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# Production Capacity and Its Relationship To Spraying Some Different Sources of Potassium Concentration of Madjool Date Palm

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## ABSTRACT

This study was conducted during the 2021 and 2022 seasons to examine beneficial the positive effects of spraying potassium citrate and potassium acetate at 1.0 to 4.0 each % on the growth, yield and quality of Madjool date palms under the environmental conditions of the Red Sea Governorate. Spraying potassium citrate or potassium acetate three times (after the establishment of the the fruit, at the beginning of Kimri stage and in the Khelal stages) from 1.0 to 4.0% had announced promotion in all growth characteristics, yield, and fruit quality relative to the control treatments.

A gradual promotion depended on increasing the concentration of each from 1.0 to 4.0% without considerable effect among the two concentrations. In this regard, the spraying of potassium acetate was significantly superior to the use of potassium citrate. The best results were obtained when potassium acetate (a source of potassium) was applied three times to Madjool date palms at 2.0%.

Keywords: Madjool date palms, potassium acetate, potassium citrate, yield, fruit quality.

## 1. INTRODUCTION

Date palm (phoenix dactylifera L.) is one of oldest known and cultivated fruit trees in many countries all over the world. Date palm trees are the most important fruit crops widely grown in different areas and had played a significant role in agricultural and economical of the people and considered a characterizing of life in desert. In Egypt, many cultivars are grown in different regions because if could be established in a wild range of soil and environmental conditions. The total area and number of females reached 135126 feddans and (22000000) palms, respectively. The produced yield reached 1710603 tons. (Annual Reports of Statistical and Agricultural Economics in Arab Republic of Egypt. (A.R.E): (2021).

Medjool date palm (phoenix dactylifera L.) is one of the most important cv. successfully grown under middles Egypt conditions. Medjool date palm fruit can take the lead in Egyptian exportation to many markets in Europe and Arab countries. The total number of females of Medjool date palms reached (1400000) palms and the total production reached (36090) tons of fruits.

Fertilization is a very important tool and limiting factor to fruiting, growth and nutrient status. Marco nutrients play an important regulatory role in cell divisions, plant pigment, translocation of sugar and reducing respiration and vitamins (Mengel et al., 2001and Diab, 1998). In this respect, potassium is an essential element in plants and enhances at least 60 different enzyme systems, promotes the assimilation of carbohydrates root growth as well as drought and salinity resistance (Marschner, 1986). In addition, potassium is involved in several basic physiological functions. Foliar application of potassium has a significant effect on fruit set production and it regulates a variety of biochemical nutrients as well as increase salt tolerance (EL-Fouly et al., 2002).

Previous studies demonstrated the favorable impact of utilizing potassium on date palm growth and fruit quality (Al-Falahy and Hassan, 2020; AL-Hajah et al., 2020 and Thabet et al., 2022)

The target of this study was to test the effect of some different sources and concentrations of potassium on growth, palm nutritional status, yield and fruit quality of Madjool date palms grown under Red Sea – Elzafarana region conditions.

## 2. MATERIALS and METHODS

This study was conducted during 2021 and 2022 seasons in a private date palm orchard situated at EL-Zafarana region, Red Sea Governorate on seven uniforms in vigour 10-years' old Madjool date palms. These palms are produced through conventional propagation by offshoots as well as characterized by regular bearing. Soil texture is sandy and the palms are planted 7 x 7 meters apart. The selected palms were irrigated with well water via drip irrigation.

Furthermore, hand pollination of all the selected palms was achieved by inserting (five fresh strands / female spathe) using the same source of pollens to avoid resides of metaxenia. All the selected Medjool date palms received common horticultural practices that are already applied in the orchard except potassium applications. Physical and chemical properties of the experimental soil at 0.0- 30 cm and from 30- 90 cm depth are presented in Table (1) according to (Wilde et al.1985)

**Table (1): Analysis of the tested soil**

| Constituents | Values |
|---|---|
| **Particle size distribution** | |
| Sand % | 58.8 |
| Silt % | 28.4 |
| Clay % | 12.8 |
| Texture | Sandy loam |
| pH ( 1: 2.5 extract) | 8 |
| EC ( 1 : 2.5 extract ) mmhos/ 1 cm 25ocm | 2.86 |
| Organic matter % | 1.12 |
| Total CaCO3 % | 3.6 |
| Total N % | 0.032 |
| P ppm | 146 |
| K ppm ( ammonium acetate) | 214 |
| **Available micronutrients (EDTA, ppm):** | |
| Fe | 1.8 |
| Zn | 2.1 |
| Mn | 1.9 |
| Cu | 0.7 |

This experiment included the following seven treatments:
Control (sprayed with water only)
Potassium citrate at 1%.
Potassium citrate at 2%.
Potassium citrate at 4%.
Potassium acetate at 1%.
Potassium acetate at 2%.
Potassium acetate at 4%.

Each treatment was replicated three times, one palm per each. Potassium citrate and potassium acetate were sprayed three times during each season after fruit set, at the beginning of Kimri stage and at Khelal stage respectively. All potassium sources solutions were subjected to triton B as a wetting agent at 0.05 % before spraying. This experiment was arranged in randomized complete block design (RCBD).

During both seasons, the following measurements were recorded:

**Fruit physical and chemical characteristics:** During both seasons when the fruits reached the Tamer stage bunches were harvested and the following parameters were recorded.

Percentages of N, P and K in the leaves (Chapman and Pratt, 1965 and Summer, 1985).
Yield / palm (kg.) and bunch weight (kg.).
Some physical and chemical characteristics of fruit namely fruit weight (g.) and dimensions (length and width in cm), percentages of pulp and seed, pulp / seed, total soluble solids %, total acidity % (as malic/ 100g pulp), as well as total and reducing sugars % and non- reducing sugars% (A.O.A.C.,2000).
Statistical analysis was done using a new L.S.D test at 5% according to (Mead et al., 1993).

## Results

### 1- Leaf chemical components

Data in Table (2) clearly demonstrate that spraying potassium citrate and potassium acetate from 1% to 4% considerably increased percentages of N, P, and K responses compared to no treatment. Without any noteworthy promotion among the higher two concentrations, there was a progressive stimulation in N, P, and K with increasing concentration. On the palms that received three times the amount of potassium acetate at 4%, the maximum values were noted. Similar

results were reported for the seasons of 2021 and 2022.

**2- Yield per palm and bunch weight**

Data in Table (3) demonstrate that applying three times to the palms with potassium citrate or potassium acetate each one at 1% to 4% significantly improved yield and bunch weight over the control. There was a progressive promotion with increasing potassium citrate and acetate concentration. Spraying potassium acetate at 1% to 4% was significantly preferable to using potassium citrate at 1% to 4% in enhancing these parameters. Higher concentrations (above 2%) of potassium citrate or acetate failed to show significant promotion in yield per palm and bunch weight. Therefore, using potassium acetate at 2% three times is advised from an economic standpoint. In comparison to untreated palms, which produced 107 and 108 kg of yield per palm over both seasons, such claimed treatment caused yield per palm to reach 141 and 143 kg, respectively. These results were true during both seasons.

**3- Physical and chemical characteristics of the fruits**

It is worth mentioning from the data in Tables (3&4 and 5) that supplying Madjool date palms with potassium citrate and acetate at 1% to 4% was significantly more effective in improving some physical and chemical of the fruits namely fruit weight and dimensions, pulp %, pulp/ seed %, TSS%, as well as total acidity %, total and reducing sugars % compared to check control. The promotion was correlated with increasing concentration. Using concentrations above 2% had no significant promotion. The best results were obtained on the palms that were sprayed three times with potassium citrate at 2%. The minimum values were recorded on the untreated palms. These results were true during 2021 and 2022 seasons.

**Table (2): Effect of spraying some different sources and concentration of potassium on percentage of N, P and K in the leaves of Madjool date palms during 2021 & 2022 seasons**

| Treatments | Leaf N % | | Leaf P % | | Leaf K % | |
|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| Control | 1.45 | 1.47 | 0.48 | 0.12 | 1.14 | 1.15 |
| Potassium citrate 1% | 1.61 | 1.63 | 0.21 | 0.22 | 1.35 | 1.36 |
| Potassium citrate 2% | 1.70 | 1.74 | 0.26 | 0.28 | 1.43 | 1.45 |
| Potassium citrate 4% | 1.72 | 1.75 | 0.27 | 0.29 | 1.46 | 1.47 |
| Potassium acetate 1% | 1.86 | 1.88 | 0.31 | 0.32 | 1.54 | 1.55 |
| Potassium citrate 2% | 1.96 | 1.99 | 0.36 | 0.37 | 1.61 | 1.62 |
| Potassium citrate 4% | 1.94 | 2.02 | 0.37 | 0.38 | 1.63 | 1.65 |
| New L.S.D at 5% | 0.06 | 0.07 | 0.02 | 0.03 | 0.04 | 0.05 |

**Table (3): Effect of spraying some different sources and concentration of potassium on some physicals characteristics of the fruits of Madjool date palms during 2021 & 2022 seasons**

| Treatments | Brunch weight (kg) | | Yield / palm (kg) | | Fruit weight (g) | | Fruit length (cm) | | Fruit diameter (cm) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| Control | 10.7 | 10.8 | 107 | 108 | 19.6 | 19.7 | 5.01 | 5.09 | 2.82 | 2.85 |
| Potassium citrate 1% | 11.6 | 11.7 | 116 | 117 | 20.3 | 20.4 | 5.54 | 5.59 | 2.85 | 2.95 |
| Potassium citrate 2% | 12.3 | 12.4 | 123 | 124 | 21.3 | 21.2 | 5.69 | 5.74 | 3.5 | 3.9 |
| Potassium citrate 4% | 12.6 | 12.6 | 126 | 126 | 21.4 | 21.5 | 5.72 | 5.76 | 3.7 | 3.11 |
| Potassium acetate 1% | 13.3 | 13.5 | 133 | 135 | 22 | 22.1 | 5.89 | 5.94 | 3.19 | 3.22 |
| Potassium acetate 2% | 14.1 | 14.3 | 141 | 143 | 22.8 | 22.9 | 6.12 | 6.15 | 3.28 | 3.31 |
| Potassium acetate 4% | 14.4 | 14.6 | 144 | 146 | 23.2 | 23.3 | 6.15 | 6.18 | 3.31 | 3.32 |
| New L.S.D at 5% | 0.7 | 0.6 | 4.8 | 4.6 | 0.6 | 0.5 | 0.04 | 0.04 | 0.03 | 0.03 |

**Table (4): Effect of spraying some different sources and concentration of potassium on some chemical characteristics of the fruits of Madjool date palms during 2021 & 2022 seasons**

| Treatments | Pulp% | | seed% | | Pulp/seed | | T.S.S. % | | acidity% | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| Control | 79.1 | 80.1 | 20.9 | 19.9 | 3.78 | 4.03 | 26 | 26.5 | 0.32 | 0.33 |
| Potassium citrate 1% | 84.7 | 85.3 | 15.3 | 14.7 | 5.53 | 5.8 | 29.2 | 29.7 | 0.29 | 0.3 |
| Potassium citrate 2% | 86.5 | 87.7 | 13.5 | 12.3 | 6.41 | 7.13 | 30.2 | 30.3 | 0.27 | 0.27 |
| Potassium citrate 4% | 86.8 | 87.9 | 13.2 | 12.1 | 6.58 | 7.26 | 30.4 | 30.5 | 0.26 | 0.27 |
| Potassium acetate 1% | 88.1 | 89.1 | 11.9 | 10.9 | 7.4 | 8.17 | 32.7 | 32.9 | 0.24 | 0.24 |
| Potassium acetate 2% | 89.2 | 90.3 | 10.8 | 9.7 | 8.26 | 9.31 | 34.6 | 34.7 | 0.21 | 0.25 |
| Potassium acetate 4% | 89.4 | 90.5 | 10.6 | 9.5 | 8.43 | 9.53 | 34.8 | 34.9 | 0.21 | 0.21 |
| New L.S.D at 5% | 1.1 | 1.1 | 0.9 | 0.9 | 0.19 | 0.2 | 0.5 | 0.4 | 0.02 | 0.02 |

**Table (5): Effect of spraying some different sources and concentration of potassium on some chemical characteristics of the fruits of Madjool date palms during 2021 & 2022 seasons**

| Treatments | Total sugars % | | Reducing sugars % | | Non-Reducing sugars % | |
|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| Control | 52.0 | 52.3 | 42.0 | 42.3 | 10.0 | 10.0 |
| Potassium citrate 1% | 56.3 | 56.4 | 43.5 | 43.7 | 12.8 | 12.7 |
| Potassium citrate 2% | 57.8 | 57.8 | 44.7 | 44.9 | 13.1 | 12.9 |
| Potassium citrate 4% | 57.9 | 58.1 | 45.1 | 45.5 | 12.8 | 12.6 |
| Potassium acetate 1% | 56.6 | 58.9 | 46.8 | 47.2 | 11.8 | 11.6 |
| Potassium acetate 2% | 60.1 | 60.4 | 48.1 | 48.4 | 12.0 | 12.0 |
| Potassium acetate 4% | 60.5 | 60.8 | 48.5 | 48.9 | 12.0 | 11.9 |
| New L.S.D at 5% | 1.2 | 1.3 | 1.0 | 1.0 | NS | NS |

## Discussion

The physiological role of potassium in enhancing various metabolic processes such as glucose synthesis translocation and accumulation. The role of potassium in maintaining cell turgidity and cell enlargement could explain that increase in yield. Spraying potassium has a significant effect on yield and quality since it regulates a variety of physiological and biochemical processes within the plant. It improves nutrient status and increases salt tolerance (EL- Fouly et al., 2002). Potassium plays an essential role in protein and amino acid synthesis as well as sugar translocation, assimilates inside the plant and accumulates carbohydrates ( Archer, 1988). Furthermore, at the plant tissue potassium level controls the cell water content and carbohydrate biosynthesis (Shahin, 2007) as well as translocation from the roots to the areal parts and nitrogen uptake (Cushnahan et al., 1995).

These results concerning the promoting effect of potassium on the yield and fruit quality of Madjool date palms are in harmony with those obtained by Abd El-Migeed et al., (2013); Awad et al., (2014); Salam et al., (2014); Aboutalebi and Mohammadi (2015); Al-Falahy and Hasan (2020); Alebidi et al., (2021); Ghazzawyet et al., (2023).

## Conclusion

Treating Madjool date palms grown under the Red sea region three times with potassium acetate at 2% gave the best results with regard to yield and fruit quality.

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# القدرة الإنتاجية وعلاقتها برش بعض المصادر المختلفة لتركيز البوتاسيوم لنخيل البلح المجدول

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## الملخص العربى

تمت هذه الدراسة خلال موسمي نمو أشجار نخيل البلح 2021، 2022 لاختبار التأثيرات المفيدة لرش كلا من سترات البوتاسيوم وأسيتات البوتاسيوم بتركيز من 1% إلي 4% علي النمو والمحصول والجودة في نخيل البلح صنف المجدول تحت الظروف البيئية لمنطقة البحر الأحمر.

وأوضحت النتائج المتحصل عليها ان رش سترات البوتاسيوم أو أسيتات البوتاسيوم الأولي بعد العقد والثانية خلال طور الكمري والثالثة في طور الخلال بتركيزات من 1% إلي 4% أدى إلي تفوق واضح في كل من صفات النمو ومساحة الورقة والمحصول وجودة الثمار بالمقارنة بمعاملة الكنترول.

ولوحظ ان هذا التفوق التدريجي كان مرتبط بزيادة التركيز من 1% إلي 4% وبدون تأثيرات واضحة بين التركيزان الأعليين، كذلك وجد ان رش أسيتات البوتاسيوم كان أفضل من استخدام سترات البوتاسيوم في هذا الصدد.

واوصت الدراسة بمعاملة ثمار نخيل البلح المجدول برشها ثلاث مرات من أسيتات البوتاسيوم (كمصدر من مصادر البوتاسيوم) بتركيز 2% حيث أعطت هذه المعاملة أفضل النتائج بخصوص المحصول وجودة الثمار.

**الكلمات الدالة:**
**نخيل البلح المجدول، أسيتات البوتاسيوم، سترات البوتاسيوم، كمية المحصول، خصائص جودة الثمار.**