Response of Bartemoda Date Palms to Spraying Silicon and Vitamin E

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Abstract: During 2016 and 2017 seasons, Bartemuda date palms grown under Aswan conditions were treated with vitamin E at 10 to 40 ppm and/or potassium silicate at 0.025 to 0.1%. The palms received four sprays at the last week of March, April, May and June. Single and combined applications of vitamins E each at 10 to 40 ppm and potassium silicate at 0.025 to 0.1% was very effective in improving vegetative growth aspects, palm nutritional status, yield and fruit quality relative to the control. The promotion was associated with increasing concentrations of both materials. Using potassium silicate was superior than vitamin E in this respect. The best results with regard to yield and fruit quality were obtained due to treating the palms four times (March, April, May and June) with a mixture of vitamin E at 20 ppm and potassium silicate at 0.05%.
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1. Introduction

The decline on the yield and the inferior in fruit quality of Bartemuda date palms is considered the main problem facing date palm growers under Aswan region. This is attributed to the unfavourable effects of biotic and abiotic stresses. From these events, the idea of using silicon and vitamins are responsible for enhancing the tolerance of fruit crops to various stresses **(Buchala and Schmid, 1997 and Ma, 2004)**.

Using vitamins **(Hegab and Hegab, 2011; Masoud and El- Sehrawy, 2012; Mekawy, 2012; Al-Wasfy, 2013; Farag, 2013; Ibrahim *et al.,* 2013; Abd El- Latief, 2014; Abdelaal *et al.*, 2014; Hassan-Huda, 2014; Omar, 2015 and Osman-Samah, 2015)** and silicon (**Ahmed *et al.,* 2013a; Ahmed *et al.,* 2013b; Abdelaal and Oraby- Mona, 2013; Al- Wasfy, 2014; El Khawaga and Mansour, 2014; Gad El-Kareem *et al.,* 2014; Ibrahim and Al- Wasfy, 2014; Mohamed *et al.,* 2015**; **Omar, 2015; Mohamed, 2016 and Youssef, 2016)** was very effective in improving growth, palm nutritional status, yield and fruit quality of fruit crops.

The objective of the study was examining the effect of spraying silicon and Vitamin E on some vegetative growth aspects, leaf chemical composition, yield as well as some physical and chemical characteristic of the fruits of Bartemuda date palms.

2. Material and Methods

This study was conducted during 2016 and 2017 seasons in a private date palm orchard situated at El-Khatara Village, Edfo district, Aswan Governorate on 20-years old offshoots Bartemuda date palms. They planted at 7 x 7 meters apart (86 palms per fed.). The selected palms were irrigated with Nile water through surface irrigation system. The texture of the soil is silty clay.

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Hand pollution of all the selected palms was achieved by inserting five fresh male strands into the center of one female spathe using the same source of pollens to avoid residues of metaxenia (according to **Saad, 2008**). The pollen grains viability was tested before carrying out pollination with acetocarmine staining. One drop of 1.0% acetocarmine was dispersed. Pollens were microscopically examined. Colorless or unstained pollen grains were considered nonviable according to **Moreria and Gurgel (1944)**. Pollination was carried out throughout two days after female spathes cracking at the day time of afternoon according to **Omar (2007)** to prevent contamination of the investigated pollens. Every bunch was bagged after pollination by white paper bags which were tied at the ends using a piece of cotton for aeration. The bags were shaken tightly to ensure pollens distribution and they were removed after one month (**Musa, 1981**). Number of bunches per palm was adjusted to ten bunches and leaf bunch ratio was maintained at 8:1 (**Diab, 2006**).

Physical and chemical properties of the experimental soil at 0.0- 90 cm depth are presented in Table (1) according to the procedure of **Black (1965) and Cottenie *et al.*, (1982)**.

All the selected Bartemuda date palm cv received a program of fertilization consists of 25kg F.Y.M., 3.0 kg ammonium nitrate (33.5 % N), 1.5 kg triple calcium superphosphate (37.5 % P2O5) and 1.5 kg potassium sulphate (48 % K2O) per each palm. Farmyard manure was applied at the middle of Jan. and ammonium nitrate was divided into three equal batches and added on the first week of Mar., June and August. Phosphate fertilizer was splitted into two equal batches, the first was added at the middle of January and the second one was applied just after fruit setting (last week of April). Potassium sulphate was applied twice before pollination (last week of Feb.) and just after fruit setting (last week of April). Other horticultural practices such as irrigation, pruning, hoeing and pest management were carried out as usual.

Table (1): Analysis of the tested soil

Characters	Values
Practical size distribution	
Sand %	**7.5**
Silt %	**61.0**
Clay %	**31.5**
Texture	**Silty clay**
pH (1: 2.5 extract)	**8.80**
E.C. (1: 2.5 extract) mmhos / 1 cm / 25°C	**0.75**
Organic matter %	**2.25**
Total $CaCO_3$	**1.95**
Available macronutrients (ppm)	
N	**80.0**
P	**6.0**
K	**420.0**
Ca	**71.0**
Mg	**5.0**
DPTA extractable available micronutrients (ppm)	
Zn	**5.2**
Fe	**6.1**
Mn	**4.2**
Cu	**0.6**

This experiment included the following ten vitamin E and potassium silicate treatments:

1- Control (sprayed with Nile water)

2- Spraying the palms with vitamin E at 10 ppm.

3- Spraying the palms with vitamin E at 20 ppm.

4- Spraying the palms with vitamin E at 40 ppm.

5- Spraying the palms with potassium silicate at 0.025%.

6- Spraying the palms with potassium silicate at 0.05%.

7- Spraying the palms with potassium silicate at 0.1%.

8- Spraying the palms with both at low concentration.

9- Spraying the palms with both at medium concentration.

10- Spraying the palms with both at high concentration.

Each treatment was replicated three times, one palm per each. Therefore, thirty similar in vigour palms were selected for achieving of this study. Potassium silicate liquid (25% + 10% K_2O) was easily soluble in water. Vitamin E was solubilized in few drops of Ethyl alcohol before application. Potassium silicate and vitamin E were sprayed four times during both seasons at the last week of March, April, May and June. Both potassium silicate and vitamin E solutions were subjected to triton B as a wetting agent at 0.1 % before spraying. The palms were sprayed till runoff (20 L vitamin solutions/ palm. The control treatment was sprayed with Nile water containing Triton B.

During both seasons, the following measurements were recorded:

1- Vegetative growth traits namely length & width (cm.) and area of leaflet (cm^2) (**Ahmed and Morsy, 1999**); length and area of leaf, number of leaflets/ leaf percentage of area of rachis that occupied by leaflets in the leaf %, total surface area (cm^2) per palm, number of spines / leaf and spine length (cm.)

2- Leaf chemical components namely Chlorophylls a & b, total chlorophylls, total carotenoids (as mg/ 1g F.W.), total carbohydrates (**Von- Wettstein, 1957, Hiscox and Isralsta, 1979**) and percentages of N, P, K, Mg and Ca in the leaves (**Chapman and Pratt, 1961; Evenhuis and Dewaard, 1980 and Summer, 1985**).

3- Flowering and fruit setting characters namely girth and length of spathe, number of strands/ spathe, number of flowers and fruits/ strand and percentages of initial fruit setting and fruit retention.

4- Harvesting date (according to **Dammas, 1998**).

5- Yield (kg.) per palm and bunch weight (kg.)

6- Physical and chemical characteristics of the fruits namely weight, height and diameter of fruit, flesh thickness, percentages of seeds and flesh, seed length, edible to non- edible portions, percentages of T.S.S., total, reducing and non- reducing sugars **(Lane and Eynon, 1965)**, total acidity, total crude

fibre % and total soluble tannins (**Balbaa, 1981 and A.O.A.C., 2000**).

All the obtained data during the course of this study were collected, tabulated and statistically analyzed. The differences between treatment means were compared using new L.S.D. at 5% test according to **Gomez and Gomez (1984) and Mead et *al.*, (1993)**.

3. Results and Discussion

1-Vgetatiev growth aspects:

It is clear from the obtained data in Tables **(2 & 3)** that single and combined applications of vitamin E at 10 to 40 ppm and K-silicate at 0.025 to 0.1% had significant stimulation on the ten growth aspects namely length, width and area of leaflet, leaf length and area, number of leaflets/leaf, percentages of leaf length of rachis occupied by leaflet, total surface area /palm, number of spines/ leaf and spine length comparing to the check treatment. The promotion on these growth traits was associated with increasing concentrations of vitamin E from 10 to 40 ppm and K-silicate from 0.025 to 0.1%. Increasing concentrations of vitamin E from 20 to 40 ppm and K-silicate from 0.05 to 0.1% had no significant promotion on these growth aspects. Using

K- silicate at 0.025 to 0.1% was significantly favourable than using vitamin E at 10 to 40 ppm in enhancing these growth traits. Combined application of vitamins E and K-silicate significantly was superior than using each material alone in stimulating growth attributes. The maximum values were recorded on the palms that treated with vitamin E and K-silicate together at the high concentration (40 ppm for vitamin E and 0.1% for K-silicate). The untreated palms produced the lowest values. These results were true during both seasons.

2-Leaf chemical composition:

It is evident from the data in Tables **(4 & 5)** that single and combined applications of vitamin E at 10 to 40 ppm and K-silicate at 0.025 to 0.1% significantly enhanced chlorophylls a & b, total chlorophylls, total carotenoids, total carbohydrates %, N, P, K, Mg and Ca in the leaves relative to the control. There was a gradual promotion on these chemical components with increasing concentrations of vitamin E and K-silicate. Meaningless promotion on these chemical components was recorded among the higher two concentrations of vitamin E (20 & 40 ppm) and K-silicate (0.05 & 0.1%). Using K-silicate at 0.025 to 0.1 was significantly favourable than using vitamin E in this respect. Combined applications were superior than using each material alone in this connection. The highest values were recorded on the palms that received four sprays of a mixture of vitamin E at 40 ppm and K- silicate at 0.1%. The lowest values were recorded on untreated palms. Similar results were announced during both seasons.

3- Flowering and fruit setting aspects

Treating Bartamuda date palms four times with vitamin E at 10 to 40 ppm and /or K- silicate at 0.025 to 0.1% had significant promotion on the seven flowering and fruit setting aspects (girth and length of spathe, number of strands per spathe, number of flowers and fruits per strand and percentages of initial fruit setting and fruit retention) relative to the control as shown in Tables **(6 & 7)**. Using K-silicate was considerably preferable than using vitamin E in enhancing these parameters. Using both materials together was significantly preferable than using each alone in this respect. There was a progressive stimulation on these parameters with increasing concentrations of vitamin E and K-silicate. No significant promotion on these flowering and fruit setting aspects was recorded among the highest two concentrations of each material. The maximum values were recorded on the palms that treated with vitamin E at 40 ppm plus K- silicate at 0.1%, but from economical point view, it is advised to use the medium concentration of each material. The lowest values were recorded on untreated palms. These results were true during both seasons.

4- Harvesting date:

Treating the palms four times with vitamin E at 10 to 40 ppm and /or K- silicate at 0.025 to 0.1% materially advanced harvesting date relative to the control. Increasing concentrations of vitamin E and K- silicate had an obvious enhancement on harvesting date **(Table 7)**. The advancement on harvesting date was slight when concentrations of each material were increased from medium to high. An obvious advancement on harvesting date was occurred on the palms that treated with K-silicate than those treated with vitamin E. Using both materials together had considerable promotion on harvesting date than using each material alone. Harvesting date was 14 September in the palms treated with vitamin E at 20 ppm and K-silicate at 0.05%. The untreated palms harvested on 10 & 11 October during both seasons, respectively. These results were true during both seasons.

5- Yield/ palm and bunch weight

It is clear from the obtained data in Table **(7)** that using vitamin E at 10 to 40 ppm and /or K-silicate at 0.025 to 0.1% resulted in significant promotion on the yield/ palm and bunch weight relative to the control. The promotion on yield/palm and bunch weight was in proportional to the increase in concentrations of vitamin E and K- silicate. Increasing concentrations of vitamin E from 20 to 40 ppm and K-silicate from 0.05 to 0.1% failed to show

significant promotion on the yield/palm and bunch weight. Using K-silicate at 0.025 to 0.1% was significantly favourable than using vitamin E in improving yield/palm and bunch weight. Combined applications were significantly preferable than using each material alone. From economical point of view, using both vitamin E at 20 ppm plus K-silicate at 0.05 gave the best results (since no significant promotion was detected among the higher two concentrations of each material). Under such promised treatment, yield per palm reached **217 & 228 Kg** during both seasons, respectively. Yield of the untreated palm reached **88.0 & 85.7 Kg** during 2016 and 2017 seasons, respectively. Similar results were announced during both seasons.

6- Fruit quality

It is noticed from the obtained data in Tables **(8 to 10)** that subjecting the palms four times to vitamin E at 10 to 40 ppm and/or K-silicate at 0.025 to 0.1% significantly was very effective in improving fruit quality in terms of increasing weight, height and diameter of fruit, flesh thickness, percentage of flesh, edible to non- edible portions, percentages of T.S.S., total and non – reducing sugars (sucrose) and decreasing seed length, seed %, total acidity %, total crude fibre % and total soluble tannins relative to the control treatment. The promotion on fruit quality was in proportional to the increase in concentrations of vitamin E and K-silicate. Using K-silicate was significantly favourable in enhancing fruit quality than using vitamin E. Combined applications significantly surpassed the application of each material alone in enhancing fruit quality. No significant promotion was recorded on fruit quality among the higher two concentrations of each material. Therefore, from economical point of view, it is recommended to use a mixture of Vitamin E at 20 ppm and K-silicate at 0.05% for improving quality of the fruits. Unfavourable effects on fruit quality were recorded on untreated palms. These results were true during both seasons. Reducing sugars was unaffected.

Table (2): Effect of single and combined applications of some vitamin E and potassium silicate on some vegetative growth characteristics of Bartamuda date palms during 2016 and 2017 seasons.

Treatments	Leaflet length (cm.)		Leaflet width (cm.)		Leaflet area (cm^2)		No. of leaflets / leaf		Leaf area (m^2)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
1-Control	37.0	36.9	2.71	2.80	47.4	48.5	150.0	149.0	0.71	0.72
2- Vitamin E at 10 ppm	38.1	38.0	2.80	2.89	49.8	50.9	153.0	154.0	0.76	0.78
3- Vitamin E at 20 ppm	39.4	39.5	2.90	2.95	52.2	53.4	157.0	158.0	0.82	0.84
4- Vitamin E at 40 ppm	39.7	39.6	2.91	3.00	53.0	54.2	158.0	159.0	0.84	0.86
5- Potassium silicate at 0.025%	40.7	40.9	3.07	3.17	56.5	58.3	160.0	161.0	0.90	0.94
6- Potassium silicate at 0.05%	41.8	41.9	3.17	3.27	59.3	61.0	162.0	163.0	0.96	0.99
7- Potassium silicate at 0.1%	42.0	42.0	3.18	3.28	59.7	61.3	163.0	164.0	0.97	1.01
8- Both at low concentration	43.1	43.9	3.29	3.39	62.8	65.4	166.0	169.0	1.04	1.11
9- Both at medium concentration	44.2	44.9	3.40	3.50	65.9	68.4	169.0	173.0	1.11	1.18
10- Both at high concentration	44.6	45.0	3.41	3.51	66.6	68.7	170.0	174.0	1.13	1.20
New L.S.D. at 5%	**1.0**	**0.9**	**0.07**	**0.06**	**0.9**	**1.0**	**2.0**	**2.0**	**0.04**	**0.05**

Table (3): Effect of single and combined applications of some vitamin E and potassium silicate on some vegetative growth characteristics of Bartamuda date palms during 2016 and 2017 seasons.

Treatments	Leaf length (cm.)		Length of rachis occupied by leaflet in leaf %		Total surface area / palm (m^2)		No. of spines / leaf		Spine length (cm)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
1-Control	3.01	3.11	71.0	71.3	71.0	72.0	18.0	17.0	9.00	9.20
2- Vitamin E at 10 ppm	3.11	3.21	71.5	71.8	76.0	78.0	19.0	20.0	9.10	9.30
3- Vitamin E at 20 ppm	3.22	3.32	72.0	72.3	82.0	84.0	20.0	21.0	9.22	9.52
4- Vitamin E at 40 ppm	3.23	3.33	72.2	72.4	84.0	86.0	20.0	21.0	9.23	9.53
5- Potassium silicate at 0.025%	3.41	3.51	73.0	73.4	90.0	94.0	22.0	23.0	9.51	9.71
6- Potassium silicate at 0.05%	3.53	3.63	73.6	74.0	96.0	99.0	24.0	25.0	9.91	10.01
7- Potassium silicate at 0.1%	3.55	3.65	73.7	74.1	97.0	101.0	24.0	25.0	9.92	10.03
8- Both at low concentration	3.75	3.85	74.8	74.6	104.0	111.0	26.0	27.0	10.19	10.40
9- Both at medium concentration	3.94	4.04	75.7	75.2	111.0	118.0	28.0	29.0	10.43	10.55
10- Both at high concentration	3.96	4.06	75.5	75.3	113.0	120.0	28.0	29.0	10.45	10.56
New L.S.D. at 5%	**0.09**	**0.10**	**0.3**	**0.4**	**3.3**	**3.0**	**1.0**	**1.0**	**0.09**	**0.08**

Table (4): Effect of single and combined applications of some vitamin E and potassium silicate on plant pigments (mg/1g F.W) and leaf total carbohydrates% of Bartamuda date palms during 2016 and 2017 seasons.

Treatments	Chlorophyll a (mg/ 1g F.W.)		Chlorophyll b (mg/ 1g F.W.)		Total chlorophylls (mg/ 1g F.W.)		Total carotenoids (mg/ 1g F.W.)		Total carbohydrates %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
1-Control	3.1	3.3	0.9	1.0	4.0	4.3	1.1	1.1	13.9	14.0
2- Vitamin E at 10 ppm	3.6	3.8	1.2	1.3	4.8	5.1	1.4	1.4	14.5	14.6
3- Vitamin E at 20 ppm	4.2	4.4	1.6	1.7	5.8	6.1	1.7	1.8	15.2	15.3
4- Vitamin E at 40 ppm	4.3	4.5	1.7	1.8	6.0	6.3	1.8	1.8	15.3	15.4
5- Potassium silicate at 0.025%	5.0	5.2	2.2	2.3	7.2	7.5	2.1	2.2	16.0	16.1
6- Potassium silicate at 0.05%	5.5	5.7	2.7	2.8	8.2	8.5	2.4	2.6	16.7	16.8
7- Potassium silicate at 0.1%	5.6	5.8	2.8	2.9	8.4	8.7	2.5	2.7	16.8	16.9
8- Both at low concentration	6.3	6.5	3.2	3.3	9.5	9.8	2.9	3.1	17.6	17.7
9- Both at medium concentration	7.0	7.2	3.5	3.7	10.5	10.9	3.4	3.4	18.2	18.3
10- Both at high concentration	7.1	7.3	3.6	3.8	10.7	11.1	3.5	3.5	18.3	18.4
New L.S.D. at 5%	**0.3**	**0.5**	**0.2**	**0.3**	**0.4**	**0.5**	**0.2**	**0.3**	**0.6**	**0.7**

Table (5): Effect of single and combined applications of some vitamin E and potassium silicate on the percentages of N, P, K, Mg and Ca in the leaves (on dry weight basis) of Bartamuda date palms during 2016 and 2017 seasons.

Treatments	Leaf N %		Leaf P %		Leaf K %		Leaf Mg %		Leaf Ca %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
1-Control	1.64	1.66	0.160	0.159	1.11	1.14	0.54	0.52	1.99	2.01
2- Vitamin E at 10 ppm	1.71	1.73	0.180	0.179	1.17	1.20	0.59	0.61	2.09	2.11
3- Vitamin E at 20 ppm	1.80	1.83	0.202	0.199	1.29	1.32	0.66	0.68	2.22	2.20
4- Vitamin E at 40 ppm	1.81	1.84	0.204	0.201	1.30	1.33	0.67	0.69	2.23	2.21
5- Potassium silicate at 0.025%	1.94	1.95	0.231	0.229	1.36	1.40	0.73	0.75	2.41	2.32
6- Potassium silicate at 0.05%	2.04	2.04	0.254	0.255	1.42	1.47	0.77	0.79	2.52	2.42
7- Potassium silicate at 0.1%	2.05	2.05	0.255	0.256	1.43	1.48	0.78	0.80	2.53	2.43
8- Both at low concentration	2.11	2.14	0.290	0.291	1.51	1.55	0.83	0.85	2.66	2.60
9- Both at medium concentration	2.20	2.22	0.313	0.314	1.56	1.61	0.88	0.91	2.76	2.71
10- Both at high concentration	2.21	2.23	0.314	0.316	1.57	1.62	0.89	0.92	2.77	2.72
New L.S.D. at 5%	**0.05**	**0.06**	**0.020**	**0.019**	**0.04**	**0.05**	**0.08**	**0.06**	**0.10**	**0.09**

Table (6): Effect of single and combined applications of some vitamin E and potassium silicate on behaviour of flowering of Bartamuda date palms during 2016 and 2017 seasons.

Treatments	Spathe girth (cm.)		Spathe length (cm.)		No. of strands/ spathe		No. of flowers/ strand		No. of retained fruits / strand	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
1-Control	18.0	18.5	44.0	43.9	70.0	71.0	36.0	35.0	10.1	9.8
2- Vitamin E at 10 ppm	18.6	19.1	44.6	45.0	72.0	73.0	38.0	38.0	10.9	11.0
3- Vitamin E at 20 ppm	19.3	19.9	45.2	45.6	75.0	76.0	40.0	41.0	11.8	12.2
4- Vitamin E at 40 ppm	19.4	20.0	45.3	45.8	75.0	76.0	41.0	41.0	12.3	12.3
5- Potassium silicate at 0.025%	20.7	21.2	45.8	46.3	78.0	80.0	43.0	44.0	13.3	13.7
6- Potassium silicate at 0.05%	21.9	22.4	46.8	47.0	81.0	83.0	46.0	47.0	14.6	15.0
7- Potassium silicate at 0.1%	22.0	22.5	47.0	47.1	82.0	84.0	46.0	48.0	14.7	15.4
8- Both at low concentration	22.7	23.2	48.0	48.4	86.0	87.0	49.0	50.0	16.2	16.8
9- Both at medium concentration	23.5	24.1	49.0	49.5	88.0	89.0	51.0	52.0	17.3	18.0
10- Both at high concentration	23.6	24.2	49.3	49.6	89.0	90.0	52.0	52.0	17.8	18.0
New L.S.D. at 5%	**0.5**	**0.6**	**0.4**	**0.5**	**2.0**	**2.0**	**2.0**	**2.0**	**1.0**	**1.0**

Table (7): Effect of single and combined applications of some vitamin E and potassium silicate on percentages of initial fruit setting and fruit retention, harvesting date, bunch weight and yield/palm of Bartamuda date palms during 2016 and 2017 seasons.

Treatments	Initial fruit setting %		Fruit retention %		Harvesting date		Bunch weight (kg.)		Yield/ palm (kg.)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
1-Control	46.0	45.9	28.0	27.9	10 Oct.	11 Oct.	8.80	8.57	88.0	85.7
2- Vitamin E at 10 ppm	47.0	47.3	28.8	28.9	6 Oct.	6 Oct.	9.92	10.06	99.2	100.6
3- Vitamin E at 20 ppm	48.5	48.8	29.6	29.7	10 Oct.	10 Oct.	11.5	11.8	115.0	118.0
4- Vitamin E at 40 ppm	48.6	48.9	30.0	30.0	30 Sept.	30 Sept.	12.0	12.0	120.0	120.0
5- Potassium silicate at 0.025%	50.9	51.2	31.0	31.1	25 Sept.	24 Sept.	13.8	14.3	138.0	143.0
6- Potassium silicate at 0.05%	52.9	53.2	31.8	31.9	20 Sept.	20 Sept.	16.1	16.7	161.0	167.0
7- Potassium silicate at 0.1%	53.0	53.3	32.0	32.0	19 Sept.	19 Sept.	16.5	17.4	165.0	174.0
8- Both at low concentration	54.9	55.2	33.0	33.5	16 Sept.	16 Sept.	19.6	20.4	196.0	204.0
9- Both at medium concentration	56.9	57.3	34.0	34.6	14 Sept.	14 Sept.	21.7	22.8	217.0	228.0
10- Both at high concentration	57.0	57.4	34.3	34.7	14 Sept.	14 Sept.	22.7	23.2	227.0	232.0
New L.S.D. at 5%	**1.0**	**1.0**	**0.8**	**0.7**	-----	---	**1.1**	**1.0**	**10.6**	**8.4**

Table (8): Effect of single and combined applications of some vitamin E and potassium silicate on some physical characteristics of the fruits of Bartamuda date palms during 2016 and 2017 seasons.

Treatments	Fruit weight (g.)		Fruit height (cm.)		Fruit diameter (cm.)		Flesh thickness (cm)		Seed length (cm)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
1-Control	11.7	11.6	4.40	4.39	1.95	1.94	0.38	0.37	2.50	2.49
2- Vitamin E at 10 ppm	12.0	11.9	4.49	4.50	2.01	2.00	0.41	0.40	2.47	2.45
3- Vitamin E at 20 ppm	12.4	12.2	4.60	4.59	2.08	2.09	0.43	0.43	2.44	2.41
4- Vitamin E at 40 ppm	12.5	12.3	4.61	4.61	2.10	2.11	0.44	0.44	2.43	2.40
5- Potassium silicate at 0.025%	12.8	12.6	4.74	4.75	2.17	2.18	0.47	0.47	2.37	2.35
6- Potassium silicate at 0.05%	13.2	13.0	4.86	4.87	2.22	2.23	0.50	0.51	2.30	2.28
7- Potassium silicate at 0.1%	13.3	13.1	4.88	4.89	2.23	2.24	0.51	0.51	2.28	2.29
8- Both at low concentration	13.7	13.6	5.02	5.03	2.41	2.44	0.54	0.55	2.20	2.18
9- Both at medium concentration	13.9	13.9	5.22	5.23	2.52	2.52	0.57	0.57	2.16	2.15
10- Both at high concentration	14.0	14.0	5.23	5.25	2.53	2.53	0.58	0.58	2.15	2.14
New L.S.D. at 5%	**0.3**	**0.3**	**0.07**	**0.06**	**0.04**	**0.05**	**0.02**	**0.02**	**0.02**	**0.02**

Table (9): Effect of single and combined applications of some vitamin E and potassium silicate on some physical and chemical characteristics of the fruits of Bartamuda date palms during 2016 and 2017 seasons.

Treatments	Fruit seed weight %		Flesh weight %		Edible / non edible portions		T.S.S. %		Total sugars %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
1-Control	13.0	12.9	87.0	87.1	6.7	6.8	70.0	69.9	64.0	64.7
2- Vitamin E at 10 ppm	12.5	12.4	87.5	87.6	7.0	7.1	70.5	70.7	64.6	65.3
3- Vitamin E at 20 ppm	12.0	11.9	88.0	88.1	7.3	7.4	71.2	71.4	65.3	66.0
4- Vitamin E at 40 ppm	11.9	11.8	88.1	88.2	7.4	7.5	71.3	71.5	65.4	66.1
5- Potassium silicate at 0.025%	11.4	11.3	88.6	88.7	7.8	7.8	72.0	72.1	66.5	67.2
6- Potassium silicate at 0.05%	11.0	10.9	89.0	89.1	8.1	8.2	72.7	73.0	67.0	67.7
7- Potassium silicate at 0.1%	10.9	10.9	89.1	89.1	8.9	8.2	72.9	73.1	67.3	68.0
8- Both at low concentration	10.4	10.4	89.6	89.6	8.6	8.6	74.0	74.0	68.0	68.7
9- Both at medium concentration	10.0	10.0	90.0	90.0	9.0	9.0	74.6	74.5	69.0	69.8
10- Both at high concentration	9.9	9.8	90.1	90.2	9.1	9.2	74.7	74.6	69.2	70.0
New L.S.D. at 5%	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**0.4**	**0.5**	**0.4**	**0.4**

Table (10): Effect of single and combined applications of some vitamin E and potassium silicate on some chemical characteristics of the fruits of Bartamuda date palms during 2016 and 2017 seasons.

Treatments	Non reducing sugars %		Reducing sugars %		Total acidity %		Crude fibre %		Soluble tannins %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
1-Control	50.0	50.3	14.0	14.4	0.230	0.231	1.51	1.52	0.75	0.76
2- Vitamin E at 10 ppm	50.6	51.0	14.1	14.3	0.215	0.216	1.41	1.42	0.70	0.71
3- Vitamin E at 20 ppm	51.2	51.6	14.1	14.4	0.200	0.201	1.31	1.31	0.65	0.66
4- Vitamin E at 40 ppm	51.3	51.7	14.1	14.4	0.199	0.200	1.30	1.30	0.64	0.65
5- Potassium silicate at 0.025%	52.0	52.4	14.5	14.8	0.184	0.185	1.20	1.19	0.60	0.59
6- Potassium silicate at 0.05%	52.9	53.3	14.1	14.4	0.169	0.170	1.10	1.09	0.57	0.55
7- Potassium silicate at 0.1%	53.0	53.4	14.3	14.6	0.168	0.169	1.09	1.07	0.56	0.54
8- Both at low concentration	54.5	54.9	13.5	13.8	0.150	0.149	0.94	0.91	0.50	0.49
9- Both at medium concentration	55.5	55.9	13.5	13.1	0.134	0.135	0.84	0.82	0.40	0.39
10- Both at high concentration	55.6	56.0	13.6	14.0	0.133	0.132	0.82	0.81	0.38	0.38
New L.S.D. at 5%	**0.5**	**0.4**	**NS**	**NS**	**0.014**	**0.013**	**0.06**	**0.08**	**0.03**	**0.02**

4. Discussion:

Previous studies showed that the favourable effects of silicon on growth, nutritional status of trees and fruiting seem to originate from its positive action on enhancing the tolerance of plants to biotic and abiotic stresses and drought tolerance. This is attributed to its essential role in maintaining plant water balance, photosynthetic activity, erecting the structure of xylem vessels. Previous studies explained these benefits to the formation of silica cuticle double layers formed on leaf epidermal tissue. Silicon also is responsible for water transport and root development as well as increasing the tolerance of plants to producing mildew. The mechanical strength provided by silicon to the plant tissues increases their resistance to diseases and insects and in responsible for reducing eth adverse effects of heavy metal toxicity (**Matoh *et al.*, 1991; Ma, 2004; and Tahir *et al.*, 2006**).

These results are in agreement with those obtained by Gad **El- Kareem (2012)** on Taimour mangoes, **Ahmed *et al.*, (2013b)** on Hindy Bisinnara mangoes, **Abdelaal and Oraby- Mona (2013)** on Ewaise mangoes trees, **Ahmed *et al.*, (2013a)** on

Zaghloul date palms, **Gad El- Kareem *et al.,* (2014)** on Zaghloul date palm, **Ibrahim and Al- Wasfy (2014)** on Valencia orange trees, **El Khawaga and Mansour (2014)** on Washington Navel orange trees, **Mohamed *et al.,* (2015)** on Succary mango trees, **Al- Wasfy (2014)** on Flame seedless grapes; **Mohamed (2015)** on Manfalouty pomegranate trees,

Nagy – Dina (2015) on Flame seedless grapevines, **Omar (2015)** on Al- Saidy date palms and **Mohamed (2016)** on Aggezie, Manzanello and Picual olives.

The previous positive action of vitamins on growth palm nutritional status, yield and fruit quality might be attributed to their great advantages in enhancing cell divisions, the biosynthesis of GA_3, IAA, cytokinins, plant pigments, amino acids, proteins, nutrient uptake and photosynthesis. (**Samiullah *et al.,* 1988**). The great benefits of vitamins on increasing the tolerance of plants to all stresses give another explanation (**Singh *et al.,* 2001**).

These results are in agreement with those obtained by **Hamad (2004); Gamal (2006); Hamad (2008); Eshmawy (2010); Hegab and Hgab (2011); Ibrahim *et al.,* (2013); Farage (2013); Al- Wasfy (2013) and Omar (2015).**

Conclusion:

The best results with regard to yield and fruit quality were obtained due to treating the palms four times (March, April, May and June) with a mixture of vitamin E at 20 ppm and potassium silicate at 0.05%.

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