Effect of Potassium and Benzyladenine Spraying and Bunching Bagging on Some Chemical Characteristics of Date Palm Fruits (*Phoenix dactylifera* L.) cv. Bream

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A field experiment was conducted at the Date Palm Research Center, Al-Rashidiyah, Baghdad, during the 2025 growing season to investigate the effect of potassium and benzyl adenine spraying and bunch bagging in some chemical characteristics of date palm fruits cv. Breem. The experiment included 36 date palm trees, 12 years old, propagated vegetatively by offshoots, and were as uniform as possible in growth. The experiment was designed as a randomized complete block design (RCBD) with three factors: the first factor was potassium spraying at three concentrations (0 , 100, and 200 g L^{-1}), the second factor was benzyl adenine spraying at two concentrations (100 and 50 mg L^{-1}), and the third factor was bunching (with or without bunching). The trees were sprayed three times during the season: the first spray was before flowering on February 25, 2025, with benzyl adenine, followed by potassium spraying 72 hours later; the second spray was one month after pollination; and the third spray was one month after the second spray. Fruit samples were collected at the tamar stage. The results showed potassium (200 mg L^{-1}) and benzyladenine (100 mg L^{-1}) spraying treatment at 200 g L-1 gave the highest average values for leaf nitrogen, phosphorus, and potassium content, as well as the total, reducing, and non-reducing sugar percentages in fruit . Bunching treatment had no significant effect on fruit sugar content. The interaction treatment between potassium at 200 g L^{-1} and benzyl adenine at 100 mg L^{-1} with or without bunch bunching produced the highest values for the measured parameters.

1- Introduction

Date palm (*Phoenix dactylifera* L.) is considered one of the oldest fruit trees cultivated in hot and dry regions, belonging to the Arecaceae family, which includes 200 genera and more than 2500 species (33). Date fruits are characterized by being rich in sugars, proteins, fibres, and vitamins, especially the B-complex vitamins, and also contain considerable amounts of phenolic compounds, carotenoids, flavonoids, and Potassium is one of the major nutrients required by date palm trees in large quantities, which is not readily available for absorption due to its slow movement in the soil. For this reason, foliar spraying of potassium is considered the best method to increase its absorption by the green tissues of the leaf. Many studies have shown that the application of potassium through foliar spraying improves photosynthesis, increases chlorophyll concentration, and leads to the anthocyanins (2), (11). The fruits also contain a good percentage of phenolic acids that act as antioxidants and anti-inflammatory agents (AIMS Agriculture and Food, 2020). Studies by the Food and Agriculture Organization show that the cultivation of date palm trees is increasing globally due to the expansion of cultivated areas and the high demand for date production (12).

formation of adenosine triphosphate (ATP), which is necessary for carbon dioxide fixation and contributes to the transfer of sugars from leaves to storage organs such as fruits and roots (17). Experiments and research have found that spraying potassium compounds stimulates cell division and increases sugar concentration, thus affecting fruit size (28). Various studies indicate that foliar fertilization of fruit trees with potassium increases yield by improving

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potassium absorption by the fruits (8). Additionally, some recent studies suggest that spraying potassium at different stages of fruit development using potassium sulfate has a significant effect on sugar concentration in the fruits (30). Benzyladenine (BA) is one of the synthetic cytokinins that play an important role in regulating plant growth, stimulating cell division, and contributing to the activation of vegetative growth. BA also helps regulate stomatal opening and closure and the transfer of nutrients from leaves to other parts of the plant. Experiments have shown that applying BA through foliar spraying increases leaf chlorophyll content, soluble sugars, proteins, and amino acids, thus stimulating the plant's physiological activity (31). It is also observed that BA spraying has a role in delaying leaf senescence by increasing chlorophyll and protein synthesis, leading to the continuity of metabolic processes in the plant, resulting in better growth of leaves, buds, and fruits, and improving the physical characteristics of the fruits (26).Bunch covering is one of the agricultural techniques used in date palm orchards, where bunches are covered with special bags after fruit set and during the early stages of fruit development to provide suitable conditions. Covering protects the fruits from insect pests and birds, reduces the impact of environmental factors such as high temperatures and rainfall, and limits moisture loss that affects fruit quality. Experiments have shown that covering improves the physical characteristics of the fruits, such as size and weight, and increases the sugar content of the fruits, leading to increased yield and improved quality (5).

Objective of the Study:

1. Determine the best concentration of potassium and growth regulator Benzyladenine (BA) in some physical and chemical characteristics of date palm cultivar ' Bream .'

2. Investigate the effect of the interaction between potassium, growth regulator (BA), and bunch covering on improving the growth and yield of date palm.

2-Materials and Methods

2-1 Research Location and Agricultural Operations

A field experiment was conducted in Baghdad Governorate - Date Palm Center, Al-Rashidiya Research Station during the 2025 growing season, to investigate the effect of potassium and benzyl adenine spraying and bunch covering on the growth and yield of date palm cultivar 'Brim'. Twelve-year-old date palm trees, propagated by offshoots and irrigated by surface irrigation, were used. Thirty-six uniform trees, free from pests and diseases, were selected and divided into three sections, each with 12 trees.Some physical and chemical properties of the orchard soil were analyzed before the experiment, with samples taken at a depth of 30-60 cm. The orchard was serviced, including pruning, removal of dry fronds, weeding, and loosening of the soil around the roots. The female flowers of the 'Brim' cultivar were pollinated with pollen from the 'Khudrawi' cultivar during the period from April 17 to June 6, 2025. The number of bunches per tree was fixed at 8, and the bunches were covered before they became woody. Fruit harvesting began on September 13, 2025, and fruit samples were taken at the tamar stage for analysis of yield characteristics.

2-2 Experimental Treatments

The experiment included 12 treatments resulting from the interaction of three factors. The first factor was spraying date palm trees with potassium, using potassium sulfate fertilizer (K_2SO_4) with a purity of 99.5% produced by Sisco Research Laboratories SRL, India, as a source of potassium, at three concentrations (0, 100, 200 g L-1). The

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second factor was spraying date palm trees with benzyl adenine (BA) at two concentrations (50, 100 mg L-1). The third factor was bunching (bunching and without bunching).The required concentrations of benzyladenine were prepared by dissolving it in an alkaline solution of sodium hydroxide (0.1 N) until complete dissolution, then completing it with distilled water to the required concentration and volume for spraying. Liquid soap was added as a surfactant at a concentration of 1% to the prepared solution of potassium and benzyl adenine separately to reduce the surface tension of water and ensure complete wetting.Date palm trees were sprayed completely using an electric sprayer, with three sprays: the first spray before flowering on February 25, 2025, and the spraying treatments were carried out using benzyl adenine and potassium. The trees were sprayed with benzyl adenine solution first, and after 72 hours from the first spray, the potassium solution was sprayed in the same manner. Spraying treatments were carried out at a rate of three sprays during the experiment period: the second spray one month after pollination on May 17, 2025, and the third spray one month after the second spray on June 17, 2025. The experiment treatments were as follow:

Table. Treatments Table

Treatment Description	No.
0 g L^{-1} Potassium + 50 mg L^{-1} Benzyl Adenine with bagging	1
0 g L^{-1} Potassium + 50 mg L^{-1} Benzyl Adenine without bagging	2
0 g L^{-1} Potassium + 100 mg L^{-1} Benzyl Adenine with bagging	3
0 g L^{-1} Potassium + 100 mg L^{-1} Benzyl Adenine without bagging	4
100 g L^{-1} Potassium + 50 mg L^{-1} Benzyl Adenine with bagging	5
100 g L^{-1} Potassium + 50 mg L^{-1} Benzyl Adenine without bagging	6
100 g L^{-1} Potassium + 100 mg L^{-1} Benzyl Adenine with bagging	7
100 g L^{-1} Potassium + 100 mg L^{-1} Benzyl Adenine without bagging	8
200 g L^{-1} Potassium + 50 mg L^{-1} Benzyl Adenine with bagging	9
200 g L^{-1} Potassium + 50 mg L^{-1} Benzyl Adenine without bagging	10
200 g L^{-1} Potassium + 100 mg L^{-1} Benzyl Adenine with bagging	11
200 g L^{-1} Potassium + 100 mg L^{-1} Benzyl Adenine without bagging	12

Table 2. Physical and Chemical Properties of the Orchard Soil Before Conducting the Experiment

Value	Unit	Property
7.53	—	Soil pH
46.3	mg kg^{-1}	Available Nitrogen (N)
13.1	mg kg^{-1}	Available Phosphorus (P)
89	mg kg^{-1}	Available Potassium (K)
0.8	%	Organic Matter
29.5	%	Calcium Carbonate ($CaCO_3$)
48	%	Sand
35.84	%	Silt
16.16	%	Clay
Loam	—	Soil Texture

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2-3 Measurements

Plant samples were taken from the fronds at the Khalal stage on August 20, 2025, and washed gently with tap water and then with distilled water, and left to air dry. A part of it was used to measure the fresh samples, while the second part was dried in an electric oven at 65°C for 48 hours (6) and ground with an electric grinder, and passed through a 1mm sieve, then stored in plastic containers to be ready for analysis.

2-3-1 Total Chlorophyll Content in Leaves (mg $100g^{-1}$ Fresh Weight)

The chlorophyll content was estimated according to the method of (13), by homogenizing 0.5 g of leaves with 50 ml of 80% acetone and measuring the optical density of the samples at 645 and 663 nm using a spectrophotometer. The total chlorophyll content was calculated using the following equation:

Total Chlorophyll Content (mg 100g-1 Fresh Weight) = [20.2 (OD645) + 8.02 (OD663)] × (V / 1000 W)

Where:
-OD645: Optical density at 645 nm
-OD663: Optical density at 663 nm
-V: Volume of the extract (ml)
- W: Weight of the sample (g)

2-3-2 Nitrogen (%): It was estimated using the Micro-Kjeldahl apparatus (7).

2-3-3 Phosphorus (%): Using ammonium molybdate, and measurement with a spectrophotometer at a wavelength of 882 nm (7).

2-3-4 Potassium (%): It was estimated using a Flamephotometer (7).

2-3-5 Percentage of Total Sugars in Fruits: The percentage of total sugars was estimated on a wet weight basis by weighing 200 mg of fruits and adding 25 ml of diluted perchloric acid (0.01 N), then 1 ml of the juice was taken and placed in a 50 ml glass flask, and 1 ml of 5% phenol solution and 5 ml of concentrated sulfuric acid were added with continuous shaking, and the mixture was left to cool, then the light absorption was read with a spectrophotometer at a wavelength of 490 nm according to the method of (19).

2-3-6 Percentage of Reducing Sugars (Glucose + Fructose) in Fruits:

The percentage of reducing sugars was estimated by taking 250 mg of fruits and mashing them well in a porcelain mortar with the addition of 10 ml of distilled water, then 1 ml of the diluted juice was taken, and 1 ml of 5% phenol solution and 5 ml of concentrated sulfuric acid were added with continuous shaking, and the mixture was left to cool, then the light absorption was read with a spectrophotometer at a wavelength of 488 nm according to the method of (19) .

2-3-7 Percentage of Non-Reducing Sugars (Sucrose) in Fruits:

It was estimated by the difference between total sugars and reducing sugars.

Non-reducing sugars = Total sugars - Reducing sugars

The statistical program SAS was used to analyze the data to study the effect of three factors, potassium, benzyadenine, and the Bagging and their interactions according to a factorial experiment (3×2×2) and implemented in a randomized complete block design (RCBD) with three replicates. The averages were compared according to Duncan's multiple range test at a probability level of 0.05

3-Results and Discussion

3-1 Leaf Nitrogen Content

The results in Table (3) show that potassium spraying treatments had a significant effect on the leaf nitrogen content, as the spraying treatment with a concentration of 200 g L-1 gave the highest content, reaching 1.226%, while the control treatment gave the lowest average, reaching 1.130%. As for the benzyadenine spraying treatments, the spraying treatment with a concentration of 100 mg L-1 was superior, with the highest average of 1.217%, while the spraying treatment with a concentration of 50 mg L-1 gave the lowest average, reaching 1.149%. No significant difference was observed between the bunching treatments (with or without bunching).The results in the table above show the interaction effect between potassium and benzyl adenine spraying treatments. We note that the spraying treatments with potassium at a concentration of 200 g L-1 and 100 mg L-1 benzyl adenine were superior, with the highest average of 1.866%, while the control treatment gave the lowest average, reaching 1.103%. Regarding the interaction between potassium spraying and bunching, we note that the spraying treatment with 200 g L^{-1} potassium with or without bunching was superior, with the highest average leaf nitrogen content, while the interaction treatment between no spraying with or without bunching gave the lowest average.As for the interaction between benzyl adenine spraying and bunching treatments, the table results show that the spraying treatment with 100 mg L-1 without bunching was superior, with the highest average leaf nitrogen content, reaching 1.218%, while the spraying treatment with 50 mg L-1 with bunching gave the lowest average, reaching 1.148%. The spraying treatment with potassium at a concentration of 200 g L-1, 100 mg L-1 benzyl adenine, and without bunching was superior, with the highest average leaf nitrogen content, reaching 1.226%, while the treatment without potassium spraying and with benzyl adenine spraying at a concentration of 50 mg L^{-1} with bunching gave the lowest average, reaching 1.096%.

Table 3: Effect of Potassium, Benzyl Adenine Spraying, and Bunch Bagging on Leaf Nitrogen Content of Date Palm cv. Breem

Potassium ($g.L^{-1}$)	Benzyl Adenine ($mg.L^{-1}$)	Bagging		Interaction (K*BA)
		Bagging	Without Bagging	
0	50	1.110 e	1.096 e	1.103 e
	100	1.156 d	1.160 d	1.158 d
100	50	1.150 d	1.166 d	1.158 d
	100	1.233	1.220	1.226

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		b	b	b
200	50	1.186 c	1.186 c	1.866 c
	100	1.266 a	1.266 a	1.266 a
Factorial Interaction(Potassium*Bagging)				Mean Potassium
0		1.133 c	1.128 c	1.130 C
100		1.191 b	1.193 b	1.192 B
200		1.226 a	1.226 a	1.226 A
Interaction Benzyl Adenin*Bagging				Mean Benzyl Adenin
50		1.148 b	1.150 b	1.149 B
100		1.215 a	1.218 a	1.217 A
Mean Bunch Bagging		1.183 A	1.182 A	

3-2 Leaf Phosphorus Content

The results in Table (4) show that potassium spraying treatments had a significant effect on the leaf phosphorus content, as the spraying treatment with a concentration of 200 g L-1 gave the highest content, reaching 0.443%, while the control treatment gave the lowest average, reaching 0.225%. As for the benzyl adenine spraying treatments, the spraying treatment with a concentration of 100 mg l^{-1} was superior, with the highest average of

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0.397%, while the spraying treatment with a concentration of 50 mg l^{-1} gave the lowest average, reaching 0.330%. No significant difference was observed between the bunching treatments (with or without bunching).

with the highest average of 0.473%, while the control treatment gave the lowest average, reaching 0.235%. Regarding the interaction between potassium spraying and bunching, we note that the spraying treatment with 200 g l^{-1} potassium with or without bunching was superior, with the highest average leaf phosphorus content, while the interaction treatment between no spraying with or without bunching gave the lowest average.

As for the interaction between benzyl adenine spraying and bunching treatments, the table results show that the spraying treatment with 100 mg L-1 without bunching was

The results in the table above show the interaction effect between potassium and benzyl adenine spraying treatments. We note that the spraying treatments with potassium at a concentration of 200 g l^{-1} and 100 mgl^{-1} benzyl adenine were superior

superior, with the highest average leaf phosphorus content, reaching 0.405%, while the spraying treatment with 50 mg L-1 with bunching gave the lowest average, reaching 0.322%.

The spraying treatment with potassium at a concentration of 200 g L-1, 100 mg L-1 benzyl adenine, and without bunching was superior, with the highest average leaf phosphorus content, reaching 0.486%, while the treatment without potassium spraying and with benzyl adenine spraying at a concentration of 50 mg L-1 with bunching gave the lowest average, reaching 0.220%.

Table 4: Effect of Potassium, Benzyl Adenine Spraying, and Bunch Bagging on Leaf Phosphorus Content of Date Palm cv. Breim

Potassium ($g.L^{-1}$)	Benzyl Adenine ($mg.L^{-1}$)	Bagging		Interaction (K*BA)
		Bagging	Without Bagging	
0	50	0.220 h	0.250 g	0.235 e
	100	0.350 e	0.320 f	0.335 d
100	50	0.336 ef	0.346 e	0.341 d
	100	0.380 d	0.386 d	0.383 c
200	50	0.410 c	0.416 c	0.413 b

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	100	0.460 b	0.486 a	0.473 a
Factorial Interaction(Potassium*Bagging)				Mean Potassium
0		0.285 c	0.285 c	0.285 C
100		0.358 b	0.366 b	0.362 B
200		0.448 a	0.438 a	0.443 A
Interaction Benzyl Adenin*Bagging				Mean Benzyl Adenin
50		0.322 d	0.337 c	0.330 B
100		0.388 b	0.405 a	0.397 A
Mean Bunch Bagging		0.363 A	0.363 A	

3-3 Leaf Potassium Content

The results in Table (5) show that potassium spraying treatments had a significant effect on the leaf potassium content, as the spraying treatment with a concentration of 200 g L-1 gave the highest content, reaching 2.024%, while the control treatment gave the lowest average, reaching 1.619%. As for the benzyl adenine spraying treatments, the spraying treatment with a concentration of 100 mg L-1 was superior, with the highest average of 1.883%, while the spraying treatment with a concentration of 50 mg L-1 gave the lowest average, reaching 1.765%. No significant difference was observed between the bunching treatments (with or without bunching).

The results in the table above show the interaction effect between potassium and benzyl adenine spraying treatments. We note that the spraying treatments with potassium at a concentration of 200 g L-1 and 100 mg L-1 benzyl adenine were superior, with the highest average of 2.098%, while the control treatment gave the lowest average, reaching 1.55%. Regarding the interaction between potassium spraying and bunching, we note that the spraying treatment with 200 g L-1 potassium with or without bunching was superior, with the highest average leaf potassium content, while the interaction treatment between no spraying without bunching gave the lowest average.

As for the interaction between benzyl adenine spraying and bunching treatments, the table results show that the spraying treatment with 100 mg L-1 without bunching was superior, with the highest average leaf potassium content, reaching 1.891%, while the spraying treatment with 50 mg L-1 with or without bunching gave the lowest average, reaching 1.763%.

The spraying treatment with potassium at a concentration of 200 g L-1, 100 mg L-1 benzyl adenine, and with bunching was superior, with the highest average leaf potassium content, reaching 2.116%, while the treatment without potassium spraying and with benzyl adenine spraying at a concentration of 50 mg L-1 without bunching gave the lowest average, reaching 1.540%.

Table 5: Effect of Potassium, Benzyl Adenine Spraying, and Bunch Bagging on Leaf Potassium Content of Date Palm cv. Breem

Potassium ($g.L^{-1}$)	Benzyl Adenine ($mg.L^{-1}$)	Bagging		Interaction (K*BA)
		Bagging	Without Bagging	
0	50	1.570 g	1.540 h	1.555 f
	100	1.686 f	1.680 f	1.683 e
100	50	1.790 e	1.790 e	1.790 d
	100	1.870 d	1.870 d	1.870 c
200	50	1.940 c	1.960 c	1.950 b
	100	2.116 a	2.080 b	2.098 a
Factorial Interaction (Potassium*Bagging)				Mean Potassium

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0	1.628 c	1.610 d	1.619 C
100	1.830 b	1.830 b	1.830 B
200	2.028 a	2.020 a	2.024 A
Interaction Benzyl Adenin*Bagging			Mean Benzyl Adenin
50	1.766 c	1.763 c	1.765 B
100	1.876 b	1.891 a	1.883 A
Mean Bunch Bagging	1.828 A	1.820 A	

3-4 Total Sugars Percentage in Fruit

The results in Table (6) show that potassium spraying treatments had a significant effect on the total sugar percentage in fruits, as the spraying treatment with a concentration of 200 g L-1 gave the highest content, reaching 81.44%, while the control treatment gave the lowest average, reaching 78.78%. As for the benzyl adenine spraying treatments, the spraying treatment with a concentration of 100 mg L-1 was superior, with the highest average of 80.41%, while the spraying treatment with a concentration of 50 mg L-1 gave the lowest average, reaching 79.75%. No significant difference was observed between bunching treatments (with or without bunching).

The results in the table above show the interaction effect between potassium and benzyl adenine spraying treatments. We note that the spraying treatments with potassium at a concentration of 200 g L-1 and 100 mg L-1 benzyl adenine were superior, with the highest average of 81.83%, while the control treatment gave the lowest average, reaching 78.53%. Regarding the interaction between potassium spraying and bunching, we note that the spraying treatment with 200 g L-1 potassium with or without bunching was superior, with the highest average total sugar percentage in fruits, while the interaction treatment between no spraying with or without bunching gave the lowest average.

As for the interaction between benzyl adenine spraying and bunching treatments, the table results show that the spraying treatment with 100 mg L-1 with or without bunching was superior, with the highest average total sugar percentage in fruits, reaching 80.43%, while the spraying treatment with 50 mg L-1 with bunching gave the lowest average, The spraying treatment with potassium at a concentration of 200 g L-1, 100 mg L-1 benzyl adenine, with bunching was superior, with the highest average total sugar percentage in fruits, reaching 82.00%, while the treatment reaching 79.68%.

without potassium spraying and with benzyl adenine spraying at a concentration of 50 mg L-1 with or without bunching gave the lowest average, reaching 78.50%.

Table 6: Effect of Potassium, Benzyl Adenine Spraying, and Bunch Bagging on Total Sugar Content in Fruits of Date Palm cv. Breem

Potassium ($g.L^{-1}$)	Benzyl Adenine ($mg.L^{-1}$)	Bagging		Interaction (K*BA)
		Bagging	Without Bagging	
0	50	78.56 h	78.50 h	78.53 f
	100	79.00 g	79.06 g	79.03 e
100	50	79.70 f	79.66 g	79.68 d
	100	80.30 e	80.46 e	80.38 c
200	50	80.80 d	81.30 c	81.05 b
	100	82.00 a	81.66 b	81.83 a
Factorial Interaction (Potassium*Bagging)				Mean Potassium
0		78.78 c	78.78 c	78.78 C
100		80.00	80.06	80.03

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	b	b	B
200	81.40 a	81.48 a	81.44 A
Interaction Benzyl Adenin*Bagging			Mean Benzyl Adenin
50	79.68 c	79.82 b	79.75 B
100	80.40 a	80.43 a	80.41 A
Mean Bunch Bagging	80.06 B	80.11 A	

3-5 Reducing Sugars Percentage (Glucose+Fructose)

The results presented in Table (7) show that potassium spraying treatments had a significant effect on the reducing sugar percentage in fruits, as the spraying treatment with a concentration of 200 g L-1 gave the highest percentage, reaching 72.30%, while the control treatment gave the lowest average, reaching 70.28%. As for the benzyl adenine spraying treatments, the spraying treatment with a concentration of 100 mg L-1 was superior, with the highest average of 71.61%, while the spraying treatment with a concentration of 50 mg L-1 gave the lowest average, reaching 71.10%. A significant difference was observed between bunching treatments, with the bunching treatment giving the highest average of 71.40%.

The results in the table above show the interaction effect between potassium and benzyl adenine spraying treatments. We note that the spraying treatments with potassium at a concentration of 200 g L-1 and 100 mg L-1 benzyl adenine were superior, with the highest average of 72.53%, while the control treatment gave the lowest average, reaching 69.98%. Regarding the interaction between potassium, spraying and bunching, we note that the spraying treatment with 200 g L-1 potassium with bunching was superior, with the highest average reducing sugar percentage in fruits, while the interaction treatment between no spraying with or without bunching gave the lowest average.

As for the interaction between benzyl adenine spraying and bunching treatments, the table results show that the spraying treatment with 100 mg L-1 without bunching was superior, with the highest average reducing sugar percentage, reaching 71.70%, while the spraying treatment with 50 mg L-1 with or without bunching gave the lowest average, reaching 71.08%.

The spraying treatment with potassium at a concentration of 200 g L-1, 100 mg L-1 benzyl adenine, with bunching was superior, with the highest average reducing sugar percentage in fruits, reaching 72.66%, while the treatment without potassium spraying and with benzyl adenine spraying at a concentration of 50 mg L-1 with or without

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bunching gave the lowest average, reaching 69.90%.

Table 7: Effect of Potassium, Benzyl Adenine Spraying, and Bunch Bagging on Reducing Sugar Content in Fruits of Date Palm cv. Breem

Potassium (g.L^{-1})	Benzyl Adenine (mg.L^{-1})	Bagging		Interaction (K*BA)
		Bagging	Without Bagging	
0	50	69.90 h	70.06 h	69.98 f
	100	70.56 g	70.60 g	70.58 e
100	50	71.26 f	71.20 f	71.23 d
	100	71.86 d	71.56 e	71.71 c
200	50	72.16 c	72.00 cd	72.08 b
	100	72.66 a	72.40 b	72.53 a
Factorial Interaction(Potassium*Bagging)				Mean Potassium
0		70.23 e	70.33 e	70.28 C
100		71.56 c	71.38 d	71.47 B
200		72.41 a	72.20 b	72.30 A
Interaction Benzyl Adenin*Bagging				Mean Benzyl

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			Adenin
50	71.11 c	71.08 c	71.10 B
100	71.52 b	71.70 a	71.61 A
Mean Bunch Bagging	71.40 A	71.30 B	

3-6 Non-Reducing Sugars Percentage

The results in Table (8) show that potassium spraying treatments had a significant effect on the non-reducing sugar percentage in fruits, as the spraying treatment with a concentration of 200 g L-1 gave the highest percentage, reaching 9.133%, while the control treatment gave the lowest average, reaching 8.491%. As for the benzyl adenine spraying treatments, the spraying treatment with a concentration of 100 mg L-1 was superior, with the highest average of 8.777%, while the spraying treatment with a concentration of 50 mg L-1 gave the lowest average, reaching 8.650%. A significant difference was observed between bunching treatments (with or without bunching).

The results in the table above show the interaction effect between potassium and benzyl adenine spraying treatments. We note that the spraying treatments with potassium at a concentration of 200 g L-1 and 100 mg L-1 benzyl adenine were superior, with the highest average of 9.300%, while the control treatment gave the lowest average, reaching 8.450%. Regarding the interaction between potassium spraying and bunching, we note that the spraying treatment with 200 g L-1 potassium without bunching was superior, with the highest average non-reducing sugar percentage in fruits, while the interaction treatment between no spraying with or without bunching gave the lowest average.

As for the interaction between benzyl adenine spraying and bunching treatments, the table results show that the spraying treatment with 100 mg L-1 with or without bunching was superior, with the highest average non-reducing sugar percentage, reaching 8.822%, while the spraying treatment with 50 mg L-1 with or without bunching gave the lowest average, reaching 8.577%.

The spraying treatment with potassium at a concentration of 200 g L-1, 100 mg L-1 benzyl adenine, with or without bunching was superior, with the highest average non-reducing sugar percentage in fruits, reaching 9.333%, while the treatment without potassium spraying and with benzyl adenine spraying at a concentration of 50 mg L-1 without bunching gave the lowest average, reaching 8.400%.

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Table 8: Effect of Potassium, Benzyl Adenine Spraying, and Bunch Bagging on Non-Reducing Sugar Content in Fruits of Date Palm cv. Breem

Potassium ($g.L^{-1}$)	Benzyl Adenine ($mg.L^{-1}$)	Bagging		Interaction (K*BA)
		Bagging	Without Bagging	
0	50	8.666 bc	8.400 c	8.533 c
	100	8.433 bc	8.466 bc	8.450 c
100	50	8.433 bc	8.466 bc	8.450 c
	100	8.433 bc	8.733 b	8.583 c
200	50	8.633 bc	9.300 a	8.966 b
	100	9.333 a	9.266 a	9.300 a
Factorial Interaction (Potassium*Bagging)				Mean Potassium
0		8.550 c	8.433 c	8.491 b
100		8.433 c	8.600 c	8.516 b
200		8.983 b	9.283 a	9.133 a
Interaction Benzyl Adenin*Bagging				Mean Benzyl Adenin

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50	8.577 b	8.722 ab	8.650 B
100	8.822 a	8.733 ab	8.777 A
Mean Bunch Bagging	8.655 B	8.772 A	

Discussion

The results presented in Tables (3, 4, and 5) show that the potassium spraying treatment at a concentration of 200 g l^{-1} had a significant effect on the leaf content of nitrogen, phosphorus, and potassium. This can be attributed to the fact that potassium spraying plays an effective role in improving the absorption of nutrients through the leaves and contributes to the transport and distribution of major elements within the plant. Additionally, potassium, has a role in activating enzymes responsible for nitrogen absorption, improving photosynthetic efficiency, and protein synthesis. When potassium is available in sufficient quantities, it leads to increased cellular efficiency in nitrogen absorption, transport, and fixation within vegetative tissues (9) .

Regarding the effect of potassium on leaf phosphorus content, this effect is due to its role in improving cell membrane permeability, which in turn leads to phosphorus transport within the plant and its incorporation into energy compounds (ATP) (27)

As for the leaf potassium content, the effect is attributed to the foliar application of this element at medium to high concentrations, which is important in regulating stomatal opening and closing, thereby improving metabolic processes. These findings are consistent with those of (1), who reported that potassium sources applied as foliar sprays improved yield and quality of date palm fruits cv. Barhi.

The results also show that the benzyl adenine spraying treatment at a concentration of 100 mg L-1 was superior in terms of leaf content of nitrogen, phosphorus, and potassium. Benzyl adenine is a growth regulator belonging to the cytokinin group, which plays a role in activating cell division, thereby promoting vegetative growth and increasing the number of physiologically active cells in leaves. This high cellular activity increases the demand for nutrients and stimulates their absorption and transport within the plant.

Benzyl adenine also contributes to delaying leaf senescence, which prolongs the period during which leaves remain active in photosynthesis and thus continue to absorb nutrients and accumulate them in leaf tissues (16). It is also important in increasing the activity of enzymes responsible for nitrogen and phosphorus metabolism, such as nitrate reductase and the formation of organic compounds, leading to the fixation of these elements within leaves and an increase in their total content (29) .

These findings are consistent with those of (23), who studied the effect of benzyl adenine spraying, organic fertilizer application, and thinning on the chemical composition of date palm leaves cv. Majhul.

The results of the study indicate that the bunching treatment did not show a significant effect on the leaf content of nitrogen,

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phosphorus, and potassium, as bunching is limited to the fruits only and not the leaves. The role of bunching is primarily physical protection from environmental factors such as pests, insects, heat, and dust (25). These results are consistent with the study by (21), which focused on pre-harvest fruit bagging to improve quality.

The results showed a significant effect of potassium spraying at a concentration of 200 g L-1 on the total, reducing, and non-reducing sugar percentages in fruits. This is attributed to the importance of potassium in activating photosynthesis in leaves by regulating stomatal opening and closing and maintaining As for non-reducing sugars, potassium plays a role in activating amylase enzyme, responsible for starch hydrolysis to simple sugars (32). These findings are consistent with those of (3), who studied the effect of foliar sprays of seaweed extracts and potassium nitrate on yield and quality of date palm fruits.

The results of the study show a significant effect of benzyl adenine spraying at a concentration of 100 mg L-1 on the total, reducing, and non-reducing sugar percentages in fruits. This is due to the role of this growth regulator in stimulating carbohydrate transport from source (leaves) to sink, as well as activating enzymes involved in sucrose breakdown to simpler sugars, contributing to increased reducing and non-reducing sugars during fruit ripening (24). These findings are consistent with the study by (14), which investigated the effect of benzyl adenine on fruit thinning and growth in deciduous fruit trees.The results presented in Table (6) show that the bunching treatment did not have a significant effect on the total sugar percentage in fruits, with or without bunching. However, photosynthetic efficiency, which leads to the formation of primary sugars, especially sucrose, in leaves as the main source. Potassium also contributes to improving sugar transport from source to sink tissues in fruits, thereby activating metabolic processes within fruit cells, leading to increased sugar accumulation and conversion to reducing and non-reducing forms, and thus increasing their total content in fruits (15)

Potassium also activates invertase enzyme, responsible for sucrose hydrolysis to glucose and fructose, contributing to increased reducing sugars.

the bunching treatment showed a significant effect on the reducing sugar percentage in fruits, as shown in Table (7). As for the non-reducing sugar percentage, the treatment without bunching showed a significant superiority, as shown in Table (8). The reason for these differences is attributed to the response of different types of sugars to the covering treatment, as it affects the metabolic pathway of sugars within the fruit more than it affects the total sugar content, indicating an improvement in some traits without changing the total sugar content (4). These findings are consistent with the study by (22), which investigated the effect of pre-harvest fruit bagging on the chemical composition and disease incidence of mango fruits.

Conclusions

The results of the study show that the interaction treatment between potassium spraying at a concentration of 200 g L-1 and benzyl adenine at a concentration of 100 mg L-1, with or without bunching, was significantly superior in chemical traits compared to the control treatment.

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