

The effect of the growth stimulant Bio 20 and thinning on some physiological and physical characteristics of date palm fruits (*Phoenix dactylifera* L.), the Al-Shwaithi cultivar growing in Thi - Qar Governorate.

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Abstract

This study was conducted during the 2023 growing season in one of the private orchards in Thi - Qar Governorate, with the aim of studying the effect of spraying fruits with concentrations of the growth stimulant Bio 20 (0, 2, and 4) ml L⁻¹ and the percentages of fruit thinning (0, 15, and 30)% and their interactions in some physiological and physical characteristics of date palm fruits of the Shuwaithi cultivar in the Rutab stage. The experiment was carried out as a factorial experiment according to a Completely Randomized Block Design with six replications to calculate the studied traits. Concentrations of the growth stimulant Bio 20 were sprayed and the thinning process was performed after (21) days of pollination and upon completion set the fruits with (6) sprays between one and the next (14 days) until the start of the coloring stage.

The results can be summarized as follows:

The results of the study showed that spraying with the growth stimulant Bio 20 achieved a significant increase in most of the physiological and physical characteristics studied, and the concentration (4 ml L⁻¹) recorded the highest averages for: ripening percentage (82.41%), bunch weight (11.16 kg), and fruit weight (11.40 gm.) and the length and diameter of the fruit (3.76 cm, 2.18 cm), respectively, and the fruit size (10.53 cm³). In addition, it recorded the lowest average with a significant difference for the percentage of fruit drop (25.58%).

The thinning percentage (30%) achieved a significant increase in: ripening percentage (84.05%), bunch weight (10.02 kg), fruit weight (11.35 g), fruit length (3.59 cm), fruit diameter (2.12 cm), and fruit size (10.33 cm³). In addition, it recorded the lowest averages with a significant difference in the percentage of fruit drop (22.65%).

As for the effect of the interaction treatment between the concentration of the growth stimulant Bio 20 (4 ml L⁻¹) and the thinning percentage (30%), it was significant in giving the highest averages of physiological and physical characteristics during the Rutab stage.

Key words : Bio 20 , Thinning , bunch weight , Fruit length and fruit weight .

I. INTRODUCTION

The date palm *Phoenix dactylifera* L. is one of the most widespread fruit trees in the world, It belongs to the palm family Arecaceae, which includes about 220 genera and 4,000 species, It is the most beneficial plant family for humans after the Graminae family. The palm has been known since 4000 years



BC and originated in Mesopotamia , from where it spread to the Arabian Peninsula and the World (Al-Bakr, 1972 ; Kader and Hussein , 2009 and Haider *et al.*, 2012).

Iraq has several cultivars of date palms, amounting to more than 627 cultivars , distributed among commercial, local and rare cultivars (Al-Bakr, 1972). The Al-Shwaithi cultivar is considered one of the well-known and widely grown cultivars in the central and southern regions of Iraq, specifically the governorates of Thi - Qar and Basra , it is one of the late-ripening cultivars , and its fruits are distinguished by their good quality with a sweet taste , its fruits are elongated , large in size, spindle-shaped, and yellow in color. The rutab stage has a good flavor and high nutritional value, while in the tamr stage its skin is soft and thin and attached to the core , and its fruits are eaten in the rutab and tamr stages . (Al-Ansari and Saleh, 2005).

The process of spraying with growth stimulants is one of the most important operations for servicing and nourishing palm trees at the present time as a result of the unsuitable conditions to which palm trees are exposed , including the salinity of the soil and irrigation water. These compounds would affect the growth of trees , raise their ability to tolerate salt , and contribute to osmotic adjustment in addition to being it contains several nutrients , for the purpose of increasing productivity and improving vegetative growth , farmers have recently turned to using growth stimulants and biostimulants found in natural compounds in agriculture instead of using chemical fertilizers , in order to preserve the environment by reducing side effects (Ibrahim , 2008). Among the growth stimulants is (Bio 20 stimulant), which is a nutritious fertilizer and growth stimulant that contains the basic macro- and micro-nutrients that the plant needs constantly, the most important of which are (nitrogen, phosphorus, potassium, magnesium, iron, zinc, copper, boron, cobalt, and manganese).

Thinning is one of the important plant service operations that must be carried out for date palm trees. It leads to improving the chemical and physical characteristics of the fruits, creating a balance between vegetative growth and fruit production , and reducing the alternate bearing that occurs in most date palm cultivars . In many date production areas , the thinning process has become an important means of improving the qualitative and productive properties of the fruits and thus raising their prices and acceptance in the local, regional and international markets (Ibrahim and Khalif , 2004 and Al-Ali , 2006).

Many studies that used growth stimulants have indicated their significant effect in improving the physiological and physical characteristics of fruits , such as increasing the ripening percentage , the length , diameter, size of the fruit , and the weights of the bunch , fruit , and core , thus improving the characteristics of the fruits that the consumer desires and increasing the demand for them , these studies include (Al-Mana, 2018 ; Jewar and Al-Ibrahimi, 2018 ; Al-Mousawi and Al-Zubaidi , 2022 ; Al-Ibrahimi and Al-Asadi , 2023 and Atti , 2022).

Other studies have shown that fruit thinning has a significant effect on increasing the weight of the bunch and the length , diameter and size of the fruit , increasing the ripening percentage and reducing the percentage of fruit drop, and all the physical and physiological quality characteristics of the fruits , these studies include (Al – Obaid *et al.*, 2005 ; Al-Qatrani , 2010 and Al- Ghazawi *et al.*, 2019).

Based on the above, this study was conducted to determine the effect of the growth stimulant Bio 20 and the percentages of fruit thinning and their interactions in improving the physiological and physical characteristics of date palm fruits of the Al-Shwaithi cultivar , improving their quality, and thus increasing consumer demand for them and raising their economic value.

II. MATERIALS AND METHOD

This study was conducted during the 2023 growing season in one of the private orchards in the Nasiriyah District, the center of Thi - Qar Governorate. Six palm trees of the Shuwaithi cultivar were selected and were identical in the strength of vegetative growth, length, diameter, and free of disease and insect infestations as much as possible. The palm trees were pollinated and bagged immediately



after pollination with brown papers . The experiment was designed as a factorial experiment according to a Completely Randomized Block Design (CRBD), with two factors and six replicates. The first factor was spraying the fruits with the growth stimulant Bio 20 at three concentrations (0, 2, and 4) ml L⁻¹, starting from the setting process and six sprays between one and the other (14) days until the fruits begin the coloring stage , the second factor is (thinning of the fruits) in three percentages (0, 15, and 30) % , when the thinning process was carried out immediately after fruit set is completed. Chemical and physical analysis of irrigation water and the soil of the orchard in which palm trees were planted was conducted .

Experimental measurements: .III

Fruits drop percentage (%):

The fruits drop percentage for all treatments was measured after (75 days) of pollination by taking (10 spikes) randomly from each bunch (repeated). The number of fruits present and the number of sites of drop fruits (empty scars) on each spikes was calculated , and the drop percentage was calculated according to the following equation :

$$\text{fruits drop percentage} = \frac{\text{Number of empty scars}}{\text{The number of empty scars} + \text{the number of present fruits}} \times 100$$

Ripening percentage (%):

The ripening percentage was calculated when the fruits entered the rutab stage , (10 spikes) were taken randomly from each bunch (repeated) and the number of ripe fruits (rutab) and the number of unripe fruits (khalal) were calculated according to the following equation:

$$\text{Ripening percentage} = \frac{\text{Number of ripe fruits}}{\text{Number of ripe fruits} + \text{number of unripe fruits}} \times 100$$

Fruit weight:

The fresh weight of the fruit was measured by taking (10 fruits) randomly from each replicate and for each treatment and weighing them using a sensitive digital scale. The average fresh weight of one fruit was extracted by dividing the weight of the total fruits by their number.

Length, diameter and size of the fruit:

(10 fruits) were taken randomly for each replicate in each treatment, and both length and diameter were measured using a Digital Vernier. Then the average of both length and diameter was extracted by dividing the sum of length and diameter by the number of fruits, and the unit of measurement was in centimeters.

Fruit size (cm³):

The size of the fruit was measured using the graduated cylinder and displaced water method, with an average of (10) fruits for each replicate. A known volume of distilled water was placed in a graduated cylinder and the fruits were added, the size was measured by finding the difference between the water level in the two cases. The average size of one fruit was extracted by dividing the size is based on the number of fruits and the unit of measurement (cm³) and according to the following equation :

The volume of water displaced when 10 fruits are submerged

$$\text{Fruit size (cm}^3\text{)} = \frac{\text{Volume of water displaced}}{\text{Number of fruits}}$$

Bunch weight (kg):

The weight of a single bunch was extracted by weighing it with a field scale for each of the study treatments, with six replicates for each treatment, with a unit of measurement (kg).

The results of the experiment were analyzed statistically as a factorial experiment according to the Complete Randomized Block Design, and the differences between the means were tested using the least significant difference (L.S.D) under the level of significance of 0.05 (Al - Rawi and Abdul Aziz, 1980).

Results and discussion :

Fruits drop percentage (%):

The results in Table (1) showed a significant effect of spraying fruits with concentrations of the growth stimulant Bio 20 in reducing the percentage of fruit drop with increasing concentration of the stimulant, the concentration treatment (4 ml L⁻¹) achieved the lowest average of (25.58%) compared to the control treatment, which gave the highest average reached (31.94%).

The results also showed that there is a significant effect of the thinning percentages in reducing the averages of drop percentage with an increase in the thinning percentage, and the treatment (30%) recorded the lowest average of (22.65%) compared to the control treatment, which gave the highest average of (34.69%).

Table (1) the effect of spraying fruits with the growth stimulant Bio 20 and thinning and their interactions on the Fruits drop percentage (%)

Bio 20 ml L ⁻¹	Thinning (%)			Bio 20 aver.
	0	15	30	
0	36.35	32.06	27.41	31.94
2	34.74	29.11	22.37	28.74
4	32.97	25.60	18.16	25.58
Thinning aver.	34.69	28.92	22.65	
L.S.D _{0.05}	Bio 20	Thinning	Interactions	
	1.017	1.017	1.762	



The interaction treatment between (Bio 20 at a concentration of (4 ml L⁻¹) and the thinning percentage (30%) showed a significant effect in reducing the percentage of fruit drop, and recorded the lowest average of (18.16%) compared to the control treatment, which recorded the highest average of (36.35%).

Ripening percentage (%):

The results in Table (2) showed a significant increase in fruit ripening percentages with increasing concentration of the growth stimulant Bio 20 , the concentration treatment (4 ml L⁻¹) achieved the highest average of (82.41%) compared to the control treatment, which gave the lowest average of (76.22%). The results also showed that there are significant differences for the thinning factor in increasing the ripening percentage with the increase in the thinning percentage , and the (30%) treatment achieved the highest average of (84.05%) compared to the control treatment, which recorded the lowest average of (74.37%).

The results showed a significant effect of the interaction treatment between (Bio 20 at a concentration of (4 ml L⁻¹) and the thinning percentage (30%), as it achieved the highest average of fruit ripening percentage of (86.50%) compared to the control treatment, which recorded the lowest average of (69.18%).

Table (2) the effect of spraying fruits with the growth stimulant Bio 20 and thinning and their interactions on the ripening percentage (%) .

Bio 20 MI L ⁻¹	Thinning (%)			Bio 20 aver.
	0	15	30	
0	69.18	77.69	81.78	76.22
2	76.20	80.61	83.87	80.23
4	77.73	83.01	86.50	82.41
Thinning aver.	74.37	80.44	84.05	
L . S . D _{0.05}	Bio 20	Thinning	Interactions	
	1.489	1.489	2.578	

Fruit weight (g):

The results in Table (3) showed that there was a significant effect of spraying the fruits with the growth stimulant Bio 20 in increasing the weight of the fruit with an increase in the concentration of the growth stimulant. The concentration treatment (4 ml L⁻¹) achieved the highest average of (11.40 g) compared to the control treatment that gave the lowest average was (9.99 g) .

The results also showed that there were significant differences between the treatments for the percentage of thinning in the weight of the fruit , as the weight of the fruit increased with an increase in the percentage of thinning , and the (30%) treatment achieved the highest average of (11.35 g) compared to the control treatment, which recorded the lowest average of (10.06 g) .

The effect of the interaction treatments between the growth stimulant Bio 20 and the thinning was significant on the weight of the fruit , as the interaction treatment between (Bio 20 at a concentration of (4 ml L⁻¹) and the thinning percentage (30%) achieved the highest average of (12.19 g) compared to the control treatment that the lowest average was recorded (9.32 g) .



Table (3) the effect of spraying fruits with the growth stimulant Bio 20 and thinning and their interactions on the fruit weight (g) for the rutab stage .

Bio 20 MI L ⁻¹	Thinning (%)			Bio 20 aver.
	0	15	30	
0	9.32	10.09	10.56	9.99
2	10.14	10.41	11.31	10.62
4	10.74	11.28	12.19	11.40
Thinning aver.	10.06	10.59	11.35	
L . S . D _{0.05}	Bio 20	Thinning	Interactions	
	0.1587	0.1587	0.274	

Fruit length (cm):

The results in Table (4) showed a significant effect of increasing fruit length with increasing concentration of Bio 20 , and the concentration treatment (4 ml L⁻¹) achieved the highest average of (3.76 cm) compared to the control treatment, which gave the lowest average of (3.01 cm). As for the effect of increasing the percentage of fruit thinning , it was significant by increasing the length of the fruit , and the treatment (30%) achieved the highest average of (3.59 cm) compared to the control treatment, which recorded the lowest average of (3.27 cm).

The effect of some interaction treatments between the concentrations of the growth stimulant Bio 20 and the percentage of thinning was significant in increasing the length of the fruit , the interaction treatment between Bio 20 (at a concentration of 4 ml L⁻¹) and the percentage of thinning (30%) achieved the highest average of (3.94 cm). Compared to the control treatment, which recorded the lowest average of (2.86 cm).

Table (4) the effect of spraying fruits with the growth stimulant Bio 20 and thinning and their interactions on the fruit length (cm) for the rutab stage .

Bio 20 MI L ⁻¹	Thinning (%)			Bio 20 aver.
	0	15	30	
0	2.86	2.95	3.22	3.01
2	3.33	3.41	3.60	3.45
4	3.62	3.71	3.94	3.76
Thinning aver.	3.27	3.36	3.59	
L . S . D _{0.05}	Bio 20	Thinning	Interactions	
	0.071	0.071	0.122	

Fruit diameter (cm):

The results in Table (5) showed a significant effect of increasing the diameter of the fruit with increasing concentration of Bio 20 , and the concentration treatment (4 ml L⁻¹) achieved the highest average of (2.18 cm) compared to the control treatment, which gave the lowest average of (1.72 cm).



The results also showed that there is a significant effect of the thinning percentage on increasing the diameter of the fruit , as the treatment (30%) achieved the highest average of (2.12 cm) compared to the control treatment, which recorded the lowest average of (1.89 cm).

The interaction treatment between (Bi0 20 at a concentration of (4 ml L⁻¹) and the thinning percentage (30%) achieved the highest average of (2.26 cm) compared to the control treatment, which recorded the lowest average of (1.55 cm) .

Table (5) the effect of spraying fruits with the growth stimulant Bio 20 and thinning and their interactions on the fruit diameter (cm) for the rutab stage .

Bio 20 MI L ⁻¹	Thinning (%)			Bio 20 aver.
	0	15	30	
0	1.55	1.66	1.94	1.72
2	2.03	2.03	2.15	2.07
4	2.09	2.19	2.26	2.18
Thinning aver.	1.89	1.96	2.12	
L . S . D_{0.05}	Bio 20	Thinning	Interactions	
	0.044	0.044	0.076	

Fruit size (cm³):

The results in Table (6) showed that there was a significant increase in fruit size averages with increasing concentration of Bio 20, and the concentration treatment (4 ml L⁻¹) achieved the highest average of (10.53 cm³) compared to the control treatment, which gave the lowest average of (9.39). cm³.

As for the effect of fruit thinning , it was significant in increasing the size of the fruit , and the treatment (30%) achieved the highest average of (10.33 cm³) compared to the control treatment, which recorded the lowest average of (9.43 cm³).

Some interaction treatments between (Bio 20 and the thinning percentage) had a significant effect on increasing the size of the fruit , as the interaction treatment between (Bio 20 at a concentration of (4 ml L⁻¹) and the thinning percentage (30%)) achieved the highest average of (10.92 cm³) , compared to the control treatment, which recorded the lowest average of (8.74 cm³) .

Table (6) the effect of spraying fruits with the growth stimulant Bio 20 and thinning and their interactions on the fruit size (cm³) for the rutab stage .

Bio 20 MI L ⁻¹	Thinning (%)			Bio 20 aver.
	0	15	30	
0	8.74	9.46	9.96	9.39
2	9.36	10.10	10.12	9.86
4	10.20	10.48	10.92	10.53
Thinning aver.	9.43	10.01	10.33	
L . S . D_{0.05}	Bio 20	Thinning	Interactions	
	0.125	0.125	0.217	



Bunch weight (kg):

The results in Table (7) showed that there was a significant increase in bunch weight averages with increasing concentration of the added Bio 20 , and the concentration treatment (4 ml L⁻¹) achieved the highest average of (11.16 kg) compared to the control treatment, which gave the lowest average of (7.76 kg) . The results also showed that there is a significant effect of the percentage of thinning on the increase in bunch weight, as it increased significantly with the increase in the percentage of thinning, and the treatment (30%) achieved the highest average of (10.02 kg) compared to the control treatment, which recorded the lowest average of (8.84 kg).

The results showed that the interaction treatment between (Bio 20 at a concentration of (4 ml L⁻¹) and the thinning percentage (30%) recorded the highest average with a significant difference in bunch weight, amounting to (11.92 kg) compared to the control treatment, which recorded the lowest average , amounting to (7.22 kg).

Table (7) the effect of spraying fruits with the growth stimulant Bio 20 and thinning and their interactions on the bunch weight (Kg) .

Bio 20 MI L ⁻¹	Thinning (%)			Bio 20 aver.
	0	15	30	
0	7.22	7.68	8.39	7.76
2	8.84	9.13	9.75	9.24
4	10.47	11.10	11.92	11.16
Thinning aver.	8.84	9.30	10.02	
L . S . D _{0.05}	Bio 20	Thinning	Interactions	
	0.090	0.090	0.156	

The results in Tables (1, 2, 3, 4, 5, 6, and 7) showed a significant increase in the ripening percentage , fruit weight, length, diameter, size, and bunch weight, and a significant decrease in the drop percentage , due to the effect of the growth stimulant Bio 20 , The reason for this significant increase may be due to the role of the components of the growth stimulant Bio 20 nutrients in encouraging plant growth and thus increasing the content of its tissues of nutrients and enabling it to carry out its important physiological roles , including reducing the drop percentage and increasing the ripening percentage (Cakmac *et al.*, 2006), or it may be attributed to the effective role of the stimulant in increasing cell division and expansion, increasing the movement of the products of the photosynthesis process , and the transfer of nutrients into the fruit , which is reflected positively in increasing the weight, length, diameter, and size of the fruit (Ozago and Reinecke, 2003).

The reason for the significant increase in the averages of weight, size, diameter, and length of the fruit, the bunch weight , and the ripening percentage, and the significant decrease in the drop percentage , due to the effect of the percentage of fruit thinning, may be due to the thinning process contributing to reducing the number of fruits and thus increasing the percentage of nutrients reaching the remaining fruits , which was reflected positively in the increase the growth of the fruits, and thus their weight, size, length, and diameter, increases as a result of the lack of competition for nutrients as a result of the thinning process. This is consistent with the findings of (Matar , 1991 ; Agha and Daoud , 1991 ; Abdel-Ghani , 2000 and Al-Ali , 2006) during their studies on date palms, in which they indicated that the physical characteristics of the fruits it increased significantly when the fruits thinned.



REFERENCES

- Abdel-Ghani , N. A. (2000). The effect of the date, quantity and style of cuttings, leaf ratio and type of pollen on the yield and quality of Zaghoul date palm fruits. Journal of the Association of Arab Universities for Agricultural Studies and Research, 8 (1) : 317-305.
- Agha , J. T. and Dawoud , A. D. (1991). Production of evergreen fruits. Part One, Mosul University Press - Mosul - Iraq: 455 – 462 .
- Al-Ali , Z. S. (2006). The effect of thinning method and cultivar on the yield, quality and storage potential of date palm fruits (*Phoenix dactylifera* L.). Master's thesis , College of Agriculture - University of Basra : 117 .
- Al-Ansari, N. A. M. and Al-Saleh , A. A. (2005). Photographer of Iraqi types from date palm. Part one - Al-Azza Press - Baghdad - Iraq.
- Al-Bakr, A. J. (1972). The date palm, its past, present, and what is new in its cultivation and industry and its trade. Al-Ani Press - Baghdad - Iraq: 1085 .
- Al- Ibrahimy , J. H. M. and Al - Asadi , A. D. K. (2023) . The Effect of Potassium , Microelements and Cultivar on the Activity of Invertase and Cellulase Enzymes for the Fruits of Date Palm (*Phoenix dactylifera* L.) Grown in Thi - Qar . IOP Conf. Series : Earth and Environmental Science : 1 - 10 .
- Al-Mana , G. N. J. (2018). The effect of cultivar, irrigation, and spraying with the growth stimulant Dizli on the qualitative characteristics of fruits and date palm yield *Phoenix dactylifera* L. . Master's thesis - College of Agriculture - University of Basra : 142.
- Al-Mousawi , S. J .K .and Al-Zubaidi , B .H .F (2022) . The effect of Gorogreen five fructus and the type of pollination on sugars and maturity rate of Barhi variety produced from tissue culture . International Journal of Health Sciences, 6(S3) : 6438–6445.
- Al-Obaid , R. S. ; Muhammad , M. H. and Al-Fayez , N. S. (2005). The effect of bunch thinning on yield and quality of sugar date palm cultivar growing in the Riyadh region. King Saud University Journal 17(2) : 235 – 249 .
- Al-Qatrani , N. A. A. (2010). The effect of potassium fertilization , thinning date, and variety on some physical, chemical, and production characteristics of date palm fruits *Phoenix dactylifera* L. the Halawi and Sayer cultivars . Doctoral thesis - College of Agriculture - University of Basra : 190 .
- Al-Rawi , K. M. and Abdul Aziz , M. K. (1980). Design and analysis of agricultural experiments . Dar Al-Kutub Foundation for Printing and Publishing - University of Mosul - Iraq.
- Atti , H. B. (2022). The effect of spraying with the biostimulant Biozyme and bagging on some physiological, physical and chemical characteristics of date palm fruits of the Barhi cultivar . Master's thesis - College of Agriculture and Marshlands - University of Thi - Qar - Iraq : 93 .
- Cakmakc, R. ; Donmez , F. ; Aydin , A. and Sahin , F. (2006). Growth promotion of plants by growth promoting rhizobacteria under greenhouse and two different field soil conditions. Soil Biol and Biochem. 38:1482- 1487.
- Ghazawi, H. S. ; Al-Hajhouj , M. R. ; Abdul Qadir , S. and Muhammad , M. (2019). The effect of chemical thinning on improving the fruiting characteristics of the Al-Ikhlal date palm variety. Iraqi Journal of Agricultural Sciences: 50 (5): 1361-1368 .
- Haider , N. ; Nabulsi . , I. and MirAli , N. (2012) . Phylogeatic relationships among date palm (*Phoenix dactylifera* L.) cultivars in Syria using RAPD and ISSR Markers. Journal of Plant Biology Research ,1(2) :12 - 24 .



Ibrahim , A. O. (2008). The date palm tree of life. Arab Center for Studies of Arid Zones and Arid Lands, Damascus, Syria: 390 p .

Ibrahim, A. M. and Khalif M. N. H. (2004). The date palm, its cultivation, care and production in the Arab world . Third edition - Origin of Knowledge - Alexandria - Egypt : 509 – 530.

Jewar, A. S. and Al-Ibrahimi , M. S. A. (2018). The effect of the male pollen cultivar and spraying with chitosan on some physiological and enzymatic traits of date palm fruits, *Phoenix dactylifera* L. Thi - Qar University Journal of Agricultural Sciences , 17 (1-2) : 18 - 35.

Journal of Plant Biology Research ,1(2) :12-24 .

Kader, A.A. and Hussein, A.(2009). Harvesting and Posthaste handing dates. ICARDA, Aleppo, Syria .

Matar, A. M. (1991). Palm cultivation and production. Dar Al-Hekma Press - University of Basra. . Iraq: 420 .

Ozaga, T.A. and Reinecke , D.M. (2003). Hormonal interactions in fruit development. J Growth Reg., Plant 31: 1-15.

