

Application Efficiency of Times and Rates Commercial Product on Medjool Date Palm Nutrition Status and Relation with Fruit Quality

Omaima M. Hafez, Malaka, A. Saleh, A. M. M. Esam and N. E. Ashour

Pomology Department, National Research Centre, Dokki, P.O. Box 12622, Cairo, Egypt

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ABSTRACT

The present study was conducted during the growing seasons 2014 and 2015 of Medjool date palm, cultivated in a private orchard located point of 63 kilo meter from Cairo-Alexandria Desert Road, grown on sandy soil with 6x6 meters a part under drip irrigation system. Aimed to evaluation the times and rates foliar application commercial product “Sword[®]” (K, Mg, Zn, Salicylic acid, L-ascorbic acid and Riboflavin) effectiveness on Medjool date palm nutrition status and relation with yield quantity and quality. Inflorescences were sprayed separately by two concentrations (1 & 2 %) at once (at full bloom), twice (at full bloom then one month later) and triple time (at full bloom, one month later and month before harvest time). Besides other inflorescences was sprayed water only as check treatment.

Generally, results showed that spraying Sword[®] had a positive effect on leaf mineral content of macro and micronutrients. In conclusion, the foliar application of common compound, it contents some different nutrients and antioxidants to enhanced nutrition status of leaves and corrected some fertilizer deficiency, increased yield and improved fruit quality of Medjool date palm, which was emphasized by the strong significant positive correlation of most nutrients in leaves, yield and fruit quality. So, we are suggested that foliar application with the high concentration and times of the commercial compound (2% Sword[®] three times) to be a good recommendation for enhanced leaves mineral content, highest yield and improved fruit quality of Medjool date palm.

Key words: Medjool date palm, nutrients, antioxidants, nutrition status, fruit quality, correlation coefficients.

Introduction

Date palm is one of the most important horticultural crops in different Arab countries. All palm parts are used for various purposes and the major food source as well as it considers income source local. So, date palm plays a significant role in economy, society and environment of these areas (Chao and Krueger, 2007). Egypt is considered among the top ten date producers (FAO, 2012). Medjool cultivar is known semi-soft date fruits. Dates can grow and produce under a wide range of soil and climatic conditions. It merits more detailed consideration than some other varieties: it has become a very important variety to the date industry in recent years and its history is somewhat unusual. Medjool is the most desirable because of its large size, soft flesh, excellent taste and attractive appearance (Zaid, 2002).

Orchard management successful practices are directed toward obtaining a suitable yield with good fruit quality. Numerous of investigations on spraying macro and micronutrients of date palm recorded that it improved fruit set, retention and development as well as cause efficient yield and quality enhancement (Elsabagh, 2012; Omar *et al.*, 2014 and Mostafa, 2015). Nutrition with all essential elements (macroelements “N, P, K & Mg” and microelements “Zn, Mn & Fe”) has a vital role in deciding the growth and development of the plant, because plays an important role in several basic physiological functions, this serves as a guide to obtain maximum productivity of fruits quality (Pathore, 1999). Over the past decade, research efforts have focused on this connection to elucidate its many roles in plant physiology. Recommendations of the scientific meetings for data palm research stressed the importance of nutrition to improve the productivity and fruit quality, due to the activation of enzymes responsible for the formation of Adenosine Triphosphate (ATP) and regulation of photosynthesis rate. its attributed to effects on stimulating biosynthesis of organic materials especially

Corresponding Author: Omaima M. Hafez, Pomology Department, National Research Centre, Dokki, P.O. Box 12622, Cairo, Egypt. E-mail: omaimahafez@yahoo.com

carbohydrates and proteins and leading to better effect on the formation and movement of natural hormones which enhances both cell division and elongation, especially in the meristematic tissues (Harhash and Abdel-Nasser, 2007 & 2010; Hafez-Omaira *et al.*, 2012; Al-Obeed *et al.*, 2013; Amro *et al.*, 2014; Darwesh *et al.*, 2015 and Mostafa *et al.*, 2016).

Antioxidants such as organic acids, amino acids and vitamins may play a definite role in solving the problem of poor yielding through enhancing growth, nutritional status, yield and fruit quality in different evergreen fruit crop namely date palm, citrus, mangoes, bananas and olives (Ahmed *et al.*, 2007; Badran & Ahmed, 2009; Abd El-Razek *et al.*, 2013 and Mostafa *et al.*, 2016).

Generally, the nutrient elements and antioxidants are essential for the plant vitality and growth, in addition to withstand adverse conditions. Accordingly, this study aim to evaluation the times and rates foliar application commercial product effectiveness, its composed combined mineral nutrient (K, Mg & Zn) with antioxidants (Salicylic acid, L-ascorbic acid and Riboflavin), on Medjool date palm nutrition status and relation with yield and fruit quality.

Material and Methods

Plant material

Medjool date palms (*Phoenix dactylifera* L.) on 10 years old were selected healthy, nearly uniform in growth vigor, fruiting and received regular horticultural practice, during the 2014 and 2015 seasons. It's cultivated in a private orchard located point of 63 kilo meter from Cairo-Alexandria Desert Road, grown on sandy soil with 6x6 meters a part under drip irrigation system. Palm dates were pruning to maintain 1 bunch/ 8 mature leaves and remained 10 bunches of spathes per palm by removing excess earliest, latest and smallest inflorescence. Pollination was carried out using the same pollen grain source.

Treatments

Female inflorescences were sprayed by two concentrations (1 & 2 %) at three times with freshly aqueous solution of commercial product called "Sword[®]" consists of the components (25% Potassium, 0.5% Magnesium, 0.5% Zinc, 25% Salicylic acid, 0.01% L-ascorbic acid, 0.01% Riboflavin and 48.98% helper's carrier materials) under seven treatments including control, as follows:

T₁: Control (water only).

T₂: 1% Sword[®] once (at full bloom).

T₃: 1% Sword[®] twice (at full bloom then one month later).

T₄: 1% Sword[®] triple times (at full bloom then one month later followed by third one a month before harvest time).

T₅: 2% Sword[®] once (at full bloom).

T₆: 2% Sword[®] twice (at full bloom and one month later).

T₇: 2% Sword[®] triple time (at full bloom, one month later and month before harvest time).

Inflorescences were sprayed separately from each side with plastic sheets to avoid any contamination between other treatments by using a small hand sprayer until run-off. All aqueous spraying were content 1% Triton B as a wetting agent. The experiment in a complete randomized block design with ten replicates (bunch/replicate).

Studied measurements

Nutrient status

Leaf nutrient contents

Twenty pinna a (as a sample) for each experimental palm were collected at Mid the November in both seasons, from the medium part of the five consecutive leaves which less were than one year old and located just over the fruiting zone as described by Rizk (1987). The samples were

washed, dried at 70°C till constant weight, grind and digested to determine the macronutrients (N, P, K, Ca and Mg %) and micronutrient (Fe, Mn and Zn ppm) contents according to Rebbeca (2004).

Fruit set (%): Calculated according to El-Mkhtoun, (1981).

Fruit retention (%): Computed according to Soliman & El-Kosary, (2002) using follows equation: Total No. of the retained fruits per bunch / Total No. of the nods per bunch.

Yield (Kg)/palm: Bunches were harvested at fruits reached Khalaal stage, during the end of September in both seasons and weights were recorded.

Fruit quality assessments: Twenty five fruits from each bunch were picked at random to determine the physical and chemical characteristics.

Fruit physical parameters: Weights (g) [pulp & seed] and dimensions (cm) [length & diameter].

The chemical components: Total soluble solid percentage (TSS %) by handy refractometer, total acidity % (as a malic acid /100g pulp), total sugars (%), reducing, non-reducing and tannins using method (AOAC, 2000).

Statistical Analysis

The full findings were presented to analysis of variance according to Snedecor and Cochran, (1967). Differences among treatments means were determined by using the LSD test at a significance level of 0.05 (Waller and Duncan, 1969).

Results and Discussion

Nutrition status

Macronutrient contents

It can be noticed that all foliar applications of commercial product Sword® at different rates and times significantly increased leaves macronutrients content (N, P, K, Ca and Mg) as compared with the control, in both seasons.

It is obvious that the application effective is approximately proportional to the increase in the rates and times of this compound. Foliar application of 3 % Sword® triple time was superior in leaves macronutrients content, since it was favorable in enhancing these nutrients than the other treatments (Table 1). It recorded the highest significant values of nutrients content, followed in a descending order by application of 2 % Sword® twice time had high statistical values between them except in the 1st of N and P whereas, in the two seasons of Ca. The reduction macronutrients value was recorded by the check treatment. On the contrary, although Mg values were better by increasing the doses and times of Sword®, but lost the statistical among all.

Table 1: Leaf macronutrient contents of Medjool date palm as affected by rates and times commercial product Sword® application during 2014 & 2015 seasons

Treatments	Leaf macronutrient contents (%)									
	N		P		K		Ca		Mg	
	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd
Control (water)	1.52	1.6	0.15	0.16	1.39	1.43	1.13	1.14	0.20	0.20
1% Sword® one	1.65	1.7	0.18	0.18	1.45	1.51	1.19	1.15	0.20	0.20
1% Sword® two	1.68	1.7	0.19	0.19	1.60	1.64	1.20	1.14	0.20	0.20
1% Sword® three	1.77	1.8	0.21	0.22	1.82	1.85	1.22	1.18	0.21	0.21
2% Sword® one	1.86	1.9	0.22	0.23	1.85	1.89	1.22	1.18	0.21	0.22
2% Sword® two	1.94	2.0	0.22	0.24	1.95	1.99	1.24	1.20	0.22	0.21
2% Sword® three	2.00	2.2	0.22	0.26	1.99	2.00	1.24	1.21	0.22	0.21
LSD _{0.05}	0.07	0.03	0.02	0.02	0.02	0.04	0.02	0.0	NS	NS

NS: not significant.

Micronutrient contents

In general, leaf micronutrient contents were given the same trend in taken of macronutrient contents.

From the above results in Table 2, it is clear that inflorescence Medjool application spray with all different concentrations and times were significantly very effective in improving leaf micronutrient content (Zn, Mn and Fe) when checked by the control. The highest significant value was obtained with the high rate and time of Sword® (2 % three times). The same concentration two times came next; with rise statistical differ between them. Other wise, the untreated check revealed the low value of Zn, Mn and Fe leaves content. Similar results were announced in the two seasons.

It is worth mentioning that, the enhanced leaves nutrition status of Medjool date palm attributed to the strong effect of commercial product, it contents of some macro element (K₂O & Mg), micro element (Zn) and antioxidants (Salicylic acid, Ascorbic acid and Riboflavin) which in turn reflected on leaves content of nutrients.

Potassium has positive role in plant growth hence this element plays an essential role in photosynthesis and osmoregulatory (Nelson, 1978), and it is required for physiological processes such as activation of enzymes, regulation of osmotic pressure and stomata movement (Gollback *et al.*, 2003). Mg is essential for chlorophyll formation (Evans, 1983).

Zinc is well known that acts a co-factor of many enzymes and affects many biological processes such as photosynthesis, nucleic acids metabolism, protein and carbohydrate biosynthesis and it has an important role to starch metabolism in plant (Marschner, 1996).

Antioxidants are playing in the biosynthesis of many plant hormones including ethylene, gibberellic acid, and abscisic acid and it serves as a co-factor for many enzymes and it contributes to the detoxification of ROS (Conklin and Barth, 2004).

The results are in line with (Mostafa, 2004; Hafez-Omaira and El-Metwally, 2007; Harhash & Abdel-Nasser, 2010; Hafez-Omaira *et al.*, 2010, 2011 & 2012 and Karimi *et al.*, 2012).

Table 2: Leaf micronutrient contents of Medjool date palm as affected by rates and times application commercial product Sword® during 2014 & 2015 seasons

Treatments	Leaf micronutrients content (ppm)					
	Zn		Mn		Fe	
	1 st	2 nd	1 st	2 nd	1 st	2 nd
Control (water)	51	53	57	58	140	144
1% Sword® one	54	54	60	60	147	148
1% Sword® two	57	59	65	66	151	154
1% Sword® three	65	66	68	69	166	169
2% Sword® one	69	70	83	84	171	173
2% Sword® two	71	72	84	85	174	176
2% Sword® three	73	79	87	93	177	191
LSD 0.05	1.7	3.3	1.8	3.9	2.4	7.6

Correlation coefficient

Tables 3&4 showed the relation between leaves nutrient content, yield and fruit quality of Medjool date palm. Results indicated that there were common positive relations with different strength between leaves nutrient content and the studied characteristics.

The strong significant positive relation was recorded between nutrients content and all most properties (percentages of fruit set, retention, soluble and total sugars; weights of bunch and fruit (pulp & seed); fruit dimension (length and diameter). Meanwhile, the moderate positive relation was found between Mg leaf content and fruit retention % and total sugars %. Some discrepancies were detected (negative strong relation) in acidity % and tannins (all nutrients) and non-soluble sugars % (Mg, Zn and Mn). On contrast, were found (negative moderate relation) in (N, P, K, Ca and Fe) and non-soluble sugars (%).

Therefore, it can be say that spraying macro and micro nutrients had an important role on fruit set, yield and fruit quality. Harhash and Abdel Nasser (2010) mentioned that K, B or mixed had significant effect in increasing the fruit set. Al-Obeed *et al.* (2013) clearly indicated that fertilization

of potassium and phosphorus rates were added in either one, two or three doses increased the fruit set, yield and improved the fruit physical characteristics (fruit weight, volume, length and diameter). Omar *et al.* (2014) found that spraying date palm inflorescences with calcium nitrate had a significant effect of fruit set, yield and fruit quality. Mostafa (2015) indicated that zinc sulphate spraying twice after fruit set and one month later increased the palm yield and fruit quality.

Table 3: Correlation coefficients of leaves macronutrient content with yield and fruit quality of Medjool date palm cultivar

Yield and quality characteristics	Leaf macronutrient content (%)				
	N	P	K	Ca	Mg
Fruit set %	0.94494**	0.90853**	0.91122**	0.90899**	0.57171**
Fruit retention %	0.91605**	0.81308**	0.84804**	0.81498**	0.50667*
Bunch weight (Kg)	0.97681**	0.90591**	0.94734**	0.90804**	0.65212**
Yield (Kg)/Palm	0.97681**	0.90591**	0.94734**	0.90804**	0.65212**
Fruit length (cm)	0.96158**	0.94926**	0.97823**	0.94263**	0.70693**
Fruit diameter(cm)	0.88470**	0.89937**	0.90804**	0.88198**	0.62438**
Fruit weight (g)	0.96927**	0.88952**	0.93845**	0.89260**	0.66283**
Pulp weight (g)	0.96982**	0.87414**	0.93412**	0.88869**	0.64422**
Seed weight (g)	0.80524**	0.73971**	0.78994**	0.72845**	0.57232**
TSS (%)	0.96658**	0.92367**	0.95099**	0.92089**	0.60021**
Acidity (%)	-0.82671**	-0.93199**	-0.88792**	-0.90700**	-0.64925**
Tannins (%)	-0.69349**	-0.76556**	-0.69776**	-0.75689**	-0.41536*
Soluble sugars (%)	0.79321**	0.86833**	0.81052**	0.86265**	0.61847**
Non-soluble sugars (%)	-0.43584*	-0.53041*	-0.50122*	-0.51640*	-0.65098**
Total sugars (%)	0.86492**	0.84938**	0.82233**	0.85721**	0.45074*

$r_{0.01} = 0.433$, $r_{0.01} = 0.549$, * = Moderate relation, ** = Strong relation, (-) = Negative relation

Table 4: Correlation coefficients of leaves micronutrient content with yield and fruit quality of Medjool date palm cultivar

Yield and quality characteristics	Leaf micronutrient content (ppm)		
	Zn	Mn	Fe
Fruit set %	0.91360**	0.87386**	0.92256**
Fruit retention %	0.86505**	0.82526**	0.87017**
Bunch weight (Kg)	0.96879**	0.96706**	0.96280**
Yield (Kg)/Palm	0.96879**	0.96706**	0.96280**
Fruit length (cm)	0.97393**	0.95109**	0.97549**
Fruit diameter(cm)	0.86554**	0.81115**	0.87610**
Fruit weight (g)	0.95902**	0.96083**	0.95021**
Pulp weight (g)	0.95515**	0.95423**	0.94614**
Seed weight (g)	0.80066**	0.78924**	0.77820**
TSS (%)	0.95123**	0.93227**	0.94009**
Acidity (%)	-0.85303**	-0.77889**	-0.86423**
Tannins (%)	-0.64585**	-0.63585**	-0.65968**
Soluble sugars (%)	0.79264**	0.75206**	0.83486**
Non-soluble sugars (%)	-0.44912**	-0.41552**	-0.49916*
Total sugars (%)	0.81957**	0.77370**	0.84250**

$r_{0.01} = 0.433$, $r_{0.01} = 0.549$, * = Moderate relation, ** = Strong relation, (-) = Negative relation

In generally, the nutrient elements and antioxidants are essential for the plant vitality and growth, in addition to withstand adverse conditions. Each particular nutrient has mutual relation between its concentration in soil and in plant. This relation serves as a guide to obtain maximum plant growing strength, yield and fruit quality. The obtained results are in conformity with the findings (Dar *et al.*, 2012; Hamouda *et al.*, 2015 and Mostafa *et al.*, 2016).

Conclusion

In conclusion, the nutrition by foliar application of common compound Sword[®], it contents some different nutrients and antioxidants to enhanced nutrition status of leaves and corrected some fertilizer deficiency, increased yield and improved fruit quality of Medjool date palm, which was emphasized by the strong significant positive correlation of most nutrients in leaves, yield and fruit quality. So, we are suggested that using high concentration and times of the commercial compound (2% Sword[®] three times) to be a good recommendation for enhanced leaves nutrient content, highest yield and improved fruit quality of Medjool date palm cultivar.

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