

Effect of Spraying Seaweed Extracts and Silicon on yield and Fruit Quality of Zaghloul Date Palms Grown under Sandy Soil Conditions

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Abstract

This study was carried out through 2014 and 2015 in a private date palm orchard located in New Assuit City district, Assuit Governorate to study the effect of spraying with different concentrations of two seaweed extraction, (Eprosil-k at 4%) and (Oligo-x at 2 or 4%) either alone or with silicon nutrient at (0.5%), on yield and fruit quality of Zaghloul date palms. palms sprayed three times during grown seasons (first of April, May and June) with Seaweed extracts at 2 or 4% either alone or with silicon were very effective on improving yield and fruit quality (fruit weight, dimensions, total soluble solids and sugar contents) in comparison with control treatment. The promotion on these characters was observed when the concentrations of Oligo-x (Seaweed extract compound) were increased from 2 to 4%. The best results with regard to yield and fruit quality of Zaghloul date palms were obtained due to spray the palms three times with a mixture of seaweed extract (Oligo-x at 4%) and silicon nutrient at 0.5%.

Keywords: Seaweed, Date palm, Yield, Biofertilization, Foliar spraying.

Introduction

Date palm (*Phoenix dactylifera* L.) is an important fruit crop of the arid regions in the world. Especially in the Middle East and North Africa, where it has been cultivated since ancient times and is closely associated with the life and culture of the people in these regions. Egypt is considered as the leader of Arab countries in producing dates (FAO 2009).

Date palm cultivars divided into three main types according to its fruit moisture content, i.e. Soft, Semi-dry and dry cultivars (Selim *et al.*, 1968). Date palm trees could grow under unfavorable conditions where many of other fruit species could not grow. Date palm is the most common fruit tree grown in semiarid and arid- regions. It plays an important role in the protection of interplant cropping systems and the stabilization of the ecological system (Hasnaoui *et al.*

2011). For this reason date palm is considered one of the suitable trees, which could be cultivated in the new reclaimed desert regions.

Low yield of palms grown under sandy soil is considered a major problem that faces growers. Likewise, modern agriculture is searching for new biotechnologies that would allow for reduction in the use of chemical inputs without negatively affecting crop yield or the farmer's income. Similarly, finding out recent techniques for promoting yield without causing any environmental pollution is an important task for pomologists. Investigations on compounds capable of reducing the sensitivity of fruit crops to all stresses and at the same time to unfavorable conditions are of great importance. Novel bioactive compounds from the marine environment have become a common practice in agriculture, which repre-

sents a rich natural resource of many functional ingredients. Previous studies showed that using seaweed extract at various concentrations and frequencies had an announced promotion on growth and fruiting of all evergreen fruit crops (El-Sawy, 2005; Gamal, 2006; Mouftah, 2007; El-Sayed-Esraa, 2010; Abdelaal *et al.*, 2012; Mahmoud, 2012; Ahmed *et al.*, 2013a and 2013b; Mohamed and El-Sehrawy 2013 and Gamal, 2013). The application of seaweed extract which contains most nutrients, organic compounds, enzyme vitamins antioxidants, amino acids and natural hormones is fast becoming an accepted practice. It increase yield quantitatively and qualitatively in various fruit crops (Soliman *et al.*, 2000 and Khan *et al.*, 2009). The results of Abdelaal *et al.*, 2012, Mahmoud 2012, Gamal 2013, Abd El Aty 2015 supported the beneficial effects of using seaweed extract on fruiting on different fruit crops.

Moreover, silicon plays an important role in increasing and enhancing with standing of fruit crops to biotic and abiotic stresses, photosynthesis, nutrient and water uptake, plant pigments and all cell division (Epstein 1999 and Ma 2004). Previous studies exhibited that using all sources of silicon was very effective in improving yield and fruit characteristics in various fruit crops (Al-Wasfy 2014, El-Khawaga and Mansour 2014, and Abd El-Wahab 2015).

Consequently, this investigation aimed to study the effect of two Seaweed extract compounds (Eprosil-k at 4%) and (Oligo-x at 2 or 4%) either alone or with silicon nutrient at (0.5%), on fruiting of Zaghloul palms

grown under new reclaimed sandy soil and to optimize the best concentration.

Material and Methods

This study was conducted during 2014 and 2015 seasons in a private date palm orchard situated in New Assuit City district, Assuit Governorate on eighteen years old Zaghloul date palms (soft date palm cultivar). The selected palms are uniform in vigor healthy, good physical conditions, free from insects, diseases and damages. The number of bunches per palm was adjusted to eight bunches and leaf / bunch ratio was maintained at 8:1 (Hassaballa *et al.*, 1983). The selected palms were irrigated with well water (EC 600 ppm) through drip irrigation system. Hand pollination was achieved by inserting five fresh male strands into the center of each female spathe using the same source of pollens to avoid residues of metaxenia.

Seaweed extracts (Oligo-x) was purchased from AGAS (Arabian group for agricultural service) company. The Oligo-x compositions were oligosaccharide (3%), alginic acid (5%), phytin (0.003%), menthol (0.001%), natural growth regulators (cytokinine, 0.001; indol acetic acid, 0.0002% and pepsin, 0.02%) and minerals (potassium oxide, 12% ; phosphorus oxide, 0.5% ; N, 1%; Zn, 0.3%; Fe, 0.2% and Mn, 0.1%). Eprosil-k is manufactured by Opal Company with following composition: potassium (k) 10 %, silicon (sio₂) 20% and *Ascophyllum nodosum* L.(Seaweed extract) 5 % (w/w). Also, Silicon nutrient (25% Si and 10% K₂O) was purchased from El-Ganeem Company Egypt.

Experimental units were arranged in a randomized complete block design with three replicates, one palm per each. This Experiment included the following six treatments:

1- Control in which palms were sprayed with water only.

2- Spraying seaweed extract (Oligo-x at 2%).

3- Spraying seaweed extract (Oligo-x at 4%).

4- Spraying seaweed extract (Oligo-x at 2%) with Silicon nutrient at 0.5 %.

5- Spraying Oligo-x seaweed extract (Oligo-x at 4%) with Silicon nutrient at 0.5 %.

6- Spraying seaweed extract (Eprosil-k at 4%).

Seaweed extract were sprayed three times at the first of April, May and June in both seasons, spraying was done till runoff using Triton B as a wetting agent.

The following indices were studied and recorded:

Average bunch weight and total yield: All fruit bunches on each palm were harvested when the fruits reached to full color stage, average bunch weight and total yield were recorded.

Physical and chemical properties of fruits: a random sample of 100 fruits collected at harvest time of each replicate (from each palm). Fruit characteristics included weight of fruit, pulp and seed, fruit volume and fruit dimensions (axial and equatorial diameter), and Pulp thickness. Total soluble solids (T.S.S) content were determined by hand refractometer. Total and reducing sugars content were determined according to the

method of Lane and Eynon as described in the A. O. A. C. (1980). Also; acidity content was determined as g malic acid per 100 g pulp (Hussein *et al* 1993). Data were subjected to statistical analysis according to Snedecor and Cochran (1990). The treatment means were compared using Least Significant Difference (LSD) at 5% level.

Results and Discussion

Bunch weight and yield per palm:

Data illustrated in Table (1) showed that a significant promotion on the bunch weight and consequently yield per palm in response to treat the palms with different sources and concentrations of seaweed extracts either alone or with silicon nutrient at 0.5% in compared with control. Spraying Oligo extract at 4 % with silicon at 0.5 % (treatment 5) gave the highest values of bunch weight (22.17 and 22.95 kg and total yield per palm (176 and 176.58 kg) during seasons 2014 and 2015, respectively compared with the other investigation treatments. The percent of increase in bunch weight compared with control were about (36.43 and 41.84 %) while it was about (57.90 and 53.90 %) in total yield during the two experimental seasons , respectively There was a gradual promotion on bunch weight and yield per palm with increasing concentration of Oligo extract from 2 to 4 % either alone or with silicon treatments. Also, adding Silicon at 0.5% to Oligo-x at 2% or 4% was performance better than Eprosil-k (which contains 20% silicon) in respect to bunch weight and total yield per palm during the two seasons.

Table 1. Effect of Seaweed extracts and silicon spraying on bunch weight and total yield of “Zaghloul” date palm during 2014 and 2015 seasons

Treatments	Bunch weight (kg)		Total yield/palm (kg)	
	2014	2015	2014	2015
Control	16.25	16.18	111.40	114.73
Oligo-x at 2 %	17.50	17.43	132.00	133.67
Oligo-x at 4 %	20.65	21.65	149.73	150.58
Oligo-x at 2 %+ Silicon at 0.5 %	19.50	20.10	155.00	161.51
Oligo-x at 4 %+ Silicon at 0.5 %	22.17	22.95	176.00	176.58
Eprosil-k at 4 %	18.25	18.61	144.00	145.00
L S D at 5 %	0.49	0.66	3.31	2.57

Fruit physical properties:

The results showed that a significant difference among treatments in most physical properties of fruit Table (2). There was a significantly increase in the fruit and pulp weight, fruit volum and fruit dimensions (height and diameter) compared with control when the palms treated with Seaweed extract at 2 or 4% either alone or with Silicon nutrient at 0.5 %. The highest values of such fruit properties were obtained from palms sprayed with Seaweed extract (Oligo-x at 4 %) with Silicon at 0.5 % (treatment 5) compared with the other treatments during the two experimental seasons, the percent of increase in fruit weight were about 42 and 41% during the two experimental seasons

respectively while it was about 47 and 46% on pulp weight compared with control, also percent of increase in fruit size was about 41% in the two experimental seasons compared with control the percent of increase in fruit heigh was about 9.6 and 9.7% compared with control while it was about 27 and 26% in fruit diameter during the two experimental seasons, respectively. In the other hand, seed weight and pulp thickness did not significantly affected by various experimental treatments during the two seasons. In other words, the increase in fruit weight by treatments could be mainly attributed to the increase in pulp weight without regard to the changes of seed weight.

Table 2. Effect of Seaweed extracts and silicon spraying on some fruit physical characteristics of Zaghloul date palm during 2014 and 2015 seasons.

Spraying treatments	Fruit weight (g)		Fruit volum (cm)		Pulp weight (g)		Fruit height (cm)		Fruit diameter (cm)		Seed weight (g)		Pulp thickness (cm)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	16.13	16.03	17.37	17.34	14.52	14.48	5.08	5.13	2.15	2.20	1.60	1.55	0.59	0.61
Oligo-x at 2 %	17.51	17.38	18.57	18.58	15.92	15.86	5.21	5.28	2.55	2.60	1.58	1.52	0.63	0.63
Oligo-x at 4 %	18.58	18.18	19.87	19.87	17.03	16.61	5.37	5.41	2.65	2.69	1.55	1.57	0.61	0.61
Oligo-x at 2%+Si at 0.5%	21.75	21.89	24.44	24.44	20.19	20.32	5.40	5.45	2.62	2.67	1.56	1.57	0.65	0.65
Oligo-x at 4%+Si at 0.5%	22.95	22.68	24.48	24.48	21.35	21.12	5.57	5.63	2.72	2.78	1.60	1.56	0.66	0.66
Eprosil-k at 4 %	18.30	18.38	19.61	19.61	16.76	16.79	5.28	5.24	2.58	2.65	1.54	1.59	0.63	0.63
LSD at 5 %	0.71	0.80	1.00	0.99	0.85	0.77	0.06	0.04	0.04	0.05	N S	N S	N S	N S

Fruit chemical properties:

Data tabulated in Table (3) showed the effect of spraying by two of Seaweed extracts (Eprosil-k) and (Oligo-x either alone or with Silicon nutrient) three times on fruit content of total soluble solids (T S S), sugar contents (total, reducing and non reducing) and acidity of Zaghloul date cultivar. It has been evidenced that spraying palms three times with Seaweed extracts either alone or with silicon resulted in significant increase in T S S and sugar content (total and reducing) compared with control, which gave the lowest values in such chemical properties during the two experimental seasons. Spraying Oligo-x Seaweed extract three times at 4 % with silicon nutrient at 0.5 % (treatment 5) gave the highest values of T S S, total and reducing sugars compared with the other treatments.

The promotion on fruit quality was associated with increasing concentration of Oligo-x extract from 2 to 4% when it used either alone or with silicon, also a significantly increase in TSS and reducing as well as total sugars obtained under Oligo-x at 4% with Silicon at 0.5 % treatment compared with Eprosil-k at 4% treatment was noticed.

Furthermore, according to non-reducing sugars data presented in Table (3) showed that the differences between treatments were significantly during the two seasons. Spraying Oligo Seaweed extract at 2% three times gave the highest non reducing sugars values (6.62 and 6.39%) compared with the other experimental treatments during the two experimental seasons, respectively. While, the lowest values was obtained by

sprayed palms with Eprosil-k (Seaweed extract) at 4 % three times (4.02 and 4.32 %).

In regard to total acidity of fruits, the results in Table (3) showed that there are no significant differences in total acidity between different treatments including the control. This was true in both seasons.

The previous positive action of Seaweed extract on growth characters and fruiting of fruit crops might be attributed to its higher content of organic matter, proteins, alginic acid, N, P, K, Mg, Ca, S, Fe, Mn, Zn, Cu, B, cytokinins and IAA. In addition, it's content of enzymes, vitamins, antioxidants and amino acids. These are responsible for enhancing cell division, photosynthesis, and building of plant pigments and increasing the tolerance of plant to all stresses (James, 1994; Soliman *et al.*, 2000 and Khan *et al.* (2009)). These results regarding the enhancing effect of seaweed extract on the yield and fruit quality could be supported by previous results demonstrated by Abdelaal *et al.* (2012), Mahmud (2012), Gamal (2013), Abd El-Aaty (2015) and Farouk *et al* (2015) who found that treating Al-Saidey palms three times with seaweed extract and/or potassium silicate each at 0.05-0.4% was very effective in improving yield and fruit quality over the check treatment. The promotion was materially associated with increasing concentrations. Meaningless promotion on these characters was observed with increasing concentrations of both materials from 0.2 to 0.4%. The best results with regard to yield and fruit quality of Al-Saidey date palms grown under New Valley conditions were obtained

due to spraying the palms three times with a mixture of seaweed extract and potassium silicate each at 0.2%. Also Malaka *et al* (2016) indicated that spraying inflorescences date palm with algae extract and/or potassium nitrate had a significant effect on yield, fruit physical and chemical characteristics of Medjool date palm when compared to the check treatment. The effective was in proportional to the increase in concentrations of both materials. The superior treatment concerning yield and fruit quality was spraying Medjool date palms two times with high doses of combined treatment (1% algae extract + 2% potassium nitrate) in the two experimental seasons.

The current findings regarding the promoting effect of silicon on growth and fruiting of fruit crops are in harmony with those obtained by Gad El-Kareem (2012), Al-Wasfy (2014), El-Khawaga (2014), El-Khawaga and Mansour 2014, Gad El-Kareem *et al.* (2014), Eshmawy 2015, Abd El-Wahab (2015) and Badran *et al* (2015) who found that Spraying “Zaghloul” and “Samany” date palm inflorescences grown in new reclaimed soil under Assuit conditions with different sources of potassium silicate at different concentrations had a positive effect on fruit set, yield and fruit quality.

Table 3. Effect of seaweed extracts and Silicon spraying on some fruit chemical propertis of “Zaghloul” dates during 2014 and 2015 seasons

Treatments	T S S %		Total sugar%		Reducing sugars %		Non-reducing sugars%		Acidity	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	21.80	2.13	20.13	20.32	15.22	15.88	4.92	4.44	0.22	0.21
Oligo at 2 %	24.00	24.44	23.55	23.72	16.93	17.33	6.62	6.39	0.20	0.21
Oligo at 4 %	28.07	28.36	24.47	24.42	19.12	19.20	5.35	5.22	0.19	0.20
Oligo at 2 %+ Si at 0.5%	24.33	24.60	22.43	22.53	19.23	19.57	3.20	2.97	0.19	0.19
Oligo at 4 %+ Si at 0.5%	28.20	28.57	26.63	26.11	20.26	20.40	6.37	5.71	0.18	0.19
Eprosil k at 4 %	24.13	24.80	21.86	22.24	17.77	17.91	4.09	4.32	0.21	0.21
L S D at 5 %	1.43	1.17	0.74	0.97	0.70	0.60	0.80	0.83	N S	N S

Conclusion

From the results presented in this study, we can concluded that spraying Zaghloul date palms grown under new reclaimed sandy soil conditions three times (at first of April, May and June) with Oligo-x seaweed extract at 4% with Silicon at 0.5 % was the promising treatment, since it improved yield. Also, it increased height, diameter of fruit, fruit weight, pulp weight and total soluble solids as well as sugars content (reducing and total). This proved that used of seaweed extracts in agricultural practices had economic impact.

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تأثير الرش بمستخلصات الاعشاب البحرية والسليكون علي محصول وخصائص ثمار نخيل البلح الزغلول المزروع تحت ظروف الاراضى الرملية

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الملخص

اجريت هذه الدراسة على اشجار نخيل البلح الزغلول المنزرعة باراضى حديثة الاستصلاح بمنطقة اسيوط الجديدة بمحافظة اسيوط وكان عمر الاشجار فى بداية التجربة ثمانية عشر عاما وذلك لدراسة تأثير استخدام رش مركبين للاعشاب البحرية (مركب ايبوسيل ومركب اوليجو مع او بدون عنصر السليكون بتركيز ٠,٥% وكانت المعاملات التجريبية كالاتى:

١- كونترول (رش الماء فقط)

٢- رش المركب اوليجو بتركيز ٢% بدون السليكون

٣- رش المركب اوليجو بتركيز ٤% بدون السليكون

٤- رش المركب اوليجو بتركيز ٢% مع السليكون

٥- رش المركب اوليجو بتركيز ٤% مع السليكون

٦- رش المركب ايبوسيل بتركيز ٤%

وقد تم الرش ثلاث مرات متتالية فى بداية كلا من ابريل مايو ويونيه عند الوصول الى مرحلة اكتمال التلوين (لون احمر) تم جمع المحصول كما تم تقدير وزن السباطة وايضا المحصول الكلى للنخلة (المكررة).

تم اخذ عينة مكونة من ١٠٠ ثمرة بطريقة عشوائية من كل مكررة وذلك لتقدير بعض الصفات الطبيعية والكيميائية.
اولا الصفات الطبيعية:

وزن وحجم الثمرة ووزن اللحم وابعاد الثمرة (الطول والقطر) وكذلك وزن البذرة كما تم تقدير سمك اللحم.

ثانيا الصفات الكيميائية:

نسبة المواد الصلبة الذائبة الكلية والمحتوى من السكريات المختزلة والكلية والغير مختزلة بجانب حموضة الثمرة.

وكان تصميم التجربة قطاعات كاملة العشوائية وتم مقارنة متوسط المعاملات باستخدام اقل فرق معنوى.

وكانت ابرز النتائج كما يلى :

١- وزن السباطة والمحصول الكلى

ادت معاملات الرش بالمستخلصات البحرية مع او بدون السليكون الى زيادة معنوية لوزن السباطة وايضا المحصول الكلى وذلك مقارنة بالكونترول كما سجلت معاملة الرش بمركب اوليجو ثلاث رشات بتركيز ٤% مع السليكون بتركيز ٠,٥% اعلى القيم خلال الموسمين الدراسيين وكانت هذه الزيادة بفروق معنوية مقارنة بباقي المعاملات.

اوضحت النتائج ايضا تفوق معاملات المركب اوليجو عند رشه مع السليكون عن المركب ايبوسيل.

٢- الصفات الطبيعية:

ادى الرش بمركبى المستخلصات البحرية ايبوسيل واوليجو مع السليكون او بدونه الى زيادة معنوية فى صفات وزن وحجم الثمرة ووزن اللحم وابعاد (الطول والقطر) الثمرة مقارنة بالكونترول وسجلت اعلى القيم لكل الصفات السابقة عند الرش بالمركب اوليجو ثلاث رشات.

بتركيز ٤% مع السليكون كما لوحظ وجود فروق معنوية بين المعاملات البحثية فى اغلب الاحوال

كما لوحظ ايضا ان معاملات الرش بالمستخلصات البحرية مع السليكون او بدونه لم يكن لها تاثير معنوي على سمك اللحم ووزن البذرة.
٣- الصفات الكيميائية

ادت معاملات الرش بالمستخلصات البحرية مع او بدون السليكون الى زيادة معنوية فى صفات نسبة المواد الصلبة الذائبة وكذلك المحتوى من السكريات الكلية والمختزلة مقارنة بالكنترول وسجلت اعلى القيم للصفات السابقة مع معاملة الرش بمركب اوليجو ثلاث رشات بتركيز ٤% مع السليكون كما لوحظ ان الفروق بين المعاملات كانت معنوية فى اغلب الاحوال لوحظ ايضا التاثير المعنوي للمعاملات البحثية على صفة نسبة السكريات الغير مختزلة حيث سجلت معاملة الرش بمركب اوليجو ثلاث رشات بتركيز ٢% اعلى القيم بينما سجلت معاملة الرش بمركب ابيروسيل ثلاث رشات بتركيز ٤% اقل قيم للسكريات الغير مختزلة وذلك خلال الموسمين الدراسيين

اخيرا اوصت الدراسة تحت ظروف التجربة والظروف المماثلة يمكن التوصية باستخدام الرش بمستخلصات الطحالب مع السليكون او بدونه ثلاث رشات (اول ابريل مايو ويونية) حيث ادى ذلك الى زيادة ملحوظة فى المحصول وتحسين صفات الجودة لثمار نخيل البلح الزغلول المنزرع باراضى حديثة الاستصلاح كما اوصت الدراسة برش مركب اوليجو بتركيز ٤% مضافا اليه السليكون بتركيز ٠,٥% حيث اعطت هذه المعاملة افضل النتائج.