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EFFECT OF ADDING CHEMICAL FERTILIZERS AT DIFFERENT DISTANCES, DATES AND CONCENTRATIONS ON THE GROWTH AND YIELD OF DATE PALM

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Abstract

A factorial experiment was conducted in one of the date palm horticulture stations of the Ministry of Agriculture for the purpose of studying the effect of adding N.P.K. fertilization with different distances, dates and concentrations in growth and yield for date palm trees of the Zahdi variety, three factors were used in the experiment after selecting 54 palm trees. The first factor included two spaces for feeding trees with fertilizer (100 and 200) cm, coded (A1 and A2). While he applied three dates for preparing fertilizer (10/2021, 3/12/2021, and 3/2/2022) code for them (B1, B2, and B3), while the concentration of fertilizer included the third factor, which included three concentrations of fertilizer, which are (250:250:500 and 500:500:750) gm L^{-1} In addition to the non-fertilization treatment, it is coded (C1, C2, and C3). The random block design was followed with three replications, and the averages were compared according to the least significant difference (L.S.D). At a probability level of 0.05 in analyzing the data statistically. The results of the experiment showed the superiority of the triple interaction treatment (A2B2C3) in the fruit content of carbohydrates, protein, phosphorus and total plant yield, while the triple interaction treatment (A2B1C3) excelled in the leaves content of chlorophyll according to the conditions of the experiment.

Keyword: Date palm, Al-Zahdi variety, NPK fertilizer, Total yield

Introduction

The date palm (*Phoenix dactylifera* L.) belongs to the Arecaceae family, This order is one of the most famous plant orders spread in hot, semi-arid and dry regions. Its cultivation is widespread in tropical and semi-tropical regions between latitudes (10-30) north and (20) south of the equator (Marzouk, 2011). The Zahdi cultivar comes first in terms of number and quantity in spread and total production for palm varieties grown in Iraq, as its total production in Iraq was estimated at (54.0%), as it is one of the famous commercial and economic varieties (Central Statistical Organization, 2020). Palm trees, especially in Iraq, suffer from a decline in their numbers and quantity of production, and this is due to several reasons, including the neglect of palm groves and the prevailing belief that the palm tree does not need fertilization (Al-Mudhaffar, 2019). Mixed mineral fertilizers or a mixture of them are relatively pure materials with a high content of nutrients for the plant, which are ready directly, decompose and release the elements quickly, and the mixing process takes place with more than one nutrient in limited and fixed proportions (Al-Mawsily, 2019). Choosing the right time and how to apply fertilizer is one of the important factors, especially for perennial plants and soils that are poor in their content of nutrients and organic matter, and that the characteristics of the fertilizer to be added have an impact on choosing the date of application (Salomy and Ghalib, 1980). The date palm has a large root system that extends to more than 10 m, which requires searching for the best distances and dimensions to

add these fertilizers. Also, the nature of the growth of palm trees, which is characterized by non-stop throughout the year and the different date for the formation of flower buds, leads to the search for the appropriate date to add these fertilizers. In view of the above, the study aimed to improve the indicators of yield and quality of date palm trees of the Zahdi variety, with the effect of different techniques of adding N.P.K.

Materials and Methods

A factorial experiment was carried out at one of the stations of the General Authority for Palms in Babil Governorate, Al-Mahaweel District, affiliated to the Ministry of Agriculture, for the purpose of studying the effect of adding N.P.K. With different distances, dates and concentrations in growth and yield of date palm trees of the Zahdi cultivar. 54 regularly planted palm trees were elected, with 18 palm trees for each replicate. Trees of approximately similar growth were chosen in terms of height and growth strength at the age of 25 years. Then, all service operations were carried out on them according to the need during the study period. They were also vaccinated with Al-Ghanami vaccine on 3/22/2022. The experiment was designed according to the randomized complete block design, and the data were analyzed according to the statistical program GenStat 2010, and the averages were compared between the treatments using the least significant difference L.S.D. At a probability level of 5% (Al-Asadi, 2019).

The experiment included three factors and three replications for each treatment, such as the first factor after adding fertilizer to the perimeter of the palm tree, as the compound fertilizer was added on two levels with two processing distances (100 and 200) cm after digging 4 holes for each palm tree with a depth of 50 cm using a mechanical excavator and preparing the fertilizer by means of plastic pipes with a diameter 2 inch and 6 cm long, it was pierced by an electric drill with 7 holes at depths of (30, 40 and 50) cm, then it was covered with a perforated plastic cover and fixed in the soil at a depth of 50 cm, denoted by the symbol (A1 and A2), while three dates for fertilizer processing were applied (3/10/ 2021, 3/12/2021, and 3/2/2022) code for it (B1, B2, and B3), while the fertilizer concentration included the third factor, which included three fertilizer concentrations (250:250:500 and 500:500:750) gm L^{-1}, in addition to The non-fertilization treatment is coded (C1, C2, and C3) by two batches for each concentration, with a one-month difference between each batch and the next. Fertilizers were prepared after mixing them and making a fertilizer mixture by dissolving them in 16 liters of water, and then injecting them into the perforated tubes located around the trunk of the tree.

The following parameters were studied after the plant reached the stage of full flowering and were as follows:

1- **The percentage of chlorophyll in the leaves (%):** It was measured in the postgraduate laboratories of the College of Technical/Musayib according to the method of Parry *et al*. (2014), after the fresh leaf samples of each experimental unit were digested with acetone (concentration 80%) and the light absorption reading was taken for each leaf sample Spectrophotometer and then the average for each treatment.

2- **The phosphorous content of the fruits (%):** It was estimated according to the method of Olsen and Sommer (1982) using ammonium molydate and ascorbic acid by the colorimetric method by Spectrophotometer at a wavelength of 882 nm.
3- **Carbohydrate content of fruits (%):** It was estimated according to the method of Masuko (2005) by taking 200 mg of dry sample powder in a test tube and adding 8 ml of ethyl alcohol with a concentration of 80%, and it was measured by Spectrophotometer at a wavelength of 560 nm.
4- **Fruit content of protein (%):** It was estimated on the basis of dry weight based on the estimation of the percentage of total nitrogen (A.O.A.C., 1970) according to the following equation:

The percentage of proteins = the percentage of nitrogen in the sample x 6.25

5- **Total yield (kg):** The weight of the total yield after the full fruiting process, according to each treatment by means of a field scale on (10/1/2022).

Results and Discussion

First/ The percentage of chlorophyll in the leaves (%)

The results of Table (1) indicate that the distance has a significant effect on the percentage of chlorophyll, as the treatment (A1) achieved a significant superiority in this characteristic and recorded the highest average of (2.72%) compared to (2.51%) for the treatment (A2), and the date of adding chemical fertilizer had a significant effect In the same capacity, treatment (B3) gave the highest average of (2.68%) compared to treatment (B1), which recorded the lowest average of (2.53%). The concentration of chemical fertilizer added injected into the soil caused a significant response to the aforementioned characteristic, so the treatment (C3) recorded a significant superiority over other treatments by achieving an average of (3.03%), while the lowest average was recorded in the comparison treatment with an average of (2.34%).

The results of the same table also showed that there were significant differences resulting from interaction the distance of fertilizer addition with the date of adding chemical fertilizer recorded a significant increase in the average percentage of chlorophyll in the leaves of the treatment (A1B3), which was significantly superior to the other treatments by recording the highest average of (2.83%) compared to the treatment Interference (A2B2), which recorded the lowest average of (2.50%). The interaction of the fertilizer application distance with the chemical fertilizer concentration also recorded a significant case in the same parameter, so the interaction treatment (A1C3) recorded the highest average of (3.14%), while the treatment (A2C2) gave the lowest average of (2.15%), and the interaction of the fertilizer application date with the fertilizer concentration The chemical effect had a significant effect on the above characteristic, as the interaction treatment (B1C3) recorded the highest average (3.20%), while the treatment (B2C1) gave the lowest average (2.12%).

The triple interaction between the factors of the experiment combined (the distance of adding chemical fertilizer N.P.K., the date of its addition and its concentration of N.P.K. fertilizer)

had a significant increase in the percentage of chlorophyll in the leaves, as the treatment (A2B1C3) recorded a significant superiority in the same trait by achieving the highest average of (3.24%), while the lowest average for this treatment was (3.24%), Characteristic (2.11%) when treating the triple interaction (A2B2C1).

Table (1) The effect of adding chemical fertilizers at different distances, dates and concentrations and their interactions on the percentage of chlorophyll in the leaves (%)

Area × Date adding	) C (Concentration of Fertilizer			Date of adding)B(	Area)A(
	C3	C2	C1		
2.54	3.16	2.25	2.22	**B1**	**A1**
2.80	3.12	3.13	2.14	**B2**	
2.83	3.15	3.11	2.24	**B3**	
2.51	3.24	2.16	2.14	**B1**	**A2**
2.50	3.23	2.16	2.11	**B2**	
2.53	2.26	2.13	3.19	**B3**	
0.13	0.22			**L.S.D. 0.05**	
Average of Area	**Area × Concentration of Fertilizer**				
2.72	3.14	2.83	2.20	**A1**	
2.51	2.91	2.15	2.48	**A2**	
0.07	0.13			**L.S.D. 0.05**	
Average of Date	**Date of adding × Concentration of Fertilizer**				
2.53	3.20	2.20	2.18	**B1**	
2.65	3.18	2.65	2.12	**B2**	
2.68	2.70	2.62	2.72	**B3**	
0.09	0.15			**L.S.D. 0.05**	
	3.03	2.49	2.34	**Average of Concentration**	
	0.09			**L.S.D. 0.05**	

Second/ The phosphorous content of the fruits (%)

The results of Table (2) indicate that that the distance has a significant effect on the percentage of phosphorous content of fruits as the treatment (A1) achieved a significant superiority in this characteristic and recorded the highest average of (0.584%) compared to (0.557%) for the treatment (A2), While the date of adding the chemical fertilizer had a significant effect, as treatment (B2) gave the highest average of (0.591%) compared with the rest of the treatments. The concentration of chemical fertilizer added injected into the soil also caused a significant response, so treatment (C3) recorded a significant superiority over other treatments by achieving an average of (0.608%). The results of the same table also showed that the interaction between the distance of adding fertilizer and the date of its addition had a significant increase in the percentage of phosphorus in the fruits in the treatment (A2B2), which was significantly superior to the other

treatments and recorded the highest average of (0.614%), compared with the interaction treatment (A2B3), which recorded the lowest an average of (0.548%). The interaction of the fertilizer addition distance with the fertilizer concentration also recorded a significant effect on the same trait. The treatment (A2C3) recorded the highest average of (0.636%), while the treatment (A2C1) achieved the lowest average of (0.519%). The same table shows that the interaction of the fertilizer application date with the fertilizer concentration had a significant effect on the above trait. The treatment (B2C3) recorded the highest average of (0.650%), outperforming the other treatments.

Table (2) The effect of adding chemical fertilizers at different distances, dates and concentrations and their interactions on the percentage of phosphorus in the fruits (%)

Area × Date adding	)C (Concentration of Fertilizer			Date of adding) B(	Area)A(
	C3	C2	C1		
0.553	0.572	0.569	0.519	**B1**	**A1**
0.569	0.598	0.585	0.523	**B2**	
0.548	0.570	0.557	0.517	**B3**	
0.579	0.615	0.604	0.519	**B1**	**A2**
0.614	0.703	0.622	0.517	**B2**	
0.559	0.589	0.566	0.521	**B3**	
0.006	0.010			**L.S.D. 0.05**	
Average of Area	**Area × Concentration of Fertilizer**				
0.557	0.580	0.570	0.520	**A1**	
0.584	0.636	0.597	0.519	**A2**	
0.03	0.006			**L.S.D. 0.05**	
Average of Date	**Date of adding × Concentration of Fertilizer**				
0.566	0.594	0.586	0.519	**B1**	
0.591	0.650	0.603	0.520	**B2**	
0.553	0.580	0.562	0.519	**B3**	
0.004	0.007			**L.S.D. 0.05**	
	0.630	0.616	0.389	**Average of Concentration**	
	0.004			**L.S.D. 0.05**	

As for the triple interaction between the experimental factors, it achieved a significant increase in the percentage of average phosphorus in the fruits. The treatment (A2B2C3) recorded a significant superiority in the mentioned trait by achieving the highest average of (0.703%), while the treatment (A1B3C1 and A2B2C1) gave the lowest average for this trait amounting to (0.517%).

Third/ Carbohydrate content of fruits (%)

The results of Table (3) show that the dimension and date of adding chemical fertilizer and its concentration had a significant effect on the percentage of carbohydrates in the fruits, as the treatments (A2, B2 and C3) achieved a significant superiority in this characteristic amounting to

(26.76, 30.82 and 29.17)%, respectively, while they gave The coefficients (A1, B3, and C1) had the lowest average (25.20, 23.38, and 20.85%), respectively.

Table (3) Effect of adding chemical fertilizers at different distances, dates and concentrations and their interactions on the percentage of carbohydrates in the fruits

Area × Date adding	)C (Concentration of Fertilizer			Date of adding) B(	Area)A(
	C3	C2	C1		
15.10	16.28	16.13	12.88	**B1**	**A1**
15.47	17.72	17.19	11.52	**B2**	
13.84	15.36	14.80	11.34	**B3**	
15.32	16.73	16.43	12.82	**B1**	**A2**
16.03	18.08	17.74	12.27	**B2**	
15.15	15.93	15.73	13.78	**B3**	
0.03	0.06			**L.S.D. 0.05**	
Average of Area	**Area × Concentration of Fertilizer**				
14.80	16.45	16.04	11.91	**A1**	
15.50	16.91	16.63	12.96	**A2**	
0.02	0.03			**L.S.D. 0.05**	
Average of Date	**Date of adding × Concentration of Fertilizer**				
15.21	16.50	16.28	12.85	**B1**	
15.75	17.90	17.46	11.89	**B2**	
14.49	15.64	15.27	12.56	**B3**	
0.02	0.04			**L.S.D. 0.05**	
	16.68	16.34	12.44	**Average of Concentration**	
	0.02			**L.S.D. 0.05**	

The results of the same table show that the interaction between the addition of fertilizer and the date of its application had a significant effect on the trait. A significant increase was recorded in the average percentage of carbohydrates in fruits when treatment (A2B2) gave (32.06%), while treatment (A1B3) gave the lowest average of (22.96%). The interaction of the distance of adding fertilizer with its concentration was significant in the same capacity, so the treatment (A2C3) recorded the highest mean of (29.82%), significantly superior to other treatments. The interaction of the time of adding fertilizer with its concentration had a significant effect on the above trait, so the treatment (B2C3) recorded the highest mean of (36.73%), outperforming the other treatments.

As for the triple interaction between the experiment factors, the treatment (A2B2C3) achieved a significant superiority in the aforementioned characteristic by achieving the highest average of (37.22%), while the lowest average was (20.18)% when the triple interaction treatment (A1B1C1).

Forth/ Fruit content of protein (%)

The results of table (4) showed that there was no significant effect of the distance on the characteristic of the percentage of the average protein content of the fruits. The same table also indicated that the time of adding chemical fertilizer and its concentration injected into the soil had a significant response to the same characteristic, as treatment (B2) and (C3) gave the highest average They were (8.371 and 8.757)% for each of them, respectively, while the two treatments (B3) and C1) gave the lowest average of (6.628 and (5.488%), respectively.

The results of the table also showed that the interaction of the distance of adding fertilizer with the date of its addition had a significant effect on the percentage of protein in the fruits when treatment (A2B2) gave the highest average (8.486%) while treatment (A2B3) gave the lowest average (6.504%). The interaction distance of fertilizer addition with its concentration had a significant effect on the same trait, so treatment (A1C3) recorded the highest average of (8.917%), in contrast to treatment (A1C1), which achieved the lowest average (5.370%). The interaction of the date of adding fertilizer with its concentration had a significant effect, so the treatment (B2C3) recorded the highest average of (10.039%), while the lowest average was achieved in the treatment (B2C1) of (5.359%). The results of the same table indicate that the triple interaction between the experimental factors had a significant impact on the protein content of the fruits, as the treatment (A2B2C3) recorded a significant superiority in the above characteristic by achieving the highest average of (10.048%), while the lowest average was (5.005%) in the interaction treatment. triple (A1B2C1).

Table (4) Effect of adding chemical fertilizers at different distances, dates and concentrations and their interactions on the percentage of protein in the fruits

Area × Date adding	)C (Concentration of Fertilizer			Date of adding) B(	Area)A(
	C3	C2	C1		
7.026	8.873	7.021	5.183	**B1**	**A1**
8.256	10.029	9.733	5.005	**B2**	
6.751	7.848	6.481	5.923	**B3**	
6.941	7.896	7.029	5.898	**B1**	**A2**
8.486	10.048	9.698	5.713	**B2**	
6.504	7.850	6.454	5.208	**B3**	
0.473	0.819			**L.S.D. 0.05**	
Average of Area	**Area × Concentration of Fertilizer**				
7.344	8.917	7.745	5.370	**A1**	
7.310	8.598	7.727	5.606	**A2**	
N.S	0.473			**L.S.D. 0.05**	
Average of Date	**Date of adding × Concentration of Fertilizer**				
6.983	8.384	7.025	5.541	**B1**	
8.371	10.039	9.716	5.359	**B2**	
6.628	7.849	6.468	5.566	**B3**	
0.334	0.579			**L.S.D. 0.05**	

8.757	7.736	5.488	**Average of Concentration**
0.334			**L.S.D. 0.05**

Fifth/ Total yield (kg):

The results of the statistical analysis in Table (5) show that there is no significant effect of the distance on the mean of the total yield. While the date of adding chemical fertilizer had a significant effect on the same trait, as treatment (B2) gave the highest average of (112.8 kg) without differing significantly from treatment (B1), which achieved an average of (108.1 kg) compared to treatment (B3), which recorded The lowest average was (74.9 kg). The concentration of chemical fertilizer added injected into the soil caused a significant response to the aforementioned characteristic, so treatment (C3) recorded a significant superiority over other treatments by achieving an average of (115.0 kg), to outperform only the control treatment without significantly differing with treatment (C2), which recorded an average of (109.5 kg), while the lowest mean for this trait was recorded in the control treatment with an average of (71.3 kg).

The results of the same table also show that the interaction of the distance of fertilizer with the time, the interaction of the distance of fertilizer application with the concentration of fertilizer, and the interaction of the time of application of fertilizer with the concentration of fertilizer, a significant increase in the average percentage of the total yield, as the binary interaction coefficients (A2B2), (A2C3) and (B2C3) gave, respectively. Significant increase over the other treatments amounted to (117.6, 117.3 and 135.8) kg, respectively, while the treatment (A2B3) and the two treatments (A1C1 and A2C1) and treatment (B3C3) gave the lowest average of (73.1 kg) and (71.3 kg) for both, and an average Has a total of (67.1) kg.

Table (5) Effect of adding chemical fertilizers at different distances, dates and concentrations and their interactions on total yield (Kg)

Area × Date adding	**)C (Concentration of Fertilizer**			**Date of adding) B(**	**Area)A(**
	C3	**C2**	**C1**		
107.3	125.3	117.0	79.7	**B1**	**A1**
108.0	131.7	122.0	70.3	**B2**	
76.7	81.0	85.2	64.0	**B3**	
108.8	133.2	119.0	74.3	**B1**	**A2**
117.6	139.8	143.7	69.3	**B2**	
73.1	79.0	70.0	70.2	**B3**	
13.01	22.54			**L.S.D. 0.05**	
Average of Area	**Area × Concentration of Fertilizer**				
97.4	112.7	108.1	71.3	**A1**	
99.8	117.3	110.9	71.3	**A2**	
NS	13.01			**L.S.D. 0.05**	
Average of Date	**Date of adding × Concentration of Fertilizer**				
108.1	129.2	118.0	77.0	**B1**	

112.8	135.8	132.8	69.8	**B2**
74.9	80.0	77.6	67.1	**B3**
9.20	15.94			**L.S.D. 0.05**
	115.0	109.5	71.3	**Average of Concentration**
	9.20			**L.S.D. 0.05**

As for the triple interaction between the factors of the experiment combined (distance of adding chemical fertilizer, when it was added, and its concentration), it achieved a significant increase in the average percentage of the total yield, as the treatment (A2B2C2) recorded a significant superiority in the same characteristic by achieving the highest average of (143.7 kg), while it reached The lowest mean for this trait was (64.0) kg when the treatment (A1B3C1).

The significant increase achieved in Tables (1-5) may be attributed to the increase in the spread of roots and their extension horizontally, as well as the large number of branches and their reach to long distances, with a clear increase in the density of the root system and its penetration into the soil confined to a circle with a diameter of 4.20m, which may reach a size of It is approximately 200 m^3, in addition to its activity throughout the year, as in the date palm, a green variety, as its roots reach more than 7 m with a horizontal and vertical extension from its point of origin (Abdel-Alal, 1977 and Elshurafa, 2020). This is reflected positively in increasing the efficiency of the root system in absorbing nutrients from the soil (Al-Mudhaffar, 2019). This result agreed with what was reached by Al-Sharifi (2019), who found that the addition of nutritious fertilizer at a distance ranging between 90-100 cm from the trunk of the palm tree had a significant effect on all the apparent and productive characteristics. This result also agreed with what was obtained by Jassim and Al-Arab (2015) that adding compound fertilizer at a concentration of 1500 gm to date palms of Al-Sayer variety at a distance of 1m from the trunk of the palm tree caused a significant increase in most of the studied traits. As for the date of adding the compound fertilizer, this may be attributed to the fact that the date palm trees may be suitable for the second date, specifically the beginning of December, as they have gone through a stressful phase as a result of the previous year's pregnancy and as a result of the formation of flower buds under the armpits of the leaves, so they will be regaining their activity for the next season and they will have benefited from the chemical fertilizer, Added to the soil, which is reflected in the increase in the formation of carbohydrates and proteins, which increases the growth rates, which eventually leads to the formation of seedlings, an increase in the number of flowers, the number and size of fruits, until the ripening date (George *et al*., 2013). The significant effect caused by the concentration of the compound fertilizer injected into the soil of cultivation may also be attributed to the fact that this concentration may be the ideal concentration at which the best results occur that are positive in bringing about a significant increase in the fruit yield in quantity and quality, in addition to the role of the three elements physiologically and their relationship to growth processes And the development that occurs during the period of the plant life cycle, including the regulation of vital activities, the increase in cell division, and an exponential increase in the process of photosynthesis and building the structure of the plant by stimulating the construction of proteins, amino acids,

energy compounds, and nucleic acids (Abu Dhahi and Al-Younes, 1988). As for the exponential increase that occurred in the chlorophyll content of the leaves, it may be due to the role of the nitrogen element added through the compound fertilizer, which is directly involved in the construction of the chlorophyll molecule, as nitrogen is an essential part in the formation of the green pigment that enters into the process of photosynthesis and gives plant leaves a green color. , as 70% of the nitrogen in the leaf is included in the composition of this organelle, and therefore the increase in the efficiency of the photosynthesis process may be due to a clear improvement in the overall growth characteristics, including an increase in the proportion of chlorophyll, in addition to the role of nitrogen as a source of energy that the plant needs in building plastids and doing this The process has the highest rates compared to the no-fertilization treatment (Hopkins, 2006).

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