



Management of fruitful date palm offshoots of *Phoenix dactylifera* L. of Barhi cultivar by using optimum pollen and antioxidant in chemical traits

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Abstract

This study was conducted in one of the orchards belonging to Al-Qurna district of Basrah province - Iraq for the purpose of showing the effect of pollen cultivars and spraying with antioxidant on the physical and physiological traits of the fruits of the date palm of the Barhi cultivars. Palm trees were pollinated with three cultivars of males, namely, Al-Ghanami green, Al-Ghanami green + Al-Ghanami Red, and Al-Ghanami green + Al-Khakri, and the palm trees were sprayed with antioxidant 0, 3, 6 ml. L⁻¹, Where the vegetative and fruits were sprayed and the spraying was provided when the fruits reached the Khalal stage. The results of the study indicated the following: The pollination of palm trees with different pollen cultivars led to the improvement of most of the chemical traits except for the percentage of sucrose, where the pollination treatment of Al-Ghanami green + Al-Ghanami red recorded the lowest percentage of moisture content of the fruits amounted to 38.02 % and the highest percentage of dry matter was 61.98% and the highest average of total sugars and The reduced amount amounted to 55.31%, 47.99 % and the total soluble solids percentage reached 59.54 % Spraying palm trees with antioxidant had a significant effect in improving the chemical properties without the percentage of moisture content and the percentage of sucrose, as the treatments of spraying with antioxidant at a concentration of 6 ml.L⁻¹ recorded the highest percentage of dry matter amounted to 61.44 % ,The same concentration also recorded the highest average of total sugars in the fruits amounting to (54.11%) and the highest percentage of total soluble solids amounted to 58.435 ,Whereas, spraying treatment with a concentration of 3 ml.L⁻¹ recorded the highest percentage of reducing sugars, which amounted to 45.77 % .

Keywords: date palm, *Phoenix dactylifera* L., Barhi cultivar, optimum pollen

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Introduction

The date palm (*Phoenix dactylifera* L.) belongs to the palm family (Arecaceae) and is one of the subtropical fruit trees. Its cultivation spreads in Iraq

and in many regions of the Middle East. It is believed that the original home of the date palm is southern Iraq and the Arabian Gulf region, and its importance lies in many Countries of the world as



having great economic and social value (Barreveld, 1993). Matar (1991) pointed out that there are more than (600) agricultural varieties of date palms that are spread in the agricultural areas of central and southern Iraq. Where (Basrah province) is considered the place where palm trees are widely spread, as the density of palm trees is along the two banks of the Shatt al-Arab. The cultivation of date palm in Iraq has witnessed an expansion recently, as in some countries of the world, which tended to develop palm cultivation significantly. As it is known, palms reproduce by seeds or cuttings, but due to the genetic heterogeneity of trees resulting from seed cultivation, as well as the offshoots produced by the mother palm are limited in number, especially rare varieties and desirable varieties, so they do not meet the needs of farmers and orchard owners to establish new orchards, and therefore the use of tissue culture Plant for seedling processing is the ideal solution. As the tissue-propagated shoots are resistant to various diseases and have a high vegetative growth rate, and some forms of trees that result from tissue cultivation occur, the most important of which is the lack of fruit-setting (shik) process, as well as the weak resistance of those trees to salt stress (Cain, 2015). The process of spraying with antioxidants is considered one of the most important service operations at the present time as a result of the inappropriate conditions that palm trees go through, including the salinity of irrigation water and soil. These compounds would increase the trees' ability to tolerate salt and osmotic adjustment, in addition to containing several compounds and nutrients (Ibrahim, 2008). For the purpose of increasing productivity and improving vegetative growth, farmers have recently tended to use bio-stimulants and antioxidants found in natural compounds in agriculture instead of using chemical fertilizers, in order to preserve the environment and to avoid side effects (Grimstad, 1995). In a study conducted by Daoud *et al*, (2001) it

was found a clear effect of pollen cultivar on the percentage of total sugars for palm fruits of Al-Zuhdi cultivar, where the resulting palm fruits vaccinated with pollen of each of Al-Ghanami red, Al-Ghanami green, Al-Khakri Samisi and Al-Khakri Kreitli contained total sugars with a percentage of 59.12 % , 58.89 % , 58.31 % and 55.6 % , respectively. Due to the occurrence of some problems in the offshoots resulting from tissue culture recently, despite the fact that the owners of the orchards vaccinate the trees with repeated pollination at different periods, the idea of this study was directed to address the failure in pollination date palm trees Barhi tissue as well as the high salinity in the palm orchards where pollination were used Different with antioxidant and the extent of its treatment of the problem of insemination and fertilization, as well as its impact on the qualitative, chemical and productive characteristics, and the reduction of the damages of salt stress through the use of one of the antioxidants.

3- Materials and methods

This study was conducted in one of the private orchards belonging to the Al-Jazirah Al-Hamra area in Al-Qurnah District - Basrah province, during the period from 1/10/2020 to 1/10/2021. As 27 tissue offshoot of the fruitful Barhi cultivar were selected based on the symmetry in the strength of vegetative growth and the absence of diseased infection, with close ages ranging between 7-9 years, palms are irrigated by surface irrigation method. The orchard was configured and the palm trees used in the experiment were identified by digital labeling on them and according to the treatment and replicates. The offshoots were pollination with three pollen, namely, Al-Ghanami green, a mixture of the Al-Ghanami green, Al-Ghanami red and a third mixture of Al-Ghanami green and Al-Khakri, starting from 30/3/2021 to 15/4/2021, considering that the Al-Ghanami green pollen is the control treatment and the mixture of



the other two pollen is mixed in a ratio of 50: 50 for each cultivars, by shaking off the pollen grains from the grounds and mixing them with the pollen grains of the other cultivar, and keeping them away from the other treatment mixture and from the control treatment. The offshoots are pollinated by scattering the pollens used in the female pollen that is available for pollination. Then, the female pollen is bagged immediately after the pollination process to ensure that pollen grains from other treatments are not transferred between the palms. Then the pollen mixture is added with the same treatments to all the offshoots to ensure that the process of pollination and the occurrence of contract and fertilization occur. The experimental units were sprayed with antioxidant for three treatments 0, 3, 6 ml.L⁻¹ by spraying the leaves and fruits in 6 batches starting from 1/10/2020 and the spraying process is repeated every 30 days. As for the control treatment, the experimental units were sprayed with distilled water, and the diffuser material was added at a concentration of (tewwn20) 0.1 % to the prepared solution in order to reduce the surface tension of the water and increase the adhesion of the substance to the leaves. Six bunches were left on each palm tree to be used in the subsequent experimental measurements.

Preparation of plant samples

Fruit samples were collected by randomly taking 10 samples (fruits) for physical and chemical characteristics from each replicate (tree) during the Khalal stage (16 weeks after pollination) and the Rutab stage (22 weeks after pollination). Where the physical traits were measured, then the fruits were dried at a temperature of 65 °C, crushed and kept in plastic containers until chemical analyzes were performed.

Chemical traits of the fruits in the Rutab stage

1- Water content and dry matter

The water content and dry matter of the flesh of the fruit, whose weight, volume and dimensions

were measured and dried in a vacuum oven at a temperature of 65 °C for 48 hours. When the weight was constant, the percentage of water content and dry matter of the fruits was calculated as in the following equations:

$$\text{Water content percentage} = \frac{\text{fresh sample weight} - \text{dry weight of the sample}}{\text{fresh sample weight}} \times 100$$

$$\text{Dry matter percentage} = \frac{\text{dry sample weight}}{\text{fresh sample weight}} \times 100$$

Total and reducing sugars and sucrose

Total, reducing sugars and sucrose were estimated in the fleshy part of the fruits of the Barhi date palm in the laboratory of the College of Agriculture, using Lane & Eynon method described in Howrtiz (1975) by taking 0.5 g of dried fruit flesh at 65 °C and adding 50 ml of distilled water to it. In a water bath at 70 °C for 45 minutes in order to extract sugars from the flesh of the fruits. Then it was placed in a centrifuge for 10 minutes in order to get rid of the precipitate, then the resulting filtrate was taken and the process of clearing was conducted by adding 3 ml of neutral lead acetate, then the precipitate was disposed of in the same way, after which the volume was completed up to 100 ml with distilled water. As for the reducing sugars, they were estimated in the leached solution by grinding with a mixture of Fahlberg solution (A + B), and the acid hydrolysis process was conducted to analyze sucrose for the purpose of estimating the total sugars. According to Howrtiz (1975), the percentage of total and reducing sugars and sucrose was calculated. The following equations show this:

$$\% \text{ Sucrose} = \text{Total Sugars \%} - \text{Reducing Sugars \%} \times 0.95$$

$$\text{Total sugars (\%)} = \text{reducing sugars (\%)} + \text{sucrose (\%)}$$

3- Total soluble solids (TSS)



10 g of the flesh of the cut fruits was weighed, 30 ml of distilled water was added to it, then it was mashed well using a ceramic mortar, then filtered, and the percentage of total soluble solids in it was estimated using a Hand Refractometer by taking a drop of juice and placing it on the device prism. The results were adjusted based on the optimum temperature of 20°C, which was measured using Howrtiz (1975) method.

Statistical design and parameters used

The experiment was coundected as a factorial experiment with two factors, the first for three cultivar of pollen Al-Ghanami green, Al-Ghanami green+ Al-Ghanami red and Al-Ghanami green and Al-Khakri , and the second factor is an antioxidant of three concentrations 3 and 6 ml.L⁻¹

According to the Randomized Complete Block Design, with three replications, the number of Barhi palm trees used in the experiment reached 27 palm trees. The data were statistically analyzed according to the followed design and using the GenStat 2007 program, and the arithmetic means were compared according to the least significant difference test (LSD) and at the level of significance (0.05) based on (Al-Rawi and Khalaf Allah, 2000).

Results and discussion

1- Moisture content (%)

Table (1) shows the effect of pollen cultivars and spraying with antioxidant and the interaction between them on the tissue date palm trees, Cultivar Barhi, on the moisture content of the fruits. The table recorded the significantly excelled of the Al-Ghanami green pollination by recording the highest average of moisture content in the fruits amounted to 40.41 5 , compared with the Al-Ghanami green + Al-Ghanami red pollination, which gave the lowest average of moisture content amounted to 38.02 % , The table also shows that there were no significant differences between the treatments of spraying with antioxidant in the percentage of moisture content of the fruits. The spray treatment was recorded at a concentration of 3 ml. L⁻¹ had the highest percentage of moisture content of fruits amounted to 40.31 % , while spraying treatment was recorded at a concentration of 6 ml. L⁻¹ had the lowest percentage of moisture content of fruits amounted to 38.56 %. As for the bi-interaction between the type of pollen and spraying with antioxidant, the table shows that there are no significant differences between the different interaction treatments.

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Table (1) Effect of pollen cultivars and spray with antioxidant and the interaction between them on the percentage of moisture content (%)

| Pollen cultivars Antioxidant | Ganami green | Ganami green + Ganami red | Ganami green + Khakri | Concentration average |
|---------------------------------|--------------|---------------------------------|-----------------------------|--------------------------|
| 0 | 40.16 | 37.69 | 38.63 | 38.83 |
| 3 | 41.47 | 38.75 | 40.48 | 40.31 |
| 6 | 39.35 | 37.61 | 38.72 | 38.56 |
| RLSD interaction | N.S | | | RLSD |
| Cultivars average | 40.41 | 38.02 | 39.27 | |



| | | |
|----------------------|-------------|--------------------------|
| RLSD cultivar | 1.26 | Concentration N.S |
|----------------------|-------------|--------------------------|

2- Dry matter percentage (%)

The results in Table (2) showed that the effect of pollen cultivars and spraying with antioxidant and the interaction between them on the tissue date palm trees, cultivar Al-Barhi, on the percentage of dry matter in the fruits. The results showed that the Al-Ghanami green + Al-Ghanami red pollination treatment was significantly excelled by recording the highest percentage of dry matter in the fruits that amounted to 61.98 % , compared to the treatment of Al-Ghanami green pollination, which recorded the lowest percentage of dry matter amounted to 59.59 % , The table shows the significant difference between the treatments of spraying with antioxidant, where the spray

treatment with a concentration of 6 ml. L⁻¹ was significantly excelled by giving it the highest percentage of dry matter amounted to 61.44 % compared to spraying treatment with a concentration of 3 ml. L⁻¹, which gave the lowest percentage of dry matter, amounted to 59.69 % , As for the bi-interaction, the table shows that there are no significant differences between the different interaction treatments, as the interaction treatment recorded Al-Ghanami green + Al-Khakri and concentration 3 ml. L⁻¹, the highest percentage of dry matter in the fruits amounted to 62.39 % While the lowest percentage of dry matter in fruits was 58.29 when dealing with the interaction of Al-Ghanami green + Al-Ghanami red and the control treatment.

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Table (2) Effect of the pollen cultivar and antioxidant and the interaction between them on the percentage of dry matter (%)

3- Total sugars:

sugars in the fruits. Where the results showed the

| <div>Pollen cultivars</div> <div>Antioxidant</div> | Ganami green | Ganami green + Ganami red | Ganami green + Khakri | Concentration average |
|--|--------------|---------------------------|-----------------------|-------------------------|
| 0 | 59.84 | 62.31 | 61.37 | 61.17 |
| 3 | 58.29 | 61.25 | 58.29 | 59.69 |
| 6 | 60.65 | 62.39 | 61.28 | 61.44 |
| RLSD interaction | N.S | | | RLSD Concentration 1.32 |
| Cultivars average | 59.59 | 61.98 | 60.73 | |
| RLSD cultivar | 1.32 | | | |

The result in Table (3) represents the effect of pollen cultivar and spray with antioxidant and the interaction between them on tissue date palm trees, cultivar Al-Barhi on the average of total

significant effect of the Al-Ghanami green + Al-Ghanami red pollination and the Al-Ghanami green + Al-Khakri , which recorded the highest average of total sugars in the fruits of 55.31 and 53.38,



respectively, As it can be seen from the table, the excelled of spraying with anti-oxidant at a concentration of 6 ml. L⁻¹ by recording the highest average of total sugars 54.11% compared to the control treatment, which recorded the lowest percentage of total sugars in the fruits, which amounted to 50.21% , As for the bi-interaction, the table shows that there are no significant

differences between the different pollen treatments, where the interaction treatment recorded Al-Ghanami green + Al-Khakri and concentration 3 ml. L⁻¹, the highest rate of total sugars reached 59.15 % Whereas, the interaction treatment of Al-Ghanami green + Al-Khakri and the control treatment gave the lowest average of total sugars which amounted to 48.44% .

Table (3) Effect of the pollen cultivars and spray with antioxidant and the interaction between them on total sugars (%)

| <div>Pollen cultivars</div> <div>Antioxidant</div> | Ganami green | Ganami green + Ganami red | Ganami green + Khakri | Concentration average |
|--|--------------|---------------------------|-----------------------|-------------------------|
| 0 | 48.95 | 49.58 | 52.11 | 50.21 |
| 3 | 50.31 | 57.20 | 52.62 | 53.38 |
| 6 | 48.44 | 59.15 | 54.74 | 54.11 |
| RLSD interaction | 5.87 | | | RLSD Concentration 3.39 |
| Cultivars average | 49.23 | 55.31 | 53.16 | |
| RLSD cultivar | 3.39 | | | |

Reducing sugars (%)

The results in Table (4) showed that the significant effect of pollen cultivar and spray with antioxidant and the interaction between them on tissue date palm trees, cultivar Barhi on the average of reducing sugars. The results showed significantly excelled of the Al-Ghanami green + Al-Ghanami red pollination by recording the highest average of reducing sugars in the fruits amounting to 47.99 % compared with the pollination of Al-Ghanami green, which recorded the lowest average of reducing sugars in the fruits amounted to 40.99% . The results of the same table also showed the significant effect of spraying with antioxidants, where the two spraying treatments were significantly excelled at the two concentrations 3, 6 ml. L⁻¹ recorded the highest rate of reducing sugars in fruits that amounted to 45.77, 45.29% for the two concentrations, respectively, compared to the control treatment, which recorded the lowest rate of reducing sugars amounted to 42.24% . As for the bi-interaction, it is clear from the table that there are clear significant differences between the different interaction treatments.



Table (4) Effect of the pollen cultivars and spray with antioxidant and the interaction between them on average reducing sugars (%)

| <div>Pollen cultivars</div> <div>Antioxidant</div> | Ganami green | Ganami green + Ganami red | Ganami green + Khakri | Concentration average |
|--|--------------|---------------------------|-----------------------|-------------------------|
| 0 | 41.89 | 42.86 | 41.98 | 42.24 |
| 3 | 41.78 | 49.90 | 45.64 | 45.77 |
| 6 | 39.02 | 51.22 | 45.64 | 45.29 |
| RLSD interaction | 4.49 | | | RLSD Concentration 2.59 |
| Cultivars average | 40.90 | 47.99 | 44.42 | |
| RLSD cultivar | 2.59 | | | |

5- Sucrose (%)

The results in Table (5), which represent the effect of pollen cultivar and spray with antioxidant and the interaction between them on tissue date palm trees, cultivar Barhi on the sucrose rate in the fruits, indicate that there are no significant differences between the different pollen cultivars. The treatment of pollination of Al-Ghanami green + Al-Khakri recorded the highest average of sucrose in the fruits amounted to 8.74% while the treatment of pollination of Al-Ghanami green + Al-Ghanami red recorded the lowest

average of sucrose in the fruits amounted to 7.32%. Also, the treatments of spraying with antioxidant did not record any significant differences in the average of sucrose in the fruits, where the spray treatment was recorded at a concentration of 6 ml. L⁻¹ had the highest average of sucrose in the fruits reached 8.82% as for spraying treatment with a concentration of 3 ml. L⁻¹, it recorded the lowest average of sucrose in fruits that reached 7.61%. As for the interaction, it is noted from the table that there are no significant differences between the different interaction treatment.

Table (5) Effect of pollen cultivars and spray with antioxidant and the interaction between them on the sucrose average(%)

| Pollen cultivars Antioxidant | Ganami green | Ganami green + Ganami red | Ganami green + Khakri | Concentration average |
|---|---------------------|--|--------------------------------------|----------------------------------|
| | | | | |



| | | | | |
|-------------------|------|------|-------|------------------------------|
| 0 | 7.06 | 6.72 | 10.13 | 7.97 |
| 3 | 8.54 | 7.30 | 6.98 | 7.61 |
| 6 | 9.42 | 7.92 | 9.11 | 8.82 |
| RLSD interaction | N.S | | | RLSD Concentration N.S |
| Cultivars average | 8.34 | 7.32 | 8.74 | |
| RLSD cultivar | N.S | | | |

6- Total soluble solids (TSS) %

Table 6 showed that the effect of pollen and spraying with antioxidants and the interaction between them on the palm trees of the tissue date palm, Barhi cultivar, on the percentage of total soluble solids(TSS)The results of the table showed the significantly excelled of the two treatments of pollination of Al-Ghanami green + Al-Ghanami red and Al-Ghanami green + Al-Khakri by recording the highest percentage of TSS amounting to 59.54 and 57.39% respectively compared to the treatment of pollination of Al-Ghanami green which gave the lowest percentage of TSS which amounted to 53.46 %.The results of the table also indicate that there are significant differences between the treatments

of spraying with antioxidant, where the spray treatment with a concentration of 6 ml was superior. L⁻¹ significantly by recording the highest percentage of TSS amounted to 58.34% compared to the control treatment which recorded the lowest percentage of TSS amounted to 54.44%, The table also recorded that there were no significant differences between the spray treatment at a concentration of 3 ml. L⁻¹ and the other two treatments, where the percentage of TSS in it reached 57.61%.As for the interaction between the pollen cultivars and spraying with antioxidants, the results recorded in the table showed record clear significant of the Ghanami green and 3 ml . L⁻¹ amounted 63.38 % .

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Table (6) Effect of pollen cultivars and spray with antioxidant and the interaction between them on the percentage of TSS (%)

| Pollen cultivars Antioxidant | Ganami green | Ganami green + Ganami red | Ganami green + Khakri | Concentration average |
|---|---------------------|--|--------------------------------------|----------------------------------|
| 0 | 53.18 | 53.81 | 56.34 | 54.44 |
| 3 | 54.54 | 61.43 | 56.85 | 57.61 |
| 6 | 52.67 | 63.38 | 58.97 | 58.34 |
| RLSD interaction | 5.87 | | | RLSD |
| Cultivars average | | | | |



| | | | | |
|---------------|-------|-------|-------|-----------------------|
| | 53.46 | 59.54 | 57.39 | Concentration 3.39 |
| RLSD cultivar | 3.39 | | | |

The discrepancy in the moisture content of the fruits may be due to the metamazine effect of the used pollen cultivars. (Rhodes, 1980). The reason for the low moisture content in the fruits treated with antioxidant may be due to the early maturity of the fruits treated with the antioxidant, which reduced the moisture content in this fruit. As for the percentage of dry matter, the reason for the difference in its results in the fruits may be due to the metamazine effect of the pollen cultivars or because the maturity process occurs faster when pollinating with pollen cultivars without others, which caused a decrease in the moisture content and an increase in the proportion of dry matter (Shabana *et al.*, 2006). The increase in the percentage of dry matter in the fruits treated with antioxidant may be due to the antioxidant content of the elements N and K, which affect the enzymes responsible for stimulating the transfer of food made in the leaves and food stored in the heart of the palm to the fruits and its accumulation in them (Al-Rubaie, 2021). The reason for the differences in the content of total and reducing sugars in fruits may be due to the metabolizing effect of pollen cultivars that work on the production of new hormones by encouraging the tissues of the fruit to do so in the transfer of sugary substances to the fruits (Daoud and Al-Dalawi, 2001) and (Altemimy *et al.*, 2019). The reason for the increase in the percentage of total and reducing sugars in the fruits may be the increase in the speed and effectiveness of the invertase enzyme, which works to convert the form of sucrose into reducing sugars (Abass *et al.* 1995). The increase in the percentage of total and reducing sugars and the decrease in the percentage of sucrose in the fruits in the Rutab stage may be due to the content of the

antioxidants treated in the fruits, where it contains elements N and K that work as a catalyst in increasing the activity of enzymes responsible for ripening such as invertase and cellulase that work to convert Sucrose into reduced sugars, and thus the proportion of reducing and total sugars increases in the fruits (Al Maraqui, 2005), (Matar, 1991) mentioned that the sucrose stored in the heart of the tree is transferred to the fruits and that the increase in the activity of the invertase enzyme converts sucrose to glucose and fructose (reducing sugars). Or, the reason for the high percentage of total and reducing sugars may be due to the role of the antioxidant contents that increase the content of the fruit of the ethylene hormone, which helps to activate the genes responsible for the activity of the enzymes responsible for the transformation of starch or sucrose into reducing sugars in the tissues of the fruit (Giovannoni, 2004). The above reasons for the difference in the percentage of sugars in fruits apply to the content of fruits from total soluble solids, since sugars constitute the largest part of TSS and therefore they increase in fruits with an increase in the percentage of sugars. These results are consistent with what was reached (Abd *et al.*, 2020) and (Al-Hamoud and Abd, 2019) and (Adafa and Faisal, 2015) and (Al-Jabri *et al.*, 2009) and (Al-Zubaidi, 2015)

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