



### Some natural plant extracts and their impact on fruit set, yield and fruit quality of Barhee date palms

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#### ABSTRACT

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The purpose of this study was to evaluate the influence of natural plant extracts on fruit set, yield, and quality of Barhee date palms under desert orchard conditions. The research was conducted over two consecutive seasons on ten-year-old palms located 63 kilometers along the Cairo–Alexandria desert road. Palms were sprayed three times with 3% moringa extract, 3% licorice extract, or 2% algae extract, applied three hours before pollination and again one and two months later, while untreated palms served as the control. The findings revealed that all treatments significantly improved fruit set percentage, yield, and fruit attributes compared with the control, with algae extract consistently producing the most favorable results. Specifically, the 2% algae treatment recorded the highest values for fruit set, fruit retention, bunch weight, and yield per palm, while also enhancing chemical properties such as total soluble solids, total sugars, and non-reducing sugars, as well as morphological traits including fruit weight, flesh weight, length, diameter, and form index. The practical implications of these results suggest that foliar application of algae extract can serve as an effective, natural biostimulant to improve both productivity and fruit quality in Barhee date palm cultivation, offering a sustainable alternative to synthetic inputs.

**Contribution/Originality:** Using natural plant extracts characterized by promoting effects on plants, such as moringa, algae, and licorice, may offer an opportunity for natural alternative applications, especially if they produce distinctive results regarding productivity and fruit quality of date palms, which are among the most economically valuable crops.

## 1. INTRODUCTION

In the Middle East, the date palm (*Phoenix dactylifera* L.) is regarded as one of the oldest domestic fruit crops. The produced fruits have a significant impact on many people's dietary habits. Egypt is one of the world's top 10 producers of dates. When many other fruits couldn't thrive in poor conditions, date palms could. The date palm is therefore regarded as one of the appropriate trees that might be grown in the recently recovered desert areas. Cultivars of the Arabian date palm thrive in Egyptian environments [1, 2].

Many crops have benefited from the widespread use of safe, natural fertilizers that increase plant growth, yield, and fruit quality. The organic materials utilized in this experiment were selected because they include minerals and plant growth regulators with the following components: lignin, tannins, starch, choline, phytosterols,

monosaccharides (glucose, fructose, and maltose), various vitamins (B1, B2, B3, B6, C, E, biotin, folic acid, and pantothenic acid), and numerous mineral compounds (aluminum, calcium, iron, magnesium, cobalt, zinc, phosphorus, sodium, silicone, and stannous acid) present in licorice extract (*Glycyrrhiza glabra*) [3, 4].

Fruit properties and yield were the best when licorice and garlic extracts were sprayed on apples [5]. Fruit quality was enhanced when date palm was sprayed with 5g/l of licorice extract [6].

Similarly, zeatin, antioxidants, B-carotene, proteins, and ascorbates are among the large amounts of calcium, potassium, and cytokinin found in moringa leaf extract (*Moringa oleifera* L.) [7]. Fruit characteristics and production increased when Hollywood plum trees were sprayed with moringa extract [8]. When compared to the control treatment in both seasons, spraying bunches of 'Khadrawi' date palms with either garlic extract or moringa extract produced the highest initial fruit set, fruit retention, yield, and physical characteristics such as fruit weight, flesh weight, and fruit length. Additionally, moringa extract increased total sugars, lowered sugars, and TSS% [9].

When 4% moringa extract was sprayed, the mineral content of the leaves (N, P, K, Ca, and Mg) increased, and the highest values were obtained, followed by 2% moringa extract. Additionally, compared to the control, 4% moringa extract produced the heaviest bunches and yield of Barhee date palm and increased the percentages of total soluble solids, total sugars, and reducing and non-reducing sugars [10].

To enhance nutritional status, vegetative development, yield, and fruit quality, algae extract was used as a novel biofertilizer containing macronutrients, micronutrients, proteins, vitamins, polyamines, and certain growth regulators [11-15]. Algae primarily improve cell metabolism through the physiological action of major and minor nutrients, vitamins, amino acids, and growth regulators, which influence cellular metabolism in treated plants and increase crop yield and growth [16-18]. The fruit setting, productivity, and quality of Balady orange trees were all improved by algae extract [19]. Once in full bloom, "Keitte" mango trees were sprayed with 2% algae or 0.2% yeast to increase fruit set, fruit retention, fruit number per tree, and yield [18]. The yield and fruit's physical and chemical properties were significantly impacted by spraying the "Medjool" date palm's inflorescences with potassium nitrate at 1 or 2%, and algae extract at 0.5 or 1%, either separately or in combinations [15].

This study aimed to investigate the effect of spraying some natural plant extracts, such as algae extract at 2%, licorice extract at 3%, and Moringa extract at 3%, on fruit set, yield, and fruit physical and chemical properties of "Barhee" date palm cultivar.

## 2. MATERIAL AND METHODS

Ten-year-old Barhee date palms planted on sandy soil six meters apart under drip irrigation were the subject of this study, which was conducted over the course of two consecutive seasons in a private orchard located 63 kilometers from the Cairo-Alexandria desert road. The chosen palms were healthy, almost uniform in shape, and productive, and given the same horticultural treatments. Additionally, the date palms were thinned at a rate of one bunch for every eight leaves (8 leaves/1 bunch ratio).

The same pollen grain source was used for the pollination of all palms. A randomized complete block design was used to organize the twelve palms that were chosen, split into four treatments, and placed in three duplicates (one palm per replication).

Palms were subjected to the following spraying treatments.

1. Control (Water only).
2. Moringa extract at 3%.
3. Algae extract at 2%.
4. Licorice extract at 3%.

Three grams of licorice roots (*Glycyrrhiza glabra*) were boiled for fifteen minutes in one liter of distilled water to create the aqueous extract. A mutton towel was used to wring out the solution and filter it. One liter of distilled water was added after the extracted material was again filtered using No. 2 Wattman filter paper.

As recommended, 30 grams of fresh moringa leaves were blended with 675 milliliters of 80% ethanol to create moringa aqueous extract [20].

The resulting suspension was filtered and homogenized by wringing it out with a mutton towel. Ultimately, the solution climbed to one liter after being re-filtered with No. 2 Wattman filter paper [21].

With the exception of Glycyrrhiza glabra extract, which includes saponin terpenes, all treatments involved spraying bunches with a little hand sprayer till runoff and 0.1% Triton B as wetting agents. Three hours prior to pollination and then one and two months later, each treatment was sprayed three times.

The earliest and latest smallest inflorescences for each palm were removed, adjusting the quantity of spathes per palm by 10 bunches.

The following determination was carried out.

### 2.1. Fruit Set and Fruit Retention

Ten female strands per bunch were randomly selected. Fruit set percentage was calculated one month after pollination, and fruit retention percentage was calculated just before harvest time.

Fruit set and fruit retention percentages were calculated as the following equations:

Fruit set % = Number of fruits setting on the strand / total number of flowers per strand  $\times$  100.

Fruit retention % = Number of retained fruits / No. of strands + No. of flower scars strand  $\times$  100.

Yield: Bunches of each palm were harvested at maturity and weighed to determine the yield in kg/palm.

### 2.2. Fruit Physical Properties

Fruit weight (gm), flesh weight (gm), seed weight (gm), and flesh percentage were measured by randomly selecting 30 fruits from each bunch. Fruit dimensions (fruit length and diameter in cm) and fruit shape index (length/diameter ratio) were then computed.

### 2.3. Fruit Chemical Properties

Total soluble solids (TSS %) of the date fruit juice were measured using a hand refractometer according to the Association of Official Analytical Chemists [22].

Total sugars and reducing sugars had been determined as a fresh weight according to the method of Lane and Eynon as described in the Association of Official Analytical Chemists [22].

Non-reducing sugars% was calculated by the difference between the total and reducing sugars.

Total acidity % was determined as the percentage of malic acid according to the method in the Association of Official Analytical Chemists [22].

Ascorbic acid (Vitamin C %) was measured by the oxidation of ascorbic acid with 2, 6- dichlorophenol endophenol dye, and the results were expressed as mg/100ml juice [23].

### 2.4. Statistical Analysis

Each treatment was replicated three times, with one palm per replication, in this randomized complete block design experiment. Analysis of variance (ANOVA) was performed on the acquired data in accordance with Snedecor and Cochran [24]. According to Duncan [25], the means of the treatments were compared using the least significant ranges (LSR) at a 5% probability level.

## 3. RESULTS AND DISCUSSION

### 3.1. Fruit Set and Fruit Retention%

The findings in Table 1 show that over the two research seasons, the percentage of Barhee date palm fruit set was considerably impacted by the various treatments in comparison to the control. With no discernible difference

between the two seasons of the research, spraying 2% algae extract produced the greatest fruit set percentages (73.0 and 75.3%), followed by spraying licorice extract or moringa. In contrast, throughout the two experimental seasons, the control fruit set percentages were the lowest, at 67.32 and 67.30 percent. Regarding fruit retention percentage, results in Table 1 indicate that spraying algae extract at 2% produced the highest fruit retention percentages in both seasons (56.0 and 59.0%), followed by licorice extract at 3% (49.0 and 54.5%). However, in both research seasons, the control treatment had the lowest fruit retention rates (45.6 and 45.7%).

Because algal extract contains minerals, vitamins, and growth regulators, including IAA and cytokinins, it may have a greater influence on fruit set by minimizing fruit drop and increasing the amount of fruits per palm [16, 18, 26].

**Table 1.** Effect of spraying moringa, algae, and licorice extracts on fruit set and yield of Barhee date palms.

Characters Treatments	Fruit set (%)		Fruit retention (%)		Bunch weight (kg)		Yield/palm(kg)	
	S1	S2	S1	S2	S1	S2	S1	S2
Moringa extract at 3%	68.60ab	69.00bc	47.00c	53.60b	14.23b	15.26b	128.10b	137.40b
Algae extract at 2%	73.00a	75.30a	56.00a	59.00a	15.73a	16.56a	141.60a	149.10a
Licorice extract at 3%	68.60ab	70.30b	49.00b	54.53b	14.83b	15.40b	133.50b	138.60b
Control (Water only)	67.32b	67.30c	45.60c	45.70c	12.40c	13.53c	111.60c	121.80c
LSD at 0.05 level	4.52	2.37	1.83	2.61	0.72	0.64	6.48	5.77

**Note:** Means having the same letters within a column are not significantly different at 5% level.

### 3.2. Bunch Weight and Yield/ Palm

The findings in Table 1 unequivocally demonstrate that, in both experimental seasons, the bunch weight of Barhee date palms was considerably impacted by the various treatments in comparison to the control treatment. Spraying 2% algae extract produced the heaviest bunches (15.7 and 16.6 kg), followed by 3% licorice or moringa extracts, with no discernible difference between the two experimental seasons. In the meantime, the control treatment produced the lightest bunches (12.4 and 13.5 kg) during the course of the two seasons.

These results are consistent with the findings showing, as compared to the untreated palms, the yield of "Medjool cv." date palm was significantly impacted by the application of algal extract and/or potassium nitrate to the inflorescences of the date palm [15].

In the two experimental seasons, the yield/palm was impacted by several treatments in comparison to the control treatment. In both experimental seasons, spraying 2% algae extract produced the maximum yield per palm (141.6 and 149.1 kg), followed by 3% licorice or moringa extract, with no significant difference between the two. In contrast, the control treatment produced the lowest yield per palm in the first and second seasons, at 111.6 and 121.8 kg, respectively.

In this case, the increase in bunch weight was credited with the rise in Medjool date palm yield per palm [15]. Prior research revealed that spraying Barhee date palms with 4% moringa extract produced the heaviest bunches and yield per palm when compared to the control [10].

### 3.3. Fruit Physical Properties

**Fruit weight:** According to the results in Table 2, during both research seasons, all treatments significantly affected the Barhee date palm's fruit weight when compared to the control.

Spraying algae extract in the first and second seasons, respectively, resulted in the highest fruit weight (12 and 13 grams), followed by 3% licorice extract or moringa spraying, with no discernible difference between the two. On the other hand, the control treatment recorded 10.0 and 10.4 grams in both experimental seasons, respectively, and gave a light statistical fruit weight.

Our findings concur with those of foliar spraying algal extract to enhance the physical characteristics of "Williams" banana plants [12].

**Table 2.** Effect of spraying with moringa, algae, and licorice extracts on fruit properties and yield of Barhee date palms.

Characters Treatments	Fruit weight (gm)		Flesh weight (gm)		Seed weight (gm)		Flesh%	
	S1	S2	S1	S2	S1	S2	S1	S2
Moringa extract at 3%	11.63b	11.86b	10.76b	10.93b	0.86b	0.93b	92.51a	92.10a
Algae extract at 2%	12.03a	13.00a	11.13a	12.10a	0.90b	0.90b	92.53a	92.66a
Licorice extract at 3%	11.63b	11.90b	10.73b	10.96b	0.90b	0.93b	92.26a	92.10a
Control (Water only)	10.00c	10.43c	8.90c	9.30c	1.10a	1.13a	89.00b	89.10b
LSD at 0.05 level	0.39	0.25	0.36	0.19	0.16	0.17	1.31	1.48

**Note:** Means having the same letters within a column are not significantly different at 5% level.

**Flesh weight:** When compared to the untreated palms in both seasons, the results in Table 2 demonstrate that all treatments had a substantial impact on flesh weight. The largest flesh weights (11.1 and 12.1 grams) were reported in the two experimental seasons when 2% algal extract was sprayed. This was followed by foliar spraying with licorice or moringa extracts, with no significant difference between the two seasons. In the first and second seasons, respectively, the control treatment produced the lowest meat weight (8.9 and 9.3 grams). Results indicate that there was no significant difference between any of the treatments in terms of seed weight and flesh % in either season.

**Fruit dimension and fruit shape index:** In Table 3, fruit dimension and fruit shape index results demonstrate a notable rise over the check treatment throughout the two seasons that followed. The treatment of 2% algal extract throughout the two seasons produced the tallest significant fruit (4.46 and 4.56 cm). In the first season, spraying 3% moringa extract produced the largest fruit diameter (2.26 cm), whereas 2% algal extract produced the same fruit diameter (2.40 cm) in the second season.

**Table 3.** Effect of spraying with moringa, algae, and licorice extracts on fruit properties and yield of Barhee date palms.

Characters treatments	Fruit length (cm)		Fruit diameter (cm)		Fruit shape index	
	S1	S2	S1	S2	S1	S2
Moringa extract at 3%	4.16b	4.20b	2.26a	2.36a	1.80b	1.76a
Algae extract at 2%	4.46a	4.56a	2.20ab	2.40a	2.00a	1.56a
Licorice extract at 3%	3.96c	4.10b	2.13b	2.33ab	1.86ab	1.73a
Control (Water only)	3.46d	3.56c	2.16ab	2.23b	1.56c	1.60a
LSD at 0.05 level	0.19	0.21	0.11	0.11	0.14	NS

**Note:** Means having the same letters within a column are not significantly different at 5% level.

### 3.4. Fruit Chemical Properties

**Total soluble solids:** Results in Table 4 show that, in comparison to the untreated palms, the various treatments had a substantial impact on total soluble solids. However, in the two research seasons, the greatest TSS levels (30.4 and 30.9%) were obtained from spraying Barhee date palms with 2% algal extract. In contrast, the control treatment yielded the lowest TSS values (28.4 and 28.5%) in both seasons.

**Total acidity percentage:** Regarding the percentage of juice total acidity, results in Table 4 indicate that, throughout the course of the study's two seasons, there were no discernible trends or significant variations between the treatments and the control treatment.

**TSS/acid ratio:** In Table 4, results show that none of the treatments, including the untreated palms during the first season, had a significant impact on TSS/acid. In the second season, it was considerably impacted by several treatments in contrast to the control treatment. The control treatment yielded the lowest TSS/acid, 73.4 and 71.3 across the two seasons.

**Table 4.** Effect of spraying with moringa, algae, and licorice extracts on fruit quality and yield of Barhee date palms.

Characters treatments	TSS%		Acidity%		TSS/acid ratio	
	S1	S2	S1	S2	S1	S2
Moringa extract at 3%	29.80ab	30.20b	0.39a	0.39a	75.13a	76.76a
Algae extract at 2%	30.40a	30.86a	0.40a	0.39a	75.46a	79.16a
Licorice extract at 3%	29.60b	29.93b	0.40a	0.39a	73.46a	76.10a
Control (Water only)	28.36c	28.53c	0.38a	0.40a	73.43a	71.33b
LSD at 0.05 level	0.75	0.27	NS	NS	NS	3.41

Note: Means having the same letters within a column are not significantly different at 5% level.

**Reducing sugars:** As compared to the control, the results shown in Table 5 clearly indicate that the various treatments had a substantial impact on the reducing sugars value. Algal extract at 2%, however, produced the greatest values in both seasons (18.4 and 19.9%), whereas the control treatment in the first and second seasons produced the lowest values (16.6 and 17.7%, respectively).

**Total sugars:** In the first season, there were no discernible changes between the various treatments in terms of total sugars, according to the results in Table 5. However, in the second season, when compared to the untreated palms, the total sugars were considerably impacted by the various treatments. The algae extract at 2% had the greatest value (28.5%). During the two research seasons, the untreated palms had the lowest values (25.1 and 26.1%).

**Non-reducing sugars:** The results in Table 5 clear that non-reducing sugars were not affected significantly by different treatments, including the control, in both seasons of the study.

**Vitamin C (mg/100 ml juice):** According to the results in Table 5, all treatments considerably raised the ascorbic acid content of the fruit in both seasons when compared to the control. In this regard, however, moringa extract at 3% is thought to be the best therapy since it produced 12.46 and 12.9 mg/100 ml of juice in both research seasons. Algae extract at 2% produced 12.4 and 12.6 mg/100 ml of juice. Ascorbic acid levels in the two study seasons were the lowest with the control treatment (10.1 and 10.5 mg/100 ml juice).

The findings observed were consistent with those reported on rocket *Eruca Vesicaria subsp. Sativa*, when sprayed with 2% moringa extract, which boosted ascorbic acid and total sugars [27]. Additionally, using a 3.5% *Moringa oleifera* extract spray on wheat, peas, and tomatoes enhanced crop properties [28]. According to the earlier research, when Barhee date palms were sprayed with 4% moringa extract, the percentages of total soluble solids, total sugars, reducing sugars, and non-reducing sugars increased in comparison to the control [10]. Additionally, Hollywood plum fruit quality and productivity were improved by foliar spray of moringa leaf extract (*Moringa oleifera* L.) [8].

Our findings were in line with those of Barhee, who sprayed date palms with potassium nitrate and algal extract, which had a favorable impact and provided the greatest results for raising fruit yield and quality [29]. However, the physiological activity of minerals, vitamins, and growth regulators is primarily responsible for the enhanced benefits of algal extract on fruit quality [11, 12].

**Table 5.** Effect of spraying with moringa, algae, and licorice extracts on fruit quality and yield of Barhee date palm.

Characters treatments	Total sugars (%)		Reducing sugars (%)		Non-reducing sugars (%)		Vitamin C (mg/100ml juice)	
	S1	S2	S1	S2	S1	S2	S1	S2
Moringa extract at 3%	26.06a	27.00b	17.93a	18.80ab	8.13a	8.20a	12.46a	12.90a
Algae extract at 2%	26.93a	28.50a	18.36a	19.90a	8.56a	8.60a	12.40a	12.63b
Licorice extract at 3%	25.93a	26.80b	17.80a	18.63ab	8.13a	8.50a	11.73b	12.03c
Control (Water only)	25.13a	26.10c	16.60a	17.70b	8.53a	8.40a	10.10c	10.50d
LSD at 0.05 level	NS	0.63	0.69	1.32	NS	NS	0.30	0.14

Note: Means having the same letters within a column are not significantly different at 5% level.

#### 4. CONCLUSION

Generally, natural plant extracts may be considered a great source to provide plants with the nutrients and different compounds they need to grow and survive. Natural plant extracts usually contain many trace elements and some promoters the plant needs, which are not found in most chemical formulations.

The results of this study demonstrated that algae extract at 2% enhanced fruit set, fruit retention, yield, and fruit quality. In this regard, it could be concluded that algae extract at 2% can be recommended (as a natural substance) for effective use due to its high potential, nutritive value, easy preparation, and environmentally friendly nature by farmers.

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