Blocks Design (R.C.B.D.), the results were analyzed using the Genstat 12 program, and the averages were compared using the least significant difference (L.S.D.) at the probability level. 0.05 (Al-Mashhadani and Al- Qasab, 2017) , the study factors were :

The first factor: Spraying the fruits with NPK nano-fertilizer at three concentrations (0, 75, and 150) mg L^{-1}.

The second factor: Spraying fruits with Amino spray at three concentrations (0, 2, and 4) ml L^{-1}.

The spraying date was starting from 2 May, 2023, with six sprays, and the period between one spray and the next was 10 days.

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Studied characteristics:

1 - Fruit weight (g)

The fresh weight of the fruit was calculated by taking 10 fruits randomly from each experimental unit and weighing them using a sensitive balance, then, the fresh weight of one fruit was calculated in units (g) by extracting the average by dividing the total weight of the fruits by their number.

2 - Weight of the core (gm fruit^{-1}):

A sharp knife was used to remove the fruit core and separate it from the seeds for 10 fruits from each replicate. Then the fruit core for the ten fruits was weighed on a sensitive scale and the total weight was divided by the number of fruits to calculate the average weight of the core of one fruit.

3 - Estimation of nitrogen concentration in fruits (%) :

Total nitrogen in fruits was determined using a steam distillation device (micro kjoldahl) based on the method described in (Page *et al*., 1982).

4 - Estimating the concentration of phosphorus in fruits (%) :

The phosphorus element in the digestion solution was determined after adjusting the acidity of the mixture using a spectrophotometer at a wavelength of 700 nm according to the method of Murphy and Riley described in (Page *et al*., 1982).

5 - Estimating the concentration of potassium in fruits (%):

Potassium in fruits was determined using a flame photometer according to the method described in (Page *et al*., 1982).

III. Results and discussion :

1. Fruit weight (g)

The results in Table (1) show that there is a significant effect on increasing the weight of the fruit when using different concentrations of Nano-macro elements , the treatment with a concentration of (150 mg L^{-1}) achieved the highest average of (9.322 g), followed by the treatment with a concentration of (75 mg L^{-1}) at an average of (7.968 g), while the control treatment gave the lowest average of (6.998 gm).

Table (1) The effect of the Nano – macro elements NPK and Amino Spray and their interaction on the weight of the fruit (g).

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The results showed significant differences in the increase in fruit weight during treatment with Amino Spray, the concentration treatment (4 ml L^{-1}) achieved the highest average of (8.483 g) compared to the control treatment which recorded the lowest average of (7.719 cm).

The effect of the interaction treatments between the study factors was significant in increasing the fruit weight averages , and the interaction treatment between (150 mg L^{-1}, NPK , and 4 ml L^{-1}, Amino Spray) excelled and achieved the highest average of (9.766 g) compared to the control treatment, which recorded the lowest average of (6.732 g).

2- Weight of the core (g):

The results of the statistical analysis in Table (2) showed that spraying the fruits with Nano-macro elements(NPK) significantly affected the increase in the core weight, as the treatment with a concentration of (150 mg L^{-1}) gave the highest average of (8.453 g), followed by the treatment with a concentration of (75 mg L^{-1}) at an average of (7,200 g), Compared with the control treatment, which gave the lowest average of (6.303 g).

Nano NPK mg L^{-1}	Amino Spray ml L^{-1} 0	Amino Spray ml L^{-1} 2	Amino Spray ml L^{-1} 4	NPK Average
0	6.063	6.294	6.552	6.303
75	6.792	7.204	7.604	7.200
150	8.055	8.427	8.877	8.453
150	8.808	9.302	9.766	9.322
Amino Spray Average	6.970	7.308	7.678	
Average	7.719	8.086	8.483	
		L.S.D.≤ 0.05		
	NPK	Amino Spray	Interactions	
	0.0678	0.0678	0.1174	
	0.678	0.0678	0.1174	

Table (2) The effect of the Nano – macro elements NPK and Amino Spray and their interaction on the weight of the core (g)

The results in the same table showed that spraying the fruits with Amino Spray had a significant effect on increasing the weight of the core , as the concentration treatment (4 ml L^{-1}) achieved the highest average of (7.678 g), followed by the concentration treatment (2 ml L^{-1}) at an average of (7.308 g) , compared to the control treatment, which recorded the lowest average of (6.970 g) .

The interaction treatment between the Nano-macro elements NPK at a concentration of 150 mg L^{-1} and Amino Spray at a concentration of 4 ml L^{-1} significantly affected the increase in the average weight of the core and achieved the highest average of (8.877 g) , compared to the control treatment that recorded the lowest average of (6.063 g) .

3 - Nitrogen percentage (%) :

The results of Table (3) show that the percentage of nitrogen was significantly affected by the concentrations of the Nano-macro elements (NPK) sprayed on the fruits of Al-Sayer date palms, and achieved the concentration treatment (150 mg L^{-1}) had the highest average of (2.60 %) , followed by the concentration treatment of (75 mg L^{-1}) with an average of (2.47 %) compared to the control treatment, which gave the lowest average of (2.33 %) .

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Table (3) the effect of the Nano – macro elements NPK and Amino Spray and their interaction on the Nitrogen percentage (%).

Spraying the fruits with Amino Spray had a significant effect in increasing the percentage of nitrogen ,the concentration treatment (4 ml L^{-1}) achieved the highest average of (2.76%), followed by the concentration treatment (2 ml L^{-1}) with an average of (2.44%) compared to the control treatment that recorded the lowest average was (2.20 %) .

Also, the interaction treatments between the concentrations of Nano-macro elements (NPK) and Amino Spray significantly affected the increase in the percentage of nitrogen , and the interaction treatment between (NPK with a concentration of 150 mg L^{-1} and Amino Spray with a concentration of

Nano NPK mg L^{-1}	Amino Spray ml L^{-1} 0	2	4	NPK Average
0	2.14	2.28	2.56	**2.33**
75	2.18	2.43	2.81	**2.47**
150	2.28	2.61	2.90	**2.60**
Amino Spray Average	**2.20**	**2.44**	**2.76**	

Nano NPK mg L^{-1}	Amino Spray ml L^{-1} 0	2	4	NPK Average
0	0.29	0.36	0.40	**0.35**
75	0.30	0.36	0.44	**0.37**
150	0.33	0.41	0.46	**0.40**
Amino Spray Average	**0.31**	**0.38**	**0.43**	

L.S.D.≤ 0.05		
NPK	**Amino Spray**	**Interactions**
0.013	**0.013**	**0.023**

(4 ml L^{-1}) was superior, recording the highest average of (2.90%) compared to the control treatment that recorded the lowest average was (2.14%).

4 - Phosphorus percentage (%) :

The results of Table (4) indicate that spraying with Nano-macro elements led to a significant increase in the percentage of phosphorus, as the treatment with a concentration of (150 mg L^{-1}) recorded the highest average of (0.40%), while the control treatment recorded the lowest average of (0.35%).

Spraying the fruits with Amino Spray had a significant effect on increasing the percentage of phosphorus, and the concentration treatment (4 ml L^{-1}) achieved the highest average of (0.43)% compared to the control treatment, which recorded the lowest average of (0.31)%.

Table (4) the effect of the Nano – macro elements NPK and Amino Spray and their interaction on the Phosphorus percentage (%).

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The interaction treatment between (NPK at a concentration of(150 mg L^{-1}) and Amino Spray at a concentration of(4 ml L^{-1}) achieved the highest average in the percentage of phosphorus, amounting to (0.46%) compared to the control treatment, which recorded the lowest average , amounting to (0.29%)

5 – Potassium percentage (%) :

The results of the analysis in Table (5) showed that spraying the fruits with Nano-macro elements (NPK) led to a significant increase in the percentage of potassium , and the concentration treatment (150 mg L^{-1}) achieved the highest average of (2.783)% compared to the control treatment, which recorded the lowest average (2.503)%.

Nano NPK mg L^{-1}	Amino Spray ml L^{-1}			NPK Average
	0	2	4	
0	2.213	2.476	2.820	**2.503**
75	2.360	2.730	2.953	**2.681**
150	2.396	2.836	3.116	**2.783**
Amino Spray Average	**2.323**	**2.681**	**2.963**	
	L.S.D.≤ 0.05			
	NPK	**Amino Spray**	**Interactions**	
	0.0456	**0.0456**	**0.0791**	

Spraying the fruits with Amino Spray had a significant effect on the percentage of potassium, and the concentration treatment (4 ml L^{-1}) recorded the highest average of (2.963)%, while the control treatment achieved the lowest average of (2.323)%.

Table (5) the effect of the Nano – macro elements NPK and Amino Spray and their interaction on the Potassium percentage (%).

The interaction treatment between (NPK at a concentration of 150 mg L^{-1} and Amino Spray at a concentration of (4 mL L^{-1}) excelled by recording the highest average of potassium percentage of (3.116 %) , compared to the control treatment that recorded the lowest average of (2.213%).

The results in Tables (1, 2, 3, 4, and 5) showed that there was a significant effect on the physical and chemical characteristics studied when spraying the fruits with concentrations of the Nano-macro elements (NPK) and Amino Spray, as there was a significant increase in the weight of the fresh fruit and the core when treated with the Nano-macro elements , NPK and Amino Spray , The reason may be that Nano fertilizers have a high penetration efficiency into cell membranes to reach their functional work centers, which is necessary for the synthesis of chlorophyll and encouraging the processes of energy transfer, metabolism, cell division, and increasing their number (Nair *et al*., 2010). Or the reason may be attributed to the role of the Nano macro elements (NPK) and amino acids, which constitute 56% of the components of Amino Spray, in addition to the organic substances present in the compound, as their absorption from cellular tissues leads to the activation of various physiological processes and stimulates growth and development of the plant. In addition to its role in increasing cell division and increasing their size, as well as increasing the movement of the products of the photosynthesis process and nutrients and their withdrawal into the fruits, which was reflected positively in increasing the fresh weight of the fruit and the weight of the core of the fruit (Rainecke and Ozaga, 2003).

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Adding fertilizers during cell division and growth led to an increase in the osmotic pressure of the cells as a result of the permeation of the added nutrients into them, which led to an increase in the absorption of water and other nutrients into the treated fruits, and then an increase in the weight of the fruits. These results are consistent with the findings of (Al-Mubarak , 2014).

The reason for the increase in the content of nitrogen, phosphorus and potassium elements in the fruits when spraying the fruits with the Nano-macro elements NPK and Amino Spray can be explained by the increase in the concentration of these elements in the fruit tissues as a result of their treatment with them and their role in stimulating the rapid growth and state of activity of the fruit tissues, as the concentration of these elements increases due to the division and construction processes of these tissues, and the reason for the increased concentration of these elements may be due to the fact that Amino Spray contains amino acids and organic materials, which play an essential role in the growth and development of fruits in particular and plants in general, as nitrogen is involved in the synthesis of amino acids, nucleic acids, proteins, hormones , enzymes and chlorophyll molecule. In addition, amino acids are a source of nitrogen that is ready for absorption and metabolism (Cardozo *et al*., 2007).

As for the reason for the increased concentration of phosphorus in fruit tissues, it may be due to the fact that Amino Spray contains amino acids that work to increase the absorption of nutrients and speed up their movement in the plant, in addition to its role in stimulating cells to enter nutrients faster and easier , nitrogen has a stimulating role in vital processes within the plant, such as building proteins, which generates the need for energy, which is translated into increased absorption of phosphorus, which reflects positively towards increasing the plant's content of it (phosphorus). On the other hand, the reason behind the increase in potassium concentration may be explained by the role of nitrogen in Stimulating the activity of biological processes, which in turn leads to an increase in the plant's potassium content, which has a regulating role in water balance and the movement of solutes, as well as stimulating many enzymes associated with the process of assimilation of carbohydrates, which leads to an increase in the plant's need for potassium (Al-Taie, 2017) .

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