Middle East Journal of Agriculture Research
ISSN 2077-4605

Volume : 08 | Issue : 01 | Jan.-Mar. | 2019
Pages:176-181

Effect of Borax on increasing the setting and reduce Fruit drop on Barhi (*Phoenix dactylifera* L.) date palm cv. during pollination and fruit set

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Received: 05 Jan. 2019 / Accepted 20 Feb. 2019 / Publication date: 25 Feb. 2019

ABSTRACT

This study was carried out in 2016 and 2017 seasons in Samarrina private orchard located in Ismailia Governorate, Egypt. The main objective of the present work is to investigate the impact of adding Borax (11 % Boron) with different concentrations (0, 50, 100, 150, 200 and 250g) through drip irrigation with the same amount two times weekly, all treatments were applied during (February, March, April). Fruit physical properties indicated increasing in all Parameters with significant effects on yield, fruit set, and all other fruit physical properties of Barhi date palm cultivar. Results clarified, The Significant increasing treatment concerning yield and fruit physical characteristics (yield, fruit weight, flesh weight, seed weight, fruit length and width) of Barhi date palm cultivar was B4 (200 g) in the two experimental seasons. Complete randomize design was conducted in this study.

Keywords: Borax, Barhee, Fruit set, Fruit drop, Date Palm.

Introduction

Date palm (*Phoenix dactylifera* L.) is extensively grown in many parts of the world including Egypt, Arabian Peninsula, Algeria, Iraq, Tunisia and Pakistan. Egypt is the world largest date producing country i.e. more than 1.5M tones/annum. (Food and Agriculture Organization, 2013). It is concerned as important minerals and most nutritive. The quality of fruit since it one of the important yields in arid and semi-arid regions (Rizzi & Abruzzese, 1990). At present, approximately 2000 or more different date palm cvs are famous to exist all over the world. It is a very essential crop in the Middle East area, since date palm grows well in the semi-dry desert areas and newly reclaimed sandy soil. The main producing countries are Egypt, Saudi Arabia, Iran, Iraq, Algeria and Pakistan. Date palm are grow successfully throughout Egypt from the northern Delta up to Aswan Governorate (Ghazzawy *et al*., 2005). Moreover, soil application can supply enough nutrients to increasing plant yield, furthermore, causes world-wild anxiety about environmental contamination for nutrients escape into ground water (Dinnes *et al*. 2002). Natural product constitutes a critical portion of a adjusted count calories as they are characteristic sources of nourishment supplement required by human and creatures, such nourishment supplement incorporates carbohydrate, protein, minerals and filaments, with the worldwide center on expanded nourishment generation and accentuation on arrangement of nutritive nourishment for the world populace. It is exceptionally critical to consider accessible natural products to decide their supplement composition for the reason of expanding the generation of such natural products (Ossi *et al* 2008) on Cola lepidota and (Al- shahib and Marshall 2003) on date palm.

Boron is a multiuse and essential element for the plants. Boron is greatly vital for development and cell division in the growth regions of the plants near the tips of their shoots and roots. Boron has big role effect on pollination, also, in the growth of viable seeds, which in turn affect the normal development of fruit. The quality and size of guava fruit can be bigger greatly by foliar application of borax (Komal *et al*., 2017). To improve our crop from several kinds of dates we must introduce the most valuable plantlets from all over the world and the Arabic countries. Also, the best researches about the introduced plants and the local ones, applying the good results of the genetic engineering, protecting, harvesting and handling dates, must be applied and the extension activity must be encouraged.

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Furthermore, it is well known that leaf mineral content is a valid guide for determining the nutritional status of the palm. Moreover, nutrients back translocation is a common habit in date palm. Thus, the purpose of this investigation is to study the effect of different Borax concentrations adding to date palm trees after setting to increasing fruit set and decrease the falling fruits on palm cultivar Barhi, also to study physical properties as affected by different Borax concentrations through the growing two successive seasons.

Materials and Methods

The present work was carried out during two successive seasons (2016 and 2017) at Samarrina private farm located in Ismailia Governorate. Eighteen Female Barhee palms were used in this study (12 years old). The palms were received normal agricultural practices. Barhi palm cultivar were pollinated by the same source of pollen grains just after 2-4 days of open spath covers in both seasons. Palms were selected and divided into 6 treatments in three replicates (each is one palm) and arranged in a randomized complete block design. Palms were subjected for the following treatments:

- (Control treatment).
- (Boron at 50 g /tree) add equal doses two times weekly to three months
- (February, March, April).
- (Boron at 100 g /tree) add equal doses two times weekly to three month (February, March, April).
- (Boron at 150 g /tree) add equal doses two times weekly to three month (February, March, April).
- (Boron at 200 g /tree) add equal doses two times weekly to three month (February, March, April).
- (Boron at 250 g /tree) add equal doses two times weekly to three month
- (February, March, April).

The treatments were added equal doses two times weekly to three month (February, March, April), throw the drip irrigation two times weekly respectively.

Fruit Set and Retention:

Initial fruit set and fruit retention % were evaluated 30 days after pollination and at harvested time, respectively. Five female strands / bunch were randomly selected from each replicate. The number of fruit set was recorded and then fruit set % and fruit retention was calculated as the following The average fruit set was calculated using the following equation:

$$\text{Fruit set } \% = \frac{\text{Total number of setting fruits per bunch}}{\text{Total scares number per bunch}} \text{ X } 100$$

$$\text{Fruit retention } \% = \frac{\text{No. of retained fruits}}{\text{No. of retained fruit+ No. of flower scars}}$$

Yield: yield (kg): was estimated as bunch weight for each treatment.

Fruit Physical Characteristics:

Samples of 15 date fruits were randomly picked when fruit color changed from each bunch of each treated palm for determining the physical properties as following:

Fruit Physical Characteristics:

Fruits of each sample were weighed (g) and measured as length (cm) and width (cm), flesh and seeds of the same sample were separately weighed (g) and volume (cm^3) by using volume trice method (A.O.A.C. 1995).

Experimental design and statistical analysis:

Complete randomized block design with six treatments having three replicates in each one. Data were analyzed using SAS software version 16 and the means were compared following t-test using L.S.D. values at 5 % level.

Results and Discussion

Regarding the growth parameters percentages of Barhi date palm cv. the fruit set were significantly influenced as response to the different concentration of Borax (as compared with control treatment). The mean maximum fruit set value was (82.9 % and 85.2 %) were recorded under B4 (Boron at 200 g /tree) which was superior with other treatments whereas, the mean minimum fruit set (47.4 and 36.0) was noticed under control (Table 1). Concerning the effect of different concentrations of Borax on remaining fruits, that were recorded the lowest Barhi fruit remaining fruits percentages (30.00) in both seasons. In addition, the minimum number of dropped fruits percentage was (2.1 & 3.9) with B4 (Boron at 200 g /tree) in the first and second season, respectively as compared with control which recorded (7.5&6.0) through the growing season. The above-mentioned results are in agreement with the findings with Komal *et al*., 2017 who observed that foliar application of borax increased fruit yield per tree (46.0 kg), yield per hectare (127.9) in the guava plant. Boron has a key role in cell division and cell elongation, and there by increased vegetative growth. A notable characteristic of Borax is that it directly effect on photosynthesis activity of plants as reported by (Bagali *et al*. (1993), Komal *et al*., 2017). these results also, accordance with Khayyat 2007 who reported that, date palm cv Shahany fruits that improved length, diameter and flesh weight with spraying when added Borax 1500 and 2500 ppm + potassium sulphate 1 and 2%, also, Soliman and Al-Obeed 2011 and El-Sabagh and Said 2012 improved flesh weight and weight, length and diameter with spraying of Borax 0.6 % + sugar 2 g/l, and potassium nitrate 1and 2% and potassium sulphate at 1 and 2% and potassium citrate at 3%. Spraying calcium + micro nutrient + amino chelate produced greater date palm fruit Kabkab cv weight, diameter and length in the khalal stage Naseri *et al*. 2013. Additionally, Kinnow (Citrus reticulate Blanco) fruit weight, length and flesh weight were increased when fruits sprayed borax 0.4% and potassium and Zn sulphate as reported by Ashraf *et al*. 2013 and Ullah 2012. Moreira *et al*. 2007 on Banana, and Rahnama *et al*. 2012 indicated that, on date palm cv. Barhi and AlBamarny 2010 on Peach (*Prunus persica* L.) cv. Early coronet. Fruit and flesh weight, length and diameter of date palm cv. Sayer fruits were increased attributed with 1000 and 1300 gm./tree potassium sulphate soil treatment.

Table 1: Effect of different concentrations of Borax of cv. Barhi date palm, Fruit set (%), Remaining and Dropped fruits (%).

Treatments	Fruit set (%)		Remaining fruits (%)		Dropped fruits (%)	
B0	47.400 d	36.067 e	30.000 f	30.000 e	17.40 ab	6.067 ab
B1	57.527 e	45.700 d	38.200 e	37.000 d	19.327 e	8.700 a
B2	58.700 c	56.200 c	50.400 d	52.300 c	8.300 ab	3.900 ab
B3	67.300 b	66.520 b	63.700 c	60.240 b	3.600 b	6.280 ab
B4	82.900 a	85.213 a	80.800 a	77.650 a	2.100 b	7.563 b
B5	81.300 a	81.863 a	79.100 b	76.650a	2.200 b	5.213 ab
LSD 0.05	**2.2439**	**4.3931**	**15.5800**	**11.7777**	**10.3240**	**4.3910**

B0 (Control) B3 (Boron at 150 g /tree)
B1 (Boron at 50 g /tree) B4 (Boron at 200 g /tree)
B2 (Boron at 100 g /tree) B5 (Boron at 250 g /tree)

Regarding yield data indicated that treatment with borax at B4 (Boron at 200 g /tree) or B5 (Boron at 250 g /tree) increased the yield percentage as compared with B0 (control) which recorded (131.0 & 130.9) in both season, respectively. The highest fruit weight percentage was obtained by B4 (Boron at 200 g /tree) which recorded (19.07) in the first season and same trend was founded in the second season. Barhi fruit set percentages were significantly affected by different concentrations of NAA sprayed at different times during fruit development in both seasons. Samani fruit weight recorded higher percentages when treated with B4 (Boron at 200 g /tree) and recorded (19.0) in the first season and same trend was founded in the second season. The increased maximum number of Flesh weight was (19.0) & (19.5) in the first and second season, respectively. On the other hand, the highest seed weight (g) was obtained by control treatment which recorded 1.2 in the first season and 1.333 in the second season. Whereas, the lowest seed weight (1.086 and 1.090 in the two seasons, respectively) was recorded by treatment B4 (Boron at 200 g /tree) borax as mentioned in (Table 2).

The increase in fruit yield may be attributed to the increase in vegetative growth whole enhancement in yield and yield attributing parameters may be due to the increased auxin production and subsequent translocation from source to sink (Komal *et al*., 2017). Borax acts as catalyst in the oxidation and reduction processes and also has great importance in the sugar metabolism; it might have improved the physical characters of guava fruit and thus increased the yield per tree assumed in our finding. Heavier fruits with more fruit weight under Borax treatment might be due to the high level of auxin in the various parts of the fruit plant maintained by Borax. Borax spray increased the fruit weight because it is an essential micro nutrient and it is considered indispensable for the growth of all organisms (Arora, and Singh, 1970). Chaitanya *et al*. (1997) and Pal *et al*. (2008) also observed that foliar spray of borax improved the fruit yield in guava cv. L-49. Stampar *et al*. (1999) observed that foliar application of borax increased yield up to 30 *percent* in apple.

Table 2: Effect of different concentrations of Borax of cv. Barhi date palm, Yield, Fruit weight, Seed weight and Flesh weight).

Treatments	Yield (kg)		Fruit weight (g)		Seed weight (g)		Flesh weight (g)	
B0	131.033 e	130.96 e	17.096 e	16.893 d	1.293a	1.333 a	15.803 e	15.560 d
B1	143.466 d	143.13 d	18.06 ed	17.233 cd	1.160 b	1.120 cd	16.90 ed	16.113cd
B2	155.667 c	155.16 c	18.406 bc	18.146 bc	1.100c	1.156bcd	17.306 bc	16.990bc
B3	162.366 b	162.03 b	19.070 a	18.553 b	1.196 ab	1.203 b	17.874 ab	17.350 b
B4	173.366 a	172.93 a	19.070a	19.593 a	1.086c	1.090 d	17.984a	18.503 a
B5	171.800 a	171.63 a	18.773 ab	18.090 a	1.907 a	1.166bc	16.866 a	16.924 a
LSD 0.05	**2.0799**	**2.7363**	**0.48890**	**0.99430**	**0.0378**	**0.0680**	**0.4889**	**0.9943**

B0 (Control) B3 (Boron at 150 g /tree)
B1 (Boron at 50 g /tree) B4 (Boron at 200 g /tree)
B2 (Boron at 100 g /tree) B5 (Boron at 250 g /tree)

Table (3) shows that Barhee fruit size was significantly affected by different concentrations of Borax in both seasons. Regarding the effect of different concentrations of Borax, B4 (Boron at 200 g /tree) gave the highest Barhi fruit size (19.8 cm^3 in the first and 18.4 cm^3 in the second season). The same results were observed with Barhi fruit length in this regard in both seasons (3.9 & 3.8). Regarding the effect of different concentrations of Borax in both seasons for fruit width and fruit thickness same trend was founded which recorded (3.1 & 3.0) for fruit length and (0.8) for both seasons.

Table 3: Effect of different concentrations of Borax of cv. Barhi date palm, Fruit size, Fruit length, Fruit width and Flesh thickness.

Treatments	Fruit size (cm)		Fruit length (cm)		Fruit width (cm)		Flesh thickness (cm)	
B0	18.956b	17.863 ab	3.793 b	3.7266 bc	2.663 bc	2.4733e	0.700 b	0.7000b
B1	19.067 b	17.170 bc	3.780b	3.7766b	2.650 bc	2.6500b	0.800 a	0.8000a
B2	19.016 b	17.360abc	3.770b	3.7566 b	2.656 bc	2.5966bc	0.800 a	0.8000a
B3	18.016 d	16.350 c	3.630 d	3.6266 cd	2.606c	2.6100b	0.700b	0.7000b
B4	19.816 a	18.466 a	3.923 a	3.8966a	3.100a	3.0566a	0.800 a	0.8000 a
B5	18.720c	16.720bc	3.710c	3.6033d	2.710b	2.6533b	0.700 b	0.7000b
LSD 0.05	**0.2473**	**1.1936**	**0.0476**	**0.1149**	**0.0632**	**0.1249**	**0.0000**	**0.0000**

B0 (Control) B3 (Boron at 150 g /tree)
B1 (Boron at 50 g /tree) B4 (Boron at 200 g /tree)
B2 (Boron at 100 g /tree) B5 (Boron at 250 g /tree)

Data presented in table (4) indicated that total fruit acidity percentage was not significantly affected by different treatments with boron for two seasons in Barhi dates, the present date are in agreement with Ashour *et al*. (2004) and Desouky *et al*. (2007). On the other hand, data in same table showed that all treatments affected significantly total soluble solids % in fruit juice for Barhi cultivar in both seasons as compared with those of the control treatment. Using (Boron at 50 g /tree, and Boron at 100 g /tree) recorded the highest total soluble solids percentage (71.2 &71.3) in the first

season, while treatment with Boron at 100 g /tree gaved the highest value in the second season (71.5), the lowest total soluble solids % was recorded due to control treatment in both seasons. The obtained results are similar to those of Desouky *et al*. (2007) and Ghazzawy *et al*. (2010) reported that using Boron at 100 g /tree improved total soluble solids in both seasons.

Table 4: Effect of different concentrations of Borax of cv. Barhi date palm, Fruit Acidity % and TSS%.

Treatments	Acidity %		TSS %	
B0	0.94a	0.88a	68.1c	69.4c
B1	0.88b	0.87b	71.2a	70.5ab
B2	0.87c	0.85c	71.3a	71.5a
B3	0.88b	0.85c	70.8b	70.4ab
B4	0.85d	0.84d	70.4b	70.3ab
B5	0.84e	0.84d	69.4bc	70.1ab
LSD 0.05	**ns**	**ns**	**0.21**	**0.32**

B0	(Control)	B3	(Boron at 150 g /tree)
B1	(Boron at 50 g /tree)	B4	(Boron at 200 g /tree)
B2	(Boron at 100 g /tree)	B5	(Boron at 250 g /tree)

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