

## Evaluation of the Efficacy of Moringa Leaf Extract Spraying and Bunch Bagging on some Physical and Quantitative Characteristics of Khidrawi and Bream Cultivars

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**Abstract.** This investigation was conducted in the 2021 growing season at the Fadak farm, which belongs to the Imam Hussein Holy Shrine/Karbala province, to assess the effectiveness of spraying with various concentrations of moringa leaf extract (0, 100, and 200 ml.L<sup>-1</sup>) and bunch bagging in some of the physical and qualitative traits of two date palms cultivars (Khidrawi and Bream). Three sprays with the previously stated concentrations were used in the study; the first spray was applied after 7 weeks of pollination (at the end of the Hababuk stage and the start of the Jamri stage), and three weeks passed between each spray. The bunches were then covered with brown paper after each spray. The obtained results revealed the superiority of spraying treatment with 200 ml. L<sup>-1</sup> of Moringa leaf extract with bagging on the Khidrawi cultivar fruit characteristics (length, diameter, size, weight, and flesh weight), bunch weight, and total yield, which did not differ significantly from treatment with spraying at a concentration of 100 ml. L<sup>-1</sup> with coverage for the same cultivar except for the seed weight, was not impacted significantly by the factors under study when comparing the results with the control treatment. The study's findings suggest that natural plant extracts can be used in place of synthetic chemicals to improve the quantitative and qualitative yield of some date palm cultivars and other horticultural crops. These natural plant extracts can be used as growth regulators or fertilizer supplements in conjunction with some agricultural practices.

**Keywords.** Bunch bagging, Date palm, *Moringa oleifera* L., Plant extract.

### Introduction

Date palm trees belong to the *Arecaceae* family, which includes about 181 genera and approximately 2600 species [1,2]. One of the genera, *Phoenix* (Coryphoideae phoeniceae), has about 14 species that are indigenous to southern Asia and Africa's tropical or subtropical climates, including *Phoenix dactylifera* L. [3]. there are around 600 different types of date palms in Iraq out of the estimated 1500 varieties worldwide [4]. Date palms are thought to have originated in Iraq and the Arabian Gulf. Consequently, Iraq is considered to have some of the world's oldest palm tree plantations [5]. The fruits of the date palm are highly nutritious and therapeutic, and

they have anti-bacterial, anti-fungal, anti-oxidant, and anti-proliferative properties, so extracts have been used in the food and pharmaceutical industries to create commercial products based on natural ingredients to improve health conditions [6]. However, production has declined in recent years under unsuitable conditions, lack of efficient use of agricultural resources, reliance on old traditional methods, and weak agricultural service operations [7].

Fruits are subjected to a variety of treatments in an attempt to enhance their quantitative and qualitative qualities without the use of harmful chemicals that threatens human health and the environment. One of these treatments is the use of plant extracts, which can perform the

same function as industrial materials without posing any risk to people or the environment [8-12]. This includes the use of natural plant extracts like *Moringa oleifera* Lam. leaf extract is a natural substitute for chemicals because it contains numerous growth hormones, antioxidants, nutrients, and vitamins [13,14]. Foliar spraying of moringa leaf extract is therefore viewed as an affordable and eco-friendly organic technique that encourages the growth of various plants [15]. In a study by [16], it was discovered that spraying moringa leaf extract on bunches of the date palm Khidrawi cultivar three times (the first spray was three hours before pollination, the second was after a month, and the third was after two months of pollination) resulted in significant differences in weight, length, size, and diameter of the fruits compared to the control treatment, as well as the weight of the flesh, the weight of the seed and the total yield. In addition, [17] discovered that spraying moringa leaf extract at a dosage of 6% produced the greatest outcomes when compared to the other concentrations when applied three times (3 hours before pollination and 4-8 weeks following pollination). The maximum yield per tree was reached when the extract was sprayed on olive trees at a concentration of 4% [18].

The practice of bunches bagging with different covers is a physical process that improves the properties of the fruits as it increases their quality and protects them from unsuitable conditions, as well as protects them from insects and dust, especially in hot and dry areas [19]. It is also one of the simple and environmentally friendly techniques that are free from harmful health or environmental effects that accompany chemical treatments; it does not require high experience or specific training and can change the micro-climate around the bunches and fruits, which promotes fruit growth and ripening [20]. In a study conducted by [21] on Barhi and Bream cultivars showing the effect of bagging in different colors (yellow, green, and red), regardless of the color of the cover, all

bagging treatments outperformed the comparison treatment in terms of fresh weight, fruit length, and total yield. According to [22], bagging the Khistawi cultivar with various covers (transparent polyethylene, black polyethylene, special sleeve bags, light fabric, and paper bags) significantly outperformed the comparison treatment in terms of characteristics (length, diameter, size, and weight of fruits), in addition to other qualitative characteristics like the weight of the seed and the yield.

The aim of the study was to assess the effectiveness of spraying two cultivars of palm trees with various concentrations of moringa leaf extract and covering them with paper bags, as well as their interaction, to determine which concentration is ideal and the role of coverage in enhancing the quantitative and qualitative properties of the fruits under dry and hot conditions, emphasizing the importance of natural extracts and some agricultural practices to achieve the highest possible yield.

### Materials and Methods

The experiment was conducted at Fadak farm belonging to the Husseiniya holy shrine for the season of 2021, where 36 palm trees were selected, with eighteen palm trees for each cultivar, at the age of six years and homogeneous in size and strength of growth as much as possible. Manual pollination and thinning were carried out by leaving 6 bunches. palm<sup>-1</sup>. Three factors were examined in the study. The first factor was spraying the bunches with aqueous moringa leaf extract in three concentrations (0-, 100-, and 200 ml. L<sup>-1</sup>) with three sprays between one spray and another 21 days, where the first spray was applied after 7 weeks of pollination (the end of the Hababuk stage and the beginning of the Jamri stage). Fresh Moringa leaves and their soft branches were collected from trees planted in the College of Agriculture/University of Kerbala, air dried, and ground by an electric grinder, then the powder was collected and soaked in distilled

water for 24 hours at a rate of 100 g. L<sup>-1</sup>. The extract was filtered through a cloth with extremely small pores before being collected in plastic containers. To obtain the required concentrations, (100 and 200 ml) of the extract per liter of water were used. The second factor was bunch bagging with closed-ended brown bags, which was done after the first spray and lifted after the third spray. The third factor involved two different varieties of date palms, Khidrawi Al-Basra and Bream. The experiment was designed with a Randomized Complete Block Design (R.C.B.D) with three replications, and the means were compared according to Duncan's polynomial test at a probability level of 0.05. To investigate the effect of the factors under study, the following characteristics were measured: length, diameter, and size of the fruit. The fresh weight of the fruits, the weight of the flesh, the weight of the seed, the weight of the bunch, and the weight of the total yield were also measured.

## Results

### *Fruit Length (mm)*

Results in Table (1) reveal that the spray treatment of 200 ml. L<sup>-1</sup> of leaf extract was superior by recording the highest average fruit length of 35.67 mm, which did not differ significantly from the spray treatment at a concentration of 100 ml. L<sup>-1</sup> compared to the comparison treatment, which gave the lowest

**Table 1.** Effect of moringa leaf extract and the bunch covering and their interactions on the average fruit length (mm) for Khidrawi and Bream cultivars.

Cultivar	Coverage	Extract (ml. L <sup>-1</sup> )			Interaction between coverage and cultivar	Cultivar averages
		0	100	200		
Khidrawi	Without coverage	32.06 d*	36.40 a	36.31 a	35.01 a	35.12 a
	With coverage	32.24 d	37.17 a	37.51 a	35.23 a	
Bream	Without coverage	31.20 d	34.17 b	33.60 bc	32.80 a	32.90 b
	With coverage	31.26 d	33.16 c	34.20 b	33.50 a	
Extract averages		30.89 b	35.48 a	35.67 a		

rate of 30.89 mm, while the coverage factor had no significant effect on the average fruit length. The Khidrawi cultivar excelled with the highest average fruit length of 35.12 mm, while the Bream cultivar recorded the lowest rate of 32.9 mm.

The same table's findings revealed that there were significant differences in the bilateral interaction between the extract and the covering of the bunches, with the treatment (spray at a concentration of 200 ml. L<sup>-1</sup> with coverage) recording the highest rate of 35.78 mm and the comparison treatment recording the lowest rate of 30.65 mm. Regarding the effect of the binary interaction between the extract and the cultivar, the Khidrawi cultivar received a spraying treatment at a concentration of 200 ml. L<sup>-1</sup> and recorded the highest value of 37.45 mm, while the Bream cultivar received a control treatment, which produced a fruit length average of 31.15 mm. There were no significant variations in the relationship between coverage and cultivar. According to the data from the same table, there were significant differences in the fruit length rates for the spraying treatment at a concentration of 200 ml. L<sup>-1</sup> with coverage of the Khidrawi cultivar, which recorded the highest rate of 37.51 mm, while the comparison treatment recorded the lowest rate of 31.20 mm for the Bream cultivar without coverage.

Interaction between extract and cultivar	Khidrawi	32.36	37.29	37.45	Coverage averages
		c	a	a	
	Bream	31.15	33.66	33.90	
Interaction between extract and coverage	Without coverage	30.65	35.75	35.59	34.10
	With coverage	31.13	35.18	35.78	34.20
		b	a	a	a

\* Means that share the same letters do not differ significantly among themselves according to Duncan's polynomial test at the 0.05 probability level.

#### Fruit Diameter (mm)

The results in Table (2) showed that there was an increase in the diameter of the fruit with an increase in the concentration of moringa leaf extract, where the spray treatment with a concentration of 200 ml. L<sup>-1</sup> was superior to giving the highest rate of 23.90 mm, followed by the spraying treatment with a concentration of 100 ml. L<sup>-1</sup>, which gave an average of 23.06

mm, while the comparison treatment recorded the lowest rate of 21.63 mm, as well as the coverage factor, had a significant effect on increasing the diameter of the fruit, where the coverage factor recorded an average of 23.32 mm, while the comparison treatment recorded 22.41 mm. As for the effect of the cultivar, there were no significant effects between the two cultivars.

**Table 2.** Effect of moringa leaf extract and the bunch covering and their interactions on the average Fruit diameter (mm) for Khidrawi and Bream cultivars.

Cultivar	Coverage	Extract (ml. L <sup>-1</sup> )			Interaction between coverage and cultivar	Cultivar averages
		0	100	200		
Khidrawi	Without coverage	21.50	23.14	23.66	23.14	23.89
	With coverage	21.63	23.56	24.43	23.51	
Bream	Without coverage	21.12	21.73	23.30	22.17	22.84
	With coverage	22.26	23.83	24.22	22.64	
Extract averages		21.63	23.06	23.90		
Interaction between extract and cultivar	Khidrawi	21.88	23.35	23.94	Coverage averages	
	Bream	21.38	22.78	23.86		
Interaction between extract and coverage	Without coverage	21.31	22.43	23.48	22.41	
	With coverage	21.95	23.70	24.32	23.32	

\* Means that share the same letters do not differ significantly among themselves according to Duncan's polynomial test at the 0.05 probability level.

As for the effect of the bilateral interaction between the extract and the cultivar, it was recorded that spraying the Khidrawi cultivar with a concentration of 200 ml. L<sup>-1</sup> the highest rate reached 23.94, while the comparison treatment of the Bream cultivar recorded the lowest rate for this trait, which reached 21.38 mm. The results also showed the superiority of the spraying treatment with a concentration of 200 ml. L<sup>-1</sup> with coverage by giving the highest rate of 24.32 mm compared to the comparison treatment, which recorded the lowest rate of 21.31 mm. Also, the covering treatment on Khidrawi achieved the highest rate of 23.51 mm, outperforming the comparison treatment of the Bream cultivar, which recorded the lowest rate of 22.17 mm. As for the overlapping effect of the three studied factors, it was superior to the treatment of spraying the Khidrawi cultivar at a concentration of 200 ml. L<sup>-1</sup> with coverage recorded the highest rate of 24.43 ml, while the control treatment of the Bream cultivar recorded the lowest rate of 21.12 mm.

#### *Fruit Size (cm<sup>3</sup>)*

The data in Table (3) indicated that the fruit size increased with an increasing concentration of moringa leaf extract, where spraying treatment was at a concentration of 200- and 100 ml. L<sup>-1</sup> recorded the largest size of the fruits with a significant difference from the control treatment, which amounted to 10.58 and 9.62 cm<sup>3</sup>, respectively, while the control treatment recorded the lowest rate of 8.51 cm<sup>3</sup>. The bagging factor had no

significant effect on increasing the size of the fruits. The two cultivars differed in the size of their fruits, where the fruits of the Khidrawi cultivar were significantly superior, with a size of 10.34 cm<sup>3</sup>, while the size of the Bream cultivar fruit was 8.80 cm<sup>3</sup>.

Regarding the impact of the bilateral interaction between spraying with extract and coverage, the outcomes indicated the superiority of spraying treatment with a concentration of 200 ml. L<sup>-1</sup> with coverage with the largest fruit size of 10.88 cm<sup>3</sup>, while the smallest size with the comparative treatment was 8.41 cm<sup>3</sup>. As for the interaction effect between spraying the extract and the cultivar, the treatment of the Khidrawi cultivar with a concentration of 200 ml. L<sup>-1</sup> was superior, as it recorded the largest average fruit size of 11.40 cm<sup>3</sup> while the comparison treatment of the Bream cultivar recorded the lowest average of 7.88 cm<sup>3</sup>, and the two treatments of coverage and without coverage of the Khidrawi cultivar excelled by recording the highest fruit sizes of 10.36 and 10.32 cm<sup>3</sup> respectively, while the comparison treatment of the Bream cultivar recorded the lowest size of 8.34 cm<sup>3</sup> (Table 3).

About the triple interaction, the treatment of spraying Khidrawi cultivar with a concentration of 200 ml. L<sup>-1</sup> with coverage was superior, as the average fruit volume reached 11.53 cm<sup>3</sup>, while the comparison treatment of the Bream cultivar recorded the lowest rate of 7.60 cm<sup>3</sup> (Table 3).

**Table 3.** Effect of moringa leaf extract and the bunch covering and their interactions on the average fruit size (cm<sup>3</sup>) for Khidrawi and Bream cultivars.

Cultivar	Coverage	Extract (ml. L <sup>-1</sup> )			Interaction between coverage and cultivar	Cultivar averages
		0	100	200		
Khidrawi	Without coverage	9.23 c*	10.60 b	11.26 a	10.32 a	10.34 a
	With coverage	9.05 c	10.40 b	11.53 a	10.36 a	
Bream	Without coverage	7.60 d	8.13 d	9.30 c	8.34 b	8.80 b
	With coverage	8.16 d	9.36 c	10.23 b	9.25 b	
Extract averages		8.51 c	9.62 b	10.58 a		
Interaction between extract and cultivar	Khidrawi	9.14 d	10.50 b	11.40 a	Coverage averages	
	Bream	7.88 e	8.75 b	9.76 c		
Interaction between extract and coverage	Without coverage	8.41 c	9.36 bc	10.28 ab	9.35 a	
	With coverage	8.60 c	9.88 ab	10.88 a	9.79 a	

\* Means that share the same letters do not differ significantly among themselves according to Duncan's polynomial test at the 0.05 probability level.

*Fresh Weight of the Fruit (g)*

The results of Table (4) revealed an increase in the average fresh weight of the fruits when sprayed with moringa leaf extract at a concentration of 200 ml. L<sup>-1</sup>, with the highest fruit weight reaching 12.23 g, while the comparison treatment recorded the lowest rate of 8.11 g. On the other hand, there was no significant effect of the covering factor on the fresh weight of the fruits, but the Khidrawi cultivar was significantly superior, with the highest average of the fresh weight of the fruits reaching 11.14 g compared to the Bream cultivar's 9.67 g. The bilateral interaction between spraying with extract and covering showed the superiority of the spraying treatment with a concentration of 200 ml. L<sup>-1</sup> with coverage by recording the highest rate of 12.47 g, while the comparison treatment recorded the lowest average fresh weight of

fruits, which amounted to 7.66 g. On the other hand, the effect of bilateral interaction between the extract and the cultivar was significant. The treatment of spraying the Khidrawi cultivar with a concentration of 200 ml. L<sup>-1</sup> significantly outperformed all treatments by giving the highest rate of 13.12 g, while the comparison treatment of the Bream cultivar recorded the lowest rate of 7.85 g, while the interaction between wrap and cultivar did not affect this characteristic. As the results of the triple interaction, the treatment of Khidrawi cultivar spraying with a concentration The Khidrawi cultivar treatment, which sprayed a 200 ml. L<sup>-1</sup> concentration under cover produced the greatest average fresh weight of the fruits, which came to 13.41 g, while the comparison treatment of the Bream cultivar recorded the lowest rate of 7.23 g.

**Table 4.** Effect of moringa leaf extract and the bunch covering and their interactions on the average fruit weight (g) for Khidrawi and Bream cultivars.

Cultivar	Coverage	Extract (ml. L <sup>-1</sup> )			Interaction between coverage and cultivar	Cultivar averages
		0	100	200		
Khidrawi	Without coverage	8.10 *ef	11.83 c	12.38 ab	10.92 a	11.14 a
	With coverage	8.66 e	12.0 bc	13.41 a	11.36 a	
Bream	Without coverage	7.23 f	10.66 d	11.16 cd	9.68 a	9.67 b
	With coverage	8.46 e	9.0 e	11.53 cd	9.66 a	
Extract averages		8.11 c	10.87 b	12.23 a		
Interaction between extract and cultivar	Khidrawi	8.38 d	11.91 b	13.12 a	Coverage averages	
	Bream	7.85 d	9.83 c	11.35 b		
Interaction between extract and coverage	Without coverage	7.66 c	10.25 b	12.00 a	10.30 a	
	With coverage	8.56 c	11.50 ab	12.47 a	10.51 a	

\* Means that share the same letters do not differ significantly among themselves according to Duncan's polynomial test at the 0.05 probability level.

*Kernel Weight (g)*

The data shown in Table (5) indicate that there was no significant effect of spraying with Moringa leaf extract and covering on kernel weight, while there was a significant effect of the cultivar factor, as the Khidrawi cultivar had the highest seed weight of 0.9 g, while the seed weight of Bream cultivar was 0.75 g.

The data in the same table showed that there were no significant differences for all the dual interaction treatments between spraying with the extract and the covering, while the dual interaction treatment between the extract and the cultivar had a significant effect, as the treatment of spraying Khidrawi cultivar with a concentration of 200 ml. L<sup>-1</sup> gave the highest rate of 1.06 g, which did not significantly differ from the spray treatment with a concentration of 100 ml. L<sup>-1</sup> for the same cultivar did not differ as well from the spray

treatment with a concentration of 200 ml. L<sup>-1</sup> of Bream cultivar, were 1.05 and 0.86 gm, respectively, while the comparison treatment of Bream cultivar recorded the lowest rate of 0.58 g. The covering treatment was also superior for the Khidrawi cultivar, and the average seed weight was 1.04 gm, which did not differ significantly from the control treatment of the same cultivar. The comparison treatment of the Bream cultivar recorded the lowest average seed weight which was 0.66 gm. The triple interaction treatment used spraying at a concentration of 200 ml. L<sup>-1</sup> with coverage of Khidrawi cultivar showed the highest average seed weight of 1.11 g, while the comparison treatment of Bream cultivar recorded the lowest rate of 0.80 g.

**Table 5.** Effect of moringa leaf extract and the bunch covering and their interactions on the average kernel weight (g) for Khidrawi and Bream cultivars.

Cultivar	Coverage	Extract (ml. L <sup>-1</sup> )			Interaction between coverage and cultivar	Cultivar averages
		0	100	200		
Khidrawi	Without coverage	0.69	1.03	1.03	0.9	0.9
	With coverage	1.0	1.10	1.11	1.04	
Bream	Without coverage	0.80	0.81	0.81	0.66	0.75
	With coverage	0.83	0.82	0.90	0.83	
Extract averages		0.85	0.93	0.85		
Interaction between extract and cultivar	Khidrawi	0.84	1.05	1.06	Coverage averages	
	Bream	0.58	0.80	0.86		
Interaction between extract and coverage	Without coverage	0.91	0.95	0.70	0.85	
	With coverage	0.79	0.91	0.95	0.88	

\* Means that share the same letters do not differ significantly among themselves according to Duncan's polynomial test at the 0.05 probability level.

#### *Fruit Flesh Weight (g)*

The information in Table (6) demonstrates that spraying with moringa leaf extract increased the weight of the fruit flesh significantly, especially at a dosage of 200 ml. L<sup>-1</sup> produced the greatest rate of 11.38 g and was followed by spraying with a 100 ml concentration. L<sup>-1</sup> weighed 9.94 g, but the control treatment weighed 7.26 g, which was the least. The bagging element had no discernible influence on improving this trait. The weight of the flesh in the fruits of the two cultivars varied, with the Khidrawi cultivar excelling by recording a weight of 10.24 g, while the weight of the flesh in the fruits of the Bream cultivar was 8.92 g. The dual interaction treatment between spraying at a concentration of 200 ml. L<sup>-1</sup> under coverage, which weighed 11.77 g of flesh weight, was superior to the rest of the treatments, but it did not differ significantly

from the treatment of spraying with the same concentration, but without coverage, which weighed 11.52 g, while the lowest rate was 7.65 g, recorded by the control treatment.

In terms of the interaction between spraying the extract and the cultivar, the Khidrawi cultivar's 200 ml. L<sup>-1</sup> spraying treatment outperformed the comparison treatment by recording the highest rate of 12.06 g, compared to the comparison treatment's 7.27 g. No obvious changes were found for this feature in the interaction between coverage and cultivar. There was a triple interaction between the factors of the study, where the treatment of spraying the Khidrawi cultivar with the concentration of 200 ml. L<sup>-1</sup> under coverage was superior to all treatments, with the highest rate of 12.03 g, while the comparison treatment of the Bream cultivar recorded the lowest rate of 6.40 g.



**Table 6.** Effect of moringa leaf extract and the bunch covering and their interactions on the average flesh weight (g) for Khidrawi and Bream cultivars.

Cultivar	Coverage	Extract (ml. L <sup>-1</sup> )			Interaction between coverage and cultivar	Cultivar averages
		0	100	200		
Khidrawi	Without coverage	7.41 j*	10.80 d	11.35 b	10.02 a	10.24 a
	With coverage	7.66 i	10.89 c	12.03 a	10.32 a	
Bream	Without coverage	6.40 k	9.68 g	10.63 e	9.02 a	8.92 b
	With coverage	7.66 i	8.20 h	10.37 f	8.83 a	
Extract averages		7.26 c	9.94 b	11.38 a		
Interaction between extract and cultivar	Khidrawi	7.54 d	10.85 b	12.06 a	Coverage averages	
	Bream	7.27 d	9.03 c	10.46 b		
Interaction between extract and coverage	Without coverage	7.65 d	10.55 bc	11.52 ab	9.45 a	
	With coverage	7.77 d	10.59 c	11.77 a	9.63 a	

\* Means that share the same letters do not differ significantly among themselves according to Duncan's polynomial test at the 0.05 probability level.

#### Bunch Weight (kg)

According to the study's findings, spraying with moringa leaf extract, particularly at a concentration of 200 ml. L<sup>-1</sup>, had a significant impact since it caused the highest rate of bunch weight, 4.42 kg, while the comparison treatment caused the lowest rate of bunch weight, 3.50 kg. The covered bunches outperformed the uncovered bunches, recording the greatest rate of 4.09 kg compared to the comparison treatment's weight of 3.35 kg, were superior treatments. Regarding the results of the dual interactions between coverage and cultivar, the Khidrawi cultivar's coverage treatment recorded the highest rate, 4.12 kg, while the Bream cultivar's comparison treatment recorded the lowest rate, 3.66 kg. The effect of the triple interaction of the study factors was significant by the superiority of the spraying treatment with a concentration of 200 ml. L<sup>-1</sup> with the bagging of the Khidrawi cultivar recorded the highest average of 4.78 kg, while the

compared to the latter's lowest rate of 3.75 kg. The cultivars did not differ from one another in this characteristic (Table 7).

The results showed that spraying with a concentration of 200 ml L<sup>-1</sup> combined with bagging, resulted in a weight of 4.75 kg compared to the comparison treatment's weight of 3.40 kg, and spraying with a concentration of 200 ml L<sup>-1</sup> for the Khidrawi cultivar, which resulted in a weight of 4.48 kg

comparison treatment of the Bream cultivar recorded the lowest rate, which was 3.23 kg (Table 7).

#### Total Yield (kg)

It is noted from Table 8 that the total yield increased by increasing the used concentration of moringa leaf extract, reaching its maximum at a concentration of 200 ml. L<sup>-1</sup>, where it was 26.45 kg, superior to the spray treatment at a concentration of 100 ml. L<sup>-1</sup> and the control treatment, which gave less yield, reached 21.04 kg. The coverage also had a significant

effect on increasing the total yield of the palm, where the total yield of covered treatments reached 24.52 kg, while the treatment without coverage recorded the lowest amount of total yield, which amounted to 22.53 kg. On the other hand, the cultivar had no significant effect on this trait. The same table also indicates that the effect of the bilateral interaction between the extract and the coverage was significant, as the spray treatment with a concentration of 200 ml. L<sup>-1</sup> under coverage was superior, as the total yield

reached 28.35 kg, while the comparison treatment recorded the lowest rate of 20.43 kg. On the other hand, the effect of the bilateral interaction between the extract and the cultivar was also significant, as the treatment of spraying the Khidrawi cultivar with a concentration of 200 ml. L<sup>-1</sup> was superior, giving the highest total yield of 26.70 kg, while the two comparison treatments of both cultivars recorded the lowest rates, reaching 21.93 kg and 20.15 kg, respectively

**Table 7.** Effect of moringa leaf extract and the bunch covering and their interactions on the average Bunch weight (Kg) for Khidrawi and Bream cultivars.

Cultivar	Coverage	Extract (ml. L <sup>-1</sup> )			Interaction between coverage and cultivar	Cultivar averages
		0	100	200		
Khidrawi	Without coverage	3.57 ef*	3.77 cde	4.18 b	3.84 ab	3.98
	With coverage	3.73 edf	3.84 cd	4.78 a	4.12 a	a
Bream	Without coverage	3.23 g	3.76 cde	4.00 bc	3.66 b	3.87
	With coverage	3.48 fg	4.01 bc	4.73 a	4.07 ab	a
Extract averages		3.50 c	3.84 b	4.42 a		
Interaction between extract and cultivar	Khidrawi	3.65 bc	3.80 b	4.48 a		
	Bream	3.35 c	3.89 b	4.46 a	Coverage averages	
Interaction between extract and coverage	Without coverage	3.40 e	3.76 cd	4.09 b	3.75 b	
	With coverage	3.60 de	3.93 bc	4.75 a	4.09 a	

\* Means that share the same letters do not differ significantly among themselves according to Duncan's polynomial test at the 0.05 probability level.

**Table 8.** Effect of moringa leaf extract and the bunch covering and their interactions on the average total yield (Kg) for Khidrawi and Bream cultivars.

Cultivar	Coverage	Extract (ml. L <sup>-1</sup> )			Interaction between coverage and cultivar	Cultivar averages
		0	100	200		
Khidrawi	Without coverage	21.46 ef*	22.62 cde	25.1 b	23.06 ab	23.82 a
	With coverage	22.40 def	23.06 cd	28.40 a	24.58 a	
Bream	Without coverage	19.40 g	22.60 cde	24.00 bc	22.00 b	23.23 a
	With coverage	20.90 fg	24.10 bc	28.30 a	24.46 ab	
Extract averages		21.04 c	23.09 b	26.45 a		
Interaction between extract and cultivar	Khidrawi	21.93 bc	22.84 b	26.70 a	Coverage averages	
	Bream	20.15 c	23.35 b	26.20 a		
Interaction between extract and coverage	Without coverage	20.43 e	22.61 cd	24.55 b	22.53 b	
	With coverage	21.65 de	23.58 bc	28.35 a	24.52 a	

\* Means that share the same letters do not differ significantly among themselves according to Duncan's polynomial test at the 0.05 probability level.

As for the effect of the dual interaction between coverage and cultivar, the coverage treatment of the Khidrawi cultivar was superior by recording the highest rate of 24.58 kg, while the treatment without coverage of the Bream cultivar recorded the lowest rate of 22.00 kg. The triple interaction between the study factors had a significant effect in increasing the total yield when covering the Khidrawi cultivar and spraying it with a concentration of 200 ml. L<sup>-1</sup> achieved the highest increase of 28.40 kg, while the comparison treatment for the Bream cultivar gave the lowest total yield of the palm at 19.40 kg (Table 8).

### Discussion

The results of the tables (1, 2, 3, 4, 5, and 6) show that spraying with moringa leaf extract had a significant impact compared to the increase was attributed to the study factors' role in increasing the weight of the fruits,

comparison treatments on the physical parameters of the fruits (length, diameter, size, fresh weight, and flesh weight). These traits may have increased due to the extract's high concentration of zeatin, a type of cytokinin that is crucial for cell division and elongation [23], as well as the action of plant hormones in attracting nutrients to the fruit, which increases the fruit's weight, diameter, and size [24]. The genotype controls the phenotypic traits of the fruits, which accounts for the discrepancies in the examined attributes between the two cultivars. The results of the study are evident in Tables 7 and 8, and they are consistent with [25], who found that spraying seedless grape vines with an extract of moringa leaves increased the total yield per acre during the two seasons of the study. This

which has a significant impact on the heterogeneity

of productive traits. The outcomes when spraying moringa leaf concur with those of [26] as well. The purpose of coverage was to raise the overall yield by increasing the fruits' wet weight, which was reflected in the weight of the bunch and the overall yield. This is consistent with what was found by [27] that bagging in different colors increased the characteristics of the weight of the bunch and the total yield of the palm. The results of this study are consistent with [28] that the characteristics of bunch weight and total yield were significantly superior in the covered treatments regardless of the cover color compared to the treatment without cover.

### Conclusion

It can be concluded from this study that it is possible to use natural plant extracts as substitutes for industrial nutrients and synthetic growth regulators individually or in combination with some agricultural practices, including the use of different covers, because these extracts contain natural plant hormones that help in improving the growth characteristics, yield, and quality of various horticultural crops. Based on the results of this study, it can be recommended to use these studied concentrations or experiment with higher concentrations of moringa extract or other plant extracts to increase and improve the production of crops to face the risk of environmental pollution resulting from the excessive use of chemical fertilizers, pesticides, and growth regulators.

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