

Evaluation of Yield and Quality of Barhee Date Palm Cultivar Under Different Potassium Sources and Rates

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ABSTRACT:

The date palm variety Barhee, grown in a private orchard at El-Fouad for Agricultural Investments, Abo Hammad district, Sharkia Governorate, Egypt, was the subject of this experiment conducted in the 2022 and 2023 growing seasons. The 15-year-old, labeled date palms underwent the usual agricultural procedures of watering, pollination, pruning, and soil replenishment with both organic and mineral fertilizers. The study looked at how the chemical composition of leaves and dates was affected by spraying potassium sources (potassium phosphate, potassium thiosulfate, potassium nitrate, and potassium citrate) at different rates (1.00, 1.50, and 2.00%), each rate combined with Zn at 0.5% + B at 0.5% beside control. The results showed that these treatments showed the highest values of bunch length and number of strands per bunch. Both treatments decreased the Barhee date palm's biannual bearing phenomenon. The highest values of reducing, non-reducing and total sugars percentages obtained when Barhee date palms were sprayed with potassium nitrate at 2.0 % + Zn at 0.5% + B at 0.5% or mono potassium phosphate at 1.5 %. Using mono potassium phosphate at 2.0 % gave the highest values of vitamin C content and acidity %, whenever, the lowest total tannins percentage was noticed in dates of control potassium nitrate or potassium citrate each at 1.0 % compared to the other treatments under study.

Conclusion: The yield components and fruit chemical characteristics of the "Barhee" date palm cultivated under Sharkia conditions are improved by spraying potassium nitrate at 2.0% in combination with Zn at 0.5% and B at 0.5%.

Keywords: Barhee date palm, potassium sources, sprays application, chemical constituents.

INTRODUCTION:

The date palm, or *Phoenix dactylifera* L., is regarded as an ancient fruit tree in many nations worldwide. The top producers and growers of date palms are Egypt, Iraq, Saudi Arabia, Iran, Libya and Algeria. Dates have high energy content, and their fruits-which are composed of 60–70% sugar, primarily fructose and glucose-are a valuable dietary source (Wrigley, 1995 and FAO, 2014). According to Statistics of the Ministry of Agriculture (2022), the total area under cultivation for Barhee in Egypt in 2022 was 7,269 feddan (6,707 fed. in new reclaimed land and 562 fed. in ancient agricultural land). This resulted in 45,957 tons of production (39,806 tons from new reclaimed land and 6,151 tons from ancient agricultural land), with an average of 145.21 kg/palm in new reclaimed land and 99.86 kg/palm in ancient agricultural land.

Fertilization is one of the key elements influencing date palm productivity and fruit quality. While soil application can provide sufficient nutrients to boost date palm production, macro and micro-elements result in an efficient output and an improvement in fruit quality. Low application rates, consistent fertilizer material distribution, and rapid nutritional response are benefits of foliar fertilization (Umer *et al.*, 1999). Since large quantities of potassium are needed during the crucial time for date palm fruit growth and development, foliar

potassium treatment is an efficient way to meet the needs of the trees (**Marschner, 1995**). Potassium sulfate spraying on Barhee date palms significantly improved fruit retention as well as the fruit's physical and chemical properties (**Al-Hamoudi, 2006**). According to a study by **Desouky et al. (2007)**, date palm CV had the greatest percentages of total sugars, reducing sugars, non-reducing sugars, and TSS. Barhee was sprayed with 0.4% potassium sulfate instead of untreated palms.

Abd El-Migeed et al. (2013) pointed out that spraying a 2% potassium citrate solution decreased the tannin level of date palm fruit cv. Amhat. **Omar (2015)** reported that adding potassium sulfate to date palm cv. Mnifi in 1%–2% solutions increased both reducing and non-reducing sugars as well as total TSS. Additionally, the inflorescences of Barhee date palms were sprayed with potassium nitrate in order to compare the yield and the fruit's physical and chemical properties to the untreated palms (**Alebidi et al., 2021**). The application of calcium nitrate and/or boric acid to the inflorescences had a substantial effect on the fruit set, yield, and physical and chemical characteristics of the "Amhat" date palm (**Sarrwy et al., 2012**). Zinc is an essential microelement for plants. Growth and development, protein and carbohydrate metabolism, and a number of enzyme functions all depend on it (**Swietlik, 1999; Harhash and Abdl-Nasser, 2010; Sarrwy et al., 2012**).

In this study, the yield components and its chemical quality of date palm cv. Barhee under Sharkia Governorate circumstances is evaluated in relation to various potassium sources (potassium phosphate, potassium thiosulfate, potassium nitrate, and potassium citrate) applied as foliar sprays with zinc sulphate and boric acid.

MATERIALS AND METHODS:

This experiment was carried out in the growing seasons of 2022 and 2023 on the date palm variety Barhee, which was produced in a private orchard at El-Fouad for Agricultural Investments, Abo Hammad district, Sharkia Governorate, Egypt. The 15-year-old date palms were subjected to the standard agricultural practices of fertilizer replenishment with both organic and mineral fertilizers, watering, pollination, and pruning. Eight bunches, about equal in size and vigor, were selected consistently from each palm. Bunches were pollinated from a single male El-Hainy palm tree using 10 new male strands positioned among female flower clusters in each of the two seasons.

The palm palms were spaced seven meters apart and planted in sandy soil. The findings of a mechanical and chemical analysis of orchard soil conducted before the experiment's first season are displayed in Table (1).

Table 1: Main mechanical and chemical properties of the orchard soil under the experimental trees

Physical analysis									Soil texture		
Clay (%)		Silt (%)	Fine sand (%)			Coarse sand (%)			Sandy		
11.02		6.12	44.34			38.52					
Chemical analysis											
pH	E C m.mohs/cm	Soluble cations (meq./100g/soil/l)				Soluble anions (meq./L)			Available (ppm)		
		Ca ⁺⁺	Mg ⁺⁺	Na ⁺	K ⁺	Cl ⁻	HCO ₃ ⁻	SO ₄ ⁻	N	P	K
7.78	4.38	1.3	2.6	0.34	0.18	0.95	2.78	0.69	21	16	190

Two foliar spray applications of each treatment were made, four weeks after pollination and four weeks after the initial spray. 1% Tween® 20 was added to the spraying solution, and batches were sprayed with a small spraying motor until the run-off stage.

Experimental design and treatments were applied:

Thirteen treatments were arranged in a randomized complete block design (RCBD) with three replicates (three trees) for each treatment which were organized as follow:

1. Mono-potassium phosphate (MPK) at 1.0 %.
2. Mono-potassium phosphate (MPK) at 1.5 %.
3. Mono-potassium phosphate (MPK) at 2.0 %.
4. Mono-potassium thiosulfate (MKT) at 1.0 %.
5. Mono-potassium thiosulfate (MKT) at 1.5 %.
6. Mono-potassium thiosulfate (MKT) at 2.0 %.
7. Potassium nitrate (KN) at 1.0 %.
8. Potassium nitrate (KN) at 1.5 %.
9. Potassium nitrate (KN) at 2.0 %.
10. Potassium citrate (KC) at 1.0 %.
11. Potassium citrate (KC) at 1.5 %.
12. Potassium citrate (KC) at 2.0 %.
13. Control (sprayed with water only).

All treatments from 1 to 12 were added plus Zn at 0.5% + B at 0.5%.

Data recorded:

Fruit yield parameters: The palm tree's yield was measured at the beser stage. A sample of ten strands was randomly selected from each replicate in both seasons for each treatment, packed in boxes, and sent straight to the lab to measure the physical characteristics of the fruit at harvest time. We did this by computing the bunch length (cm), number of strands per bunch, fruit weight (g) and fruit yield per palm (kg).

Fruit quality: The **A.O.A.C. (1995)** was followed in determining the chemical qualities of fruits at a tamer stage, namely their sugar content (reducing, non-reducing and total sugar). Additionally, using the method outlined by **Swain and Hillis (1959)**, the total tannin content as a percentage of the fresh weight of date pulp was ascertained. Titratable acidity percentage in fruit juice was determined as citric acid by titration against 0.1 N sodium hydroxide solution in the presence of phenolphthalein index as indicator and the total acidity percentage was calculated (**A.O.A.C., 2006**). According to **Moreno and Salvadó (2000)**, vitamin C was measured using a reversed-phase high performance liquid chromatographic technique.

Statistical analysis:

One-way analysis of variance (ANOVA) was used for statistical analysis of the collected data. According to **Steel and Torrie (1980)**, the least significant difference (LSD) at the 0.05 level of probability was used to compare the means. The statistical analysis for the acquired data was carried out using the Statistix Version 9 computer application (**Analytical software, 2008**).

RESULTS AND DISCUSSION:

Fruit yield parameters:

All treatments increased bunch length, number of strands per bunch, fruit weight and fruit yield per palm, compared to the control, in 2022 and 2023 seasons (Table 2). The highest values of bunch length of Barhee date palm (186.00 and 194.00 cm) were achieved with potassium nitrate at 2.0 % + Zn at 0.5% + B at 0.5% treatment. Furthermore, the highest strands number per bunch (66.67 and 72.67 as well as 66.33 and 72.67 strands) were obtained with mono potassium phosphate at 1.5 % + Zn at 0.5% + B at 0.5% as well as potassium

nitrate at 2.0 % + Zn at 0.5% + B at 0.5% in 1st and 2nd seasons, respectively. In addition, **Thabet *et al.* (2022)** reported that foliar spray with potassium nitrate (KN) at 3% could be used to improve fruit yield and quality of Medjool dates.

Table (2): Influence of potassium sources on bunch length (cm), strands number /bunch, fruit weight (g) and fruit yield /palm (kg) of Barhee date palm cultivar during 2022 and 2023 seasons

Treatments	Bunch length (cm)		Strands number /bunch		Fruit weight (g)		Fruit yield /palm (kg)	
	2022	2023	2022	2023	2022	2023	2022	2023
MKP* at 1.0 %	168.00	176.00	58.00	61.00	15.96	16.07	130.17	132.50
MKP at 1.5 %	181.67	189.67	66.67	72.67	16.56	16.98	140.00	146.17
MKP at 2.0 %	156.00	164.00	58.00	62.00	16.14	16.20	128.67	131.67
MKT* at 1.0 %	161.00	168.00	57.00	60.00	16.03	16.15	122.67	124.17
MKT at 1.5 %	172.33	181.33	61.67	64.67	15.46	15.54	122.17	122.83
MKT at 2.0 %	165.67	174.67	53.33	59.00	15.87	15.93	133.83	134.50
KN* at 1.0 %	168.67	178.67	53.67	58.00	15.21	15.29	119.33	123.33
KN at 1.5 %	182.00	187.00	60.33	63.33	15.56	15.67	136.17	137.33
KN at 2.0 %	186.00	194.00	66.33	72.67	16.56	16.68	144.00	151.50
KC* at 1.0 %	172.67	178.67	59.67	62.67	15.65	15.70	132.33	135.33
KC at 1.5 %	156.00	163.00	60.33	64.33	15.80	15.87	125.33	126.67
KC at 2.0 %	173.33	176.67	64.00	67.33	15.67	15.78	126.33	125.33
Control	144.33	148.33	54.00	60.67	15.02	15.09	119.17	122.33
L.S.D. at 5 %	15.99	15.15	5.88	6.10	1.40	1.41	2.37	2.77

* **MKP**= Mono potassium phosphate, **MKT**= Mono potassium thiosulfate, **KN** = Potassium nitrate and **KC**= Potassium citrate ** every treatment of potassium sources combined with Zn at 0.5 % + B at 0.5 %.

Fruit quality:

Data described in Table 3 pointed out that, the highest values in reducing sugars (30.70 and 31.18 %), non-reducing sugars (in second season only) and total sugars (32.82 and 35.92 %) percentages were obtained when Barhee date palm cultivar sprayed two times/ season with mono potassium phosphate at 1.5 % + Zn at 0.5% + B at 0.5% compared to the other treatments under in both seasons. Potassium contributes to the production of carbohydrates in the leaves, which are essential for root growth, nutrient absorption, shoot growth, leaf and fruit development, and more (**Cushnahan *et al.*, 1995**). Furthermore, Potassium fertilization in both seasons had a substantial impact on the total sugar percentage of the Barhee date palm cultivar, according to **Elsayd *et al.* (2018)**.

In comparison to control and the other treatments studied in both seasons, the mono potassium phosphate treatment at 2.0% + Zn at 0.5% + B at 0.5% treatment primarily raised the percentages of total tannins and total sugars as well as the vitamin C content in fruit flesh (Table 4). Potassium influences fruit quality (**Geraldson, 1985**), since its nutrition is directly related to high yield, fruit size, long shelf life, high level of soluble solids and ascorbic acid in many horticultural crops (**Lester *et al.*, 2005, 2006**).

Table (3): Influence of potassium sources on reducing sugars, non-reducing sugars and total sugars (%) of Barhee date palm cultivar during 2022 and 2023 seasons

Treatments	Reducing sugars (%)		Reducing sugars (%)		Total sugars (%)	
	2022	2023	2022	2023	2022	2023
MKP* at 1.0 %	27.94	30.47	4.30	4.80	32.24	35.27
MKP at 1.5 %	28.14	30.93	4.68	4.98	32.82	35.92
MKP at 2.0 %	30.70	31.18	3.37	5.95	34.06	37.13
MKT* at 1.0 %	26.57	29.81	4.29	4.00	30.85	33.81
MKT at 1.5 %	27.06	30.27	4.57	3.92	31.63	34.19
MKT at 2.0 %	27.80	30.78	4.28	4.41	32.08	35.19
KN* at 1.0 %	26.37	29.51	3.77	5.11	30.13	34.62
KN at 1.5 %	26.87	29.81	3.64	5.10	30.51	34.91
KN at 2.0 %	27.58	30.28	3.44	5.01	31.02	35.29
KC* at 1.0 %	25.48	28.73	3.78	4.07	29.26	32.80
KC at 1.5 %	26.83	28.85	2.94	4.08	29.77	32.93
KC at 2.0 %	26.03	29.07	4.13	3.98	30.16	33.05
Control	24.70	27.91	3.57	3.28	28.27	31.18
L.S.D. at 5 %	0.85	0.09	0.82	0.16	0.11	0.12

* MKP= Mono potassium phosphate, MKT= Mono potassium thiosulfate, KN = Potassium nitrate and KC= Potassium citrate ** every treatment of potassium sources combined with Zn at 0.5 % + B at 0.5 %.

Table (4): Influence of potassium sources on vitamin C content, acidity (%) and tannins content of Barhee date palm cultivar during 2022 and 2023 seasons

Treatments	Vitamin C content (mg/100 g f.w.)		Acidity (%)		Total tannins (%)	
	2022	2023	2022	2023	2022	2023
MKP* at 1.0 %	3.79	3.90	0.170	0.165	0.68	0.71
MKP at 1.5 %	3.94	4.02	0.185	0.173	0.72	0.75
MKP at 2.0 %	4.00	4.12	0.188	0.182	0.78	0.81
MKT* at 1.0 %	3.62	3.77	0.163	0.164	0.61	0.73
MKT at 1.5 %	3.68	3.81	0.178	0.175	0.63	0.72
MKT at 2.0 %	3.86	3.96	0.185	0.181	0.68	0.73
KN* at 1.0 %	3.51	3.84	0.157	0.151	0.59	0.62
KN at 1.5 %	3.72	3.91	0.169	0.155	0.61	0.66
KN at 2.0 %	3.95	4.11	0.176	0.167	0.64	0.69

KC* at 1.0 %	3.31	3.67	0.152	0.145	0.57	0.63
KC at 1.5 %	3.41	3.86	0.160	0.153	0.61	0.68
KC at 2.0 %	3.43	3.85	0.168	0.162	0.61	0.72
Control	2.88	3.12	0.140	0.135	0.54	0.65
L.S.D. at 5 %	0.03	0.01	0.006	0.004	0.03	0.03

* MKP= Mono potassium phosphate, MKT= Mono potassium thiosulfate, KN = Potassium nitrate and KC= Potassium citrate ** every treatment of potassium sources combined with Zn at 0.5 % + B at 0.5 %.

Conclusion:

The yield components and fruit chemical characteristics of the "Barhee" date palm cultivated under Sharkia conditions are improved by spraying potassium nitrate at 2.0% in combination with Zn at 0.5% and B at 0.5%.

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