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POSSIBILITY OF IMPROVEMENT QUALITY OF FRUITS AND YIELD OF DATE PALMS CV. BRAIM USING SPRAY OF NAPHTHALENE ACETIC ACID AND POTASSIUM SULPHATE

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Abstract

The research study was performed at the station of horticulture located in Latifiya region, for exploring possibility improving the physiochemical features of palms fruits cv. Braim with age 28 years, by spraying naphthalene acetic acid (NAA) at 0, 50, and 100 mg L^{-1} and potassium sulphate(K_2SO_4) at concentrations of 0, 15, and 20g L^{-1}, this was done three times after pollination, i.e., during the hababuk phase, onset of the kimri phase, and starting of the break green color phase. Results indicated that NAA spraying, especially at high concentration, boosted fruit weight and bunch weight , yield, moisture content, acidity, and reducing fruit drop, fruit ripening, dry matter content, total sugars, monosaccharide , disaccharide , and TSS which reached (10.76g, 11.60kg $bunch^{-1}$, 92.81 kg $palm^{-1}$, 44.67 %, 0.252%, 7.82%, 50.43%, 55.33%, 40.99%, 22.68%, 18.30% and 47.62%).In the same context, potassium sulphate, especially at concentration of 20 g L^{-1}, led to enhanced all physical and chemical traits while reducing fruit drop and acidity which gave (10.63 g, 11.21 kg $bunch^{-1}$, 89.68 kg $palm^{-1}$, 41.32% and 8.25% and 0.213%) compared with control. Furthermore, the interaction between the studied factors followed the same direction, NAA at concentration 100 mg L^{-1} plus 20 g L^{-1}, attained the greatest possible values for weight of fruit and

bunch, yield, and minimizing fruit maturation and dropping which gave (11.06 g, 12.23kg bunch^{-1}, 97.88 kg palm^{-1}, 51.12% and 8%) compared to control treatment.

Keywords: Date Palms,yield, Auxin, NAA, Potassium Sulphate.

أمكانية تحسين نوعية وحاصل ثمار نخيل التمر (Phoenix dactylifera L.) صنف بريم بأستخدام الرش بنفثالين حامض الخليك وكبريتات البوتاسيوم

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الخلاصة

نُفذت التجربة في محطة أبحاث البستنة في منطقة اللطيفية العائدة الى وزارة الزراعة العراقية، بهدف استكشاف إمكانية تحسين الصفات الفيزيائية والكيميائية لثمار نخيل التمر صنف بريم بأستخدام الرش بنفثالين حامض الخليك (NAA) بتركيز 0 و50 و100 ملغم لتر$^{-1}$ وكبريتات البوتاسيوم (K_2SO_4) بتركيز 0 و15 و20 غم لتر$^{-1}$، وتم رش العذوق ثلاث مرات بعد التلقيح، أي خلال مرحلة الحبابوك، وفي بداية مرحلة الجمري، وفي بداية مرحلة الخلال. وأشارت النتائج إلى أن رش NAA وخاصة مستوى الرش 100 ملغم لتر$^{-1}$، أدى إلى زيادة وزن الثمار ووزن العذق والحاصل لكل نخلة وزيادة المحتوى الرطوبي للثمار والحموضة وانخفاض نسبة تساقط الثمار ونضج الثمار ومحتوى المادة الجافة في الثمار والسكريات الكلية والسكريات المختزلة وغير المختزلة والمواد الصلبة الذائبة الكلية والتي بلغت (10.76غم و11.60 كغم عذق$^{-1}$ و92.81 كغم نخلة$^{-1}$ و44.67% و0.252% و7.82% و50.43% و55.33% و40.99% و22.68% و18.30% و47.62%). وفي السياق ذاته، أدى رش كبريتات البوتاسيوم، وخاصة مستوى الرش 20 غم لتر$^{-1}$ إلى تحسين جميع الصفات الفيزيائية والكيميائية مع تقليل نسبة تساقط الثمار والحموضة والتي بلغت (10.63 غم و11.21 كغم عذق$^{-1}$ و89.68 كغم نخلة$^{-1}$ و41.32% و8.25% و0.213%). علاوة على ذلك، فإن التداخل بين عاملي الدراسة سار في نفس الاتجاه، حيث حقق NAA بتركيز (100 ملغم لتر$^{-1}$ + بوتاسيوم بتركيز 20 غم لتر$^{-1}$) أعلى القيم لوزن الثمار ووزن العنقود والغلة للنخلة وتقليل نضج الثمار وتساقطها والتي بلغت (11.06 غم و12.23 كغم عذق$^{-1}$ و97.88 كغم نخلة$^{-1}$ و51.12% و8%) قياساً بمعاملة المقارنة.

كلمات مفتاحية: نخيل التمر، حاصل، اوكسين، NAA، كبريتات البوتاسيوم.

Introduction

Date Palms, is an ancient fruit known for its highly nutrition fruits, these fruits are packed with various compounds and nutritional elements essential for the body, providing the necessary energy for vital activities (5). Date fruits are abundant in carbohydrate (glucose and fructose), which make up 70% of its composition, as well as proteins, nutrients like (Ca, B, N, Cu, K, Mn, etc.), it is also contains several B vits, involving thiamine, riboflavin ,niacin, pantothenic, and pyridoxine (2 and 25). Date palm encompasses numerous and commonly consumed cultivars in Iraq, one of these cultivars is known as Braim, which is consumed in three stages: Khalal (Bisir), Rutab and Tamar, the number of palm trees in Iraq is 17,348,741 palm trees, and the total production of the governorates covered is 735,353 thousand tons, with an average productivity per palm of 68.2 kg. Baghdad Governorate ranked first in terms of production, which was estimated at 126.2 thousand tons, representing (17.2%) of Iraq's total production, followed by Babil Governorate, whose production was estimated at 117.9 thousand tons, representing (16.0%) of Iraq's total production, while Diyala Governorate ranked third, whose production was estimated at 88.1 thousand tons, representing (12.0%) of Iraq's total production, while the rest of the governorates constituted a percentage of (54.8%) (10, 14 and 17). Numerous studies have provided substantial evidence supporting the significant role of growth regulators in the fruit's developmental stages of date palm, these regulators, often referred to as growth stimulants, have been extensively researched and their positive effects have been highlighted in studies such as conducted by (18 and 21), these studies have shed light on the importance of growth regulators in enhancing the processes of metabolism in date palm crop. Auxins are known for their ability to stimulate growth, which often leads to raising all physical crop trait. Additionally, they contribute in the enlargement of pulp promoting cell growth (24 and 30). Moreover, auxins can help in reducing the rate of fruit drop; by maintaining a proper balance of auxin levels, the detachment of fruits is minimized, ensuring a higher yield. Furthermore, auxins contribute to the delay of fruit softening and the decomposition of chlorophyll, by slowing down these processes, as well as, auxins help in prolonging fruits shelf life, and delaying their ripening, (9) found that spray NAA at a concentration of (0, 100 and 150 mg L^{-1}) on the bunches of Rothana and Ghur date palms, spraying was carried out after 40 and 70 days of pollination, results showed that spraying at 150 mg L^{-1} for the Ghur cultivar at the Khalal stage achieved the best values for the percentage of fruit drop, bunch weight, ripening , fruit weight, flesh weight, length and diameter of fruit, on the other hand, (19) found that spray NAA at a concentration of (0, 50 and 100 mg L^{-1}), spraying was done one day before the pollination process, and the second spray was at the beginning of the kimri stage, while the third spray was at the beginning of the fruit coloration (Khalal stage). The results of the study showed that the spray level of 100 mg L^{-1} achieved the best values for the yield, bunch weight, fruit weight, fruit length, fruit flesh weight, seed weight, TSS percentage, low acidity percentage and high TSS\acidity percentage .

Notwithstanding the fact that potassium is not a structural component of any organic compound, many investigations have found that plants fail to grow without it. It

functions by inducing the activation of numerous enzymes, having potassium being the main source of this activation (8), this activation has direct or indirect effects on activating about 80 enzymes, which are crucial for respiration, energy consumption and nitrogen absorption. As a result, potassium plays a regulatory role in plants, because of this, some authors refer to potassium as the "traffic police" in plants (8 and 11). In the case of potassium nutrition, many studies have discovered a favorable collaboration between carbon assimilation and transportation of manufacturing materials to sites in plant, where which reserves, due to K^+ is important for stimulating ATP formation, which is necessary for CO_2 assimilation, as well as stimulating the growth and cell division, which increase physical and chemical features of yield, (7) found that potassium sulphate spraying at a concentration of (0, 10 and 15 g L^{-1}), spraying was done during the kimri stage and the second spraying was done four weeks after the first spraying (the beginning of the khalal stage). The results of the study showed that the spraying level of 15 g L^{-1} achieved the highest values for fruit length, fruit diameter, fruit length/fruit diameter ratio, fruit flesh weight, fruit weight, dry weight, bunch weight, yield, total soluble solids ratio, total sugars and reducing sugars. on the other hand, (23) found potassium nitrate spray at a concentration of (0, 1 and 2%) in two stages, one after fruit set and the other one month after the first spray, showed a noticeable effect, especially spraying at a concentration of 2%, which achieved the highest values for fruit length, fruit diameter, fruit weight, fruit flesh weight, seed weight, reducing sugars and total sugars.

The primary goal of this investigation is to explore the impact of Auxin (NAA) and potassium sulphate spray on various fruits features, overall yield, reducing fruit drop and finally prolonging shelf life of fruits.

Materials and Methods

The trial was performed from April to October 2023 within the horticulture station located in Latifiya region, which is located approximately 45 km south of Baghdad city, to investigating possibility improvement physiochemical features of date palm fruits "Braim" by using aqueous spray of NAA, and potassium sulphate (K_2SO_4). At the age of 28, a total of twenty-seven date palms were chosen, with the objective of achieving maximum uniformity in their vegetative growth, and were cultivated in (10×10 m). The same horticultural techniques were used in the orchard for all palms, which included removed of old fronds, fertilizing (organic and chemical), irrigation, controlling disease and insects throughout the period of this study. After selecting 8 inflorescences, the other ones were eliminated, 4 male strands were inserted into the center of each female inflorescence to begin the pollination process, using "Red Ghanami" as a source of pollen grain.

Fertilizing (organic and chemical): Soil application was made by making a circular trench around the palm trees with diameter of 1.5m from the palm trunk and organic fertilizer (cow manure), was added at rate 50kg. $Palm^{-1}$. Triple superphosphate (P_2O_5 45%), at rate 1.5 kg during December of year 2022.The organic fertilizer mixture plus phosphorus was covered with the soil, while nitrogen fertilizer was urea used as a source of nitrogen (N 46%), and was added at a rate (4 kg $palm^{-1}$ $year^{-1}$) (15 and 16).

Treatments and Experimental Design: The investigation employed two factors: first, three concentration of NAA (purity 99%), were sprayed till run off at 0,50, and 100 mg L^{-1}, representing (N_0, N_1, and N_2), respectively. The second is that K_2SO_4 was sprayed at three different concentrations (0, 15, and 20 g L^{-1}), to represent K_0, K_1, and K_2. This was done three times i.e., during hababuk phase, onset of the kimri phase, and starting of the break green color phase. The experiment utilized a randomized complete block design with three replications, each replicate contains 9 palms, the total palms reached 27 palms, where every palm tree served as an individual experimental unit.

Studied Parameters:

Physical characteristics: Three bunches were selected, marked, and fifteen strands were taken from each bunch, from these strands, a sample of thirty fruits was selected in khalal stage (5/8/2023) in order to measure the physical traits, including, weight per flesh (g), seed (g), fruit (g), while bunch (kg), and yield per palm (kg) in (15/9/2023).

Fruit dropping (%): approximately two weeks following pollination and prior to the initiation of treatments, ten strands were selected from each pre-marked bunch. At the khalal stage (5/8/2023), the quantity of fruits in every strand was calculated as follow:

$$dropping\ (\%) = \frac{\text{dropped fruits number per bunch}}{\text{total fruits number per bunch}} \times 100$$

Fruit moisture content (%), and fruit dry matter (%): Ten fruits that were in the rutub stage (25/8/2023) were sampled. The fruit flesh was cleaned and the seeds removed before being sliced into little pieces and having its fresh weight assessed. It was then dried for 72 hours at 60 to 70 C°. Equation provided by (20), were used to determine the moisture and dry matter content after constant weight.

$$Moisture\ (\%) = \frac{\text{a verage fresh weight} - \text{a verage drying weight}}{\text{a verage fresh weight}} \times 100$$

$$Dry\ matter\ (\%) = \frac{\text{a verage drying weight (g)}}{\text{a verage fresh weight (g)}} \times 100$$

Chemical characteristics: Sugars (%), and monosaccharide (%) were extracted from the fruit flesh at the rutub stage (25/8/2023), and estimated according to (20), while disaccharide (%) was estimated by the difference between whole sugars and monosaccharide. TSS (%): using an electric blender, 10 g of fresh fruit flesh was totally crushed with water (30 cm^3). After filtering sample, a hand refractometer was used to calculate the fruits percentage of TSS, according to (1). Titratable Acidity (%): By using 0.1*N* sodium hydroxide using Phenol naphthalene indicator until the equivalency point was reached, and acidity was estimated according to (1). While TSS/ Acidity was obtained by dividing values of TSS by the values of Acidity.

Data Analysis: ANOVA was used to analyze the data obtained from the experiment using GenStat. The F-test was used to determine whether there were differences between the treatments, and P=5% was considered to be the least significant differences (6).

Results and Discussion

Flesh weight (g), seed weight(g), and fruit weight (g): Results illustrated (table1) revealed that different levels of NAA spray had a high increase of flesh weight and fruit weight as compared with untreated bunches, the maximum values were obtained for concentration N2(100 mg L^{-1}), which reached (9.55 and 10.76g), respectively, compared to the minimum flesh and fruit weight in N0 (spray distilled water only), (8.47 and 9.67g). On the other hand, potassium sulphate spray increased flesh and fruit weight in comparison with untreated fruits, K2 (20 g L^{-1}) achieved the highest weight (9.42 and 10.63g) respectively, compared to K0(spray distilled water only), which gave (8.71 and 9.92 g), respectively. Moreover, the interaction between the studied factors has the same direction, N2K2 (100 mg L^{-1} + 20 g L^{-1}) recorded the highest value (9.84 and 11.06 g), compared to N0K0(control) which gave (8.19 and 9.38 g), respectively. Whereas, there is no significant effect was noticed in seed weight.

Table 1: Impact of Auxin and Potassium, and combine between them on some fruit's traits.

Auxin (NAA) (N)	Potassium (K)			
	K0 (Control)	K1(15 g L^{-1})	K2 (20 g L^{-1})	**Mean N**
Fruit flesh weight (g)				
N0 (Control)	8.19	8.38	8.83	8.47
N1 (50 mg L^{-1})	8.83	9.11	9.58	9.18
N2 (100 mg L^{-1})	9.12	9.69	9.84	9.55
Mean K	8.71	9.06	9.42	
	N	K	N × K	
F- Probality ≤0.05	0.09	0.09	0.16	
Seed weight (g)				
N0 (Control)	1.19	1.21	1.21	1.20
N1 (50 mg L^{-1})	1.20	1.20	1.21	1.20
N2 (100 mg L^{-1})	1.21	1.21	1.21	1.21
Mean K	1.20	1.20	1.21	
	N	K	N × K	
F- Probality ≤0.05	N.S	N.S	N.S	
Fruit weight (g)				
N0 (Control)	9.38	9.59	10.04	9.67
N1 (50 mg L^{-1})	10.04	10.32	10.79	10.38
N2 (100 mg L^{-1})	10.33	10.91	11.06	10.76
Mean K	9.92	10.27	10.63	
	N	K	N × K	
F- Probality ≤0.05	0.09	0.09	0.15	

Fruit dropping (%), bunch Weight (Kg), and yield / Palm (Kg): Evidence via table 2 demonstrated, in contrast to N0 and K0, which provided the largest percentage of fruit dropping (8.96 and 8.33%), NAA and potassium concentrations spray suppressed fruit dropping, particularly N2 and K1, which recorded (7.82 and 8.16%). Regarding the interaction between treatments, N1K0, N1K1, N2K0, and N2K1 exhibited a significant reduction in fruit drop, i.e., (7.94, 7.90, 7.79 and 7.67%) respectively, in contrast with the control (9.27%). Results in the same table, revealed that spray of N2 and K2 achieved the highest weight and yield (11.60 kg, 92.81 kg $Palm^{-1}$ and 11.21 kg, 89.68 kg $Palm^{-1}$) respectively, in contrast to N0 and K0 which reached (10.25 kg, 82.08 kg

Palm^{-1} and 10.53 kg,84.28 kg Palm^{-1}) In the same context, the combined between treatments followed the same path, N2K2 achieved the largest bunch weight and yield (12.23 kgand 97.88 kg Palm^{-1}), in comparison with N0K0 which reached (10.04 kg and 80.63 kg Palm^{-1}) respectively.

Table 2: Impact of auxin and potassium, and combine between them on Fruit dropping, Bunch weight, and Yield.

Auxin (NAA) (N)	Potassium (K)			
	K0 (Control)	K1(15 g L^{-1})	K2 (20 g L^{-1})	Mean N
Fruit dropping (%)				
N0 (Control)	9.27	8.92	8.68	8.96
N1 (50 mg L^{-1})	7.94	7.90	8.06	7.97
N2 (100 mg L^{-1})	7.79	7.67	8.00	7.82
Mean K	8.33	8.16	8.25	
	N	K	N × K	
F- Probality ≤0.05	0.13	0.13	0.23	
Bunch weight (Kg)				
N0 (Control)	10.04	10.39	10.33	10.25
N1 (50 mg L^{-1})	10.48	10.91	11.05	10.81
N2 (100 mg L^{-1})	11.07	11.49	12.23	11.60
Mean K	10.53	10.93	11.21	
	N	K	N × K	
F- Probality ≤0.05	0.14	0.14	0.25	
Yield / Palm (Kg)				
N0 (Control)	80.36	83.16	82.71	82.08
N1 (50 mg L^{-1})	83.85	87.31	88.47	86.54
N2 (100 mg L^{-1})	88.63	91.93	97.88	92.81
Mean K	84.28	87.47	89.68	
	N	K	N × K	
F- Probality ≤0.05	1.19	1.19	2.06	

Moisture content (%), dry matter content (%), and fruit ripening (%): It was noticed from results that illustrated in table 3, that with NAA elevated fruit moisture specially N2 which reached (44.67%), in comparison with N0, which gave the minimum moisture (41.30%). On the contrary, potassium spraying reduced fruit moisture to reach (41.32%), while K0 gave the largest moisture (44.68%). In the same context, N2K0 achieved the highest moisture reached (47.05%) in contrast with N0K2 (40.73%). On the other hand, N2 spraying decreased fruit dry matter and fruit ripening which reached (55.33 and 50.43%) respectively, while N0 was gave superior value (58.71 and 57.04%) respectively. Regarding potassium spraying, K2 markedly increased fruit dry matter and fruit ripening (58.68 and 54.19%) respectively, while K0 gave (55.32 and 52.26%).

Table 3: Impact of auxin and potassium, and combine between them on Fruit moisture content, Fruit dry matter content, Fruit ripening.

Auxin (NAA) (N)	Potassium (K)			
	K0 (Control)	K1(15 g L^{-1})	K2 (20 g L^{-1})	Mean N
Fruit moisture content (%)				
N0 (Control)	42.34	40.81	40.73	41.30
N1 (50 mg L^{-1})	44.65	41.97	40.78	42.46
N2 (100 mg L^{-1})	47.05	44.50	42.45	44.67
Mean K	44.68	42.43	41.32	
	N	K	N × K	
F- Probality ≤0.05	0.76	0.76	1.31	
Fruit dry matter content (%)				
N0 (Control)	57.66	59.19	59.27	58.71
N1 (50 mg L^{-1})	55.35	58.03	59.22	57.54
N2 (100 mg L^{-1})	52.95	55.50	57.55	55.33
Mean K	55.32	57.57	58.68	
	N	K	N × K	
F- Probality ≤0.05	0.76	0.76	1.31	
Fruit ripening (%)				
N0 (Control)	56.06	56.44	58.62	57.04
N1 (50 mg L^{-1})	51.50	52.28	52.83	52.21
N2 (100 mg L^{-1})	49.23	50.95	51.12	50.43
Mean K	52.26	53.22	54.19	
	N	K	N × K	
F- Probality ≤0.05	0.60	0.60	1.04	

Total sugars (%), monosaccharides (%), and disaccharides (%): From the outputs in Table 4, we found that spraying NAA led to decreased total sugars, mono, and disaccharides sugar, especially in concentration N2, which reached (40.99, 22.68, and 18.30%) respectively, in contrast with N0, which achieved the highest sugars reached (44.17, 24.55 and 19.61%) respectively. On the contrary, potassium spraying led to an increasing in total sugars, mono and disaccharides especially K2 concentration (44.80, 24.09 and 20.71%) respectively, while K0 reduced these characteristics to reach (39.88, 23.11 and 16.76%) respectively.

Table 4: Impact of Auxin and Potassium, and combine between them on Total Sugars (%), Monosaccharides (%), and Disaccharides (%).

Auxin (NAA) (N)	Potassium (K)			
	K0 (Control)	K1(15 g L^{-1})	K2 (20 g L^{-1})	**Mean N**
Total sugars (%)				
N0 (Control)	43.22	44.07	45.22	44.17
N1 (50 mg L^{-1})	38.06	43.04	44.43	41.84
N2 (100 mg L^{-1})	38.36	39.85	44.75	40.99
Mean K	39.88	42.32	44.80	
	N	K	N × K	
F- Probality ≤0.05	0.51	0.51	0.89	
Monosaccharides (%)				
N0 (Control)	24.68	24.36	24.62	24.55
N1 (50 mg L^{-1})	22.75	23.22	24.16	23.38
N2 (100 mg L^{-1})	21.91	22.65	23.48	22.68
Mean K	23.11	23.41	24.09	
	N	K	N × K	
F- Probality ≤0.05	0.35	0.35	0.61	
Disaccharides (%)				
N0 (Control)	18.53	19.70	20.60	19.61
N1 (50 mg L^{-1})	15.32	19.82	20.27	18.47
N2 (100 mg L^{-1})	16.44	17.20	21.27	18.30
Mean K	16.76	18.91	20.71	
	N	K	N × K	
F- Probality ≤0.05	0.61	0.61	1.06	

TSS (%), Acidity (%), and TSS/ Acidity: Statistical analysis results shown in Table 5 indicated that spraying NAA led to reducing TSS and increased acidity, particularly in N2 concentration, which reached (47.62 and 0.252%) respectively, in comparison with N0 which increased TSS and reduced acidity (50.84 and 0.190%) respectively, furthermore, N2 spraying led to reduced TSS/ Acidity to reach 194.6 in comparison with N0 292.2. In contrast, K2 spraying led to increasing TSS, and reducing acidity to reach (50.46 and 0.213%) respectively. Likewise, K2 increased TSS/ Acidity which achieved (276.6%), while K0 gave the minimum values 47.68, 0.245, and 211.9 respectively.

Table 5: Impact of Auxin and Potassium, and combine between them on TSS, Acidity, and TSS/ Acidity.

Auxin (NAA) (N)	Potassium (K)			
	K0 (Control)	K1(15 g L^{-1})	K2 (20 g L^{-1})	**Mean N**
TSS (%)				
N0 (Control)	49.33	50.64	52.57	50.84
N1 (50 mg L^{-1})	47.48	49.74	50.18	49.13
N2 (100 mg L^{-1})	46.25	47.99	48.63	47.62
Mean K	47.68	49.46	50.46	
	N	K	N × K	
F- Probality ≤0.05	0.51	0.51	N.S	
Acidity (%)				
N0 (Control)	0.206	0.191	0.171	0.190
N1 (50 mg L^{-1})	0.250	0.200	0.183	0.211
N2 (100 mg L^{-1})	0.278	0.250	0.230	0.252
Mean K	0.245	0.213	0.213	
	N	K	N × K	
F- Probality ≤0.05	0.016	0.016	N.S	
TSS/ Acidity				
N0 (Control)	265.1	281.1	330.4	292.2
N1 (50 mg L^{-1})	200.4	254.1	282.6	245.7
N2 (100 mg L^{-1})	170.2	196.6	217.0	194.6
Mean K	211.9	244.0	276.6	
	N	K	N × K	
F- Probality ≤0.05	24.05	24.05	N.S	

The results of the research indicated that applying NAA to date palm bunches of the Braim cultivar could effectively raise the fruit weight, yield, fruit moisture, and decreased fruit dropping. This might be explained by auxins capacity to stimulate enlargement, and boost the pliability, this in turn triggered permeability, boosting the quantity of solutes, nutrients that could pass through cells and elevating fruits weight (27 and 29). Moreover, the auxin application aligned with differentiation phase of fruits cell, which starts from kimri phase till fruit ripening which led to increasing cell volume and increasing fruit weight (3). Fruit dropping was substantially decreased in the current experiment through using NAA at both low and high levels (Table 2). The treated fruits outperform the control due to the decrease in fruit dropping. It has been suggested that the main trigger of fruit drop is an imbalance in the quantity of ethylene and auxin in fruit tissues. Hydrolytic enzymes, i.e., (polygalacturonase and cellulase), which break down cell walls, and induce fruit drop, are activated by ethylene, which in turn activates the process responsible for the formation of the abscission zone, and it well known that auxins prevent the breakdown of the abscission layer – causing enzymes 12, 26 , 13). Increased auxin levels in the fruits as a result of fruit spray with NAA are one of the physiological responses to NAA, and this might cause the fruit to avoid the normal rise in respiration that is related to ripening (4). For many fruits, including dates, this increase is necessary to start the ripening process, because of this, fruit that have been treated with NAA may take longer to mature and may not get as ripe as they should and ultimately delayed fruit ripening (19). Furthermore, lowering in the ripening percentage result of NAA feeding probably the cause of the decrease in

the total sugars, reducing sugars, TSS. This could have delayed all associated enzymatic transformations and processes, as well as, increasing moisture content of the fruits may be led to dilution fruits sugars leading to reduce TSS (26). The results of this study are in harmony with what was found by (13), who observed that NAA spraying at 90 and 60 mg L^{-1}, respectively, substantially generated the largest fruit weight, bunch weight, yield, acidity, in comparison with untreated trees.

Regard to potassium spraying, we observed that potassium increased physical and chemical traits of fruits, viz., (weight of date fruit and bunch, total yield per palm, dry matter, fruit ripening, total sugars, reducing sugars, TSS, and reducing fruit dropping). This may be due to, that potassium has an impact on a lot of essential functions, including photosynthesis and enzyme activation, which promote tissue and development and cell division. According to (27) the concentration of solutes like potassium affects how long cells may elongate. One of the primary solutes in the cell is potassium, which raises the osmotic pressure, and as a result, lengthens the cell. Furthermore, potassium is necessary for the transportation of metabolized materials, including fruits, from producing site (source) to storage locations (sink) (22). Consequently, it is anticipated that fruits quantity and quality would increase. Fruit drop may be reduced when potassium is sprayed due to potassium acting as a cofactor in facilitating the passage and transfer of other macro and micronutrients that are closely related to plant hormones, such as auxins, which implement a pivotal function in inhibiting enzymes action, like, cellulase and pectinase, that decompose the abscission layer. Finally, potassium performs a crucial mechanism in facilitating transfer of nutrient s and sugars to the abscission layer, which results in the abscission process being inhibited(27). Therefore, it is predicted that as a result of raising physical and chemical trats of fruits. These results are in agreement with (15), on Barhee date palm, when using potassium sulphate at 2%, and with (7 and 17), when using potassium on Barhee and Braim date palm.

Conclusions

Overall, it can be stated that spray bunches with NAA, especially at high concentration, increased physical characteristics, and reducing dry matter content, dropping, fruit ripening, and acidity, as well as decreasing total sugars, mono, and disaccharides, consequently reducing TSS in comparison with control. On the contrary, bunches sprayed with potassium sulphate, particularly at high concentration (20 g L^{-1}), improved all physical and chemical traits of fruits, viz., fruit weight, bunch weight, yield per palm, dry matter content, ripening.

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