

Improving Yield Quantitatively and Qualitatively of Zaghoul Date Palms by Using some Antioxidants

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Abstract: During 2011 and 2012 seasons, Zaghoul date palms were sprayed three times (at growth start, just after fruit setting and at one month late) with three antioxidants namely citric acid, ascorbic acid and amino acids (tryptophane, methionene and cysteine) each at 500 to 2000 ppm. The study focused on the effect of these antioxidants on growth and fruiting of the palms. Spraying the palms with any of these antioxidants three times at 500 to 2000 ppm considerably enhanced all growth characters, percentages of N, P, K, Mg and Ca, yield and fruit quality in relative to the check treatment. In ascending order, spraying citric acid, ascorbic acid and amino acids was accompanied with enhancing growth, nutritional status, yield and fruit quality. Meaningless promotion on these parameters was observed the higher two concentrations namely 1000 and 2000 from each antioxidant. The best results with regard to yield and fruit quality Zaghoul date palms were obtained with spraying amino acids three times at 1000 ppm.

[Ibrahim, H. I. M.; Ahmed, F. F.; Akl, A. M. M. A. and Rizk, M. N. S. **Improving Yield Quantitatively and Qualitatively of Zaghoul Date Palms by Using some Antioxidants**] *Stem Cell* 2013;4(2):35-40] (ISSN 1545-4570). <http://www.sciencepub.net>. 6

Key words: Zaghoul date palms, ascorbic acid, citric acid, amino acids, antioxidant, growth and productivity.

1. Introduction

Yield decline of Zaghoul date palms grown under middle Egypt conditions is considered to be a serious and major problem that faces date palm growers. Recently, it was suggested that vitamins as essential antioxidants participate in plant growth flowering and fruit development through their positive action on enhancing the biosynthesis of natural hormones, nutrient uptake, photosynthesis, biosynthesis of plant pigments and sugars and protecting the plant from biotic and abiotic stresses, since they increase antioxidant defense systems and reduce reactive oxygen species (Klesiig *et al.*, 2000 and Rao *et al.*, 2000). Therefore, the idea of using antioxidants for improving the yield of Zaghoul date palms was arised or borne.

Previous studies showed that using antioxidants in different fruit crops was very effective in improving growth and fruiting (Gamal, 2006; Mahfouz, 2007; Ahmed *et al.*, 2007; Hamad, 2008; Ali- Ragaa, 2008; Badran and Ahmed, 2009; Eshmawy, 2010; Roshdy *et al.*, 2011; Sayed *et al.*, 2011; Hegab and Hegab, 2011; Masoud and El- Sehrawy, 2012 and Al-Wasfy, 2013).

The target of this study was testing the influence of some antioxidants on growth, palm nutritional status, yield and fruit quality of Zaghoul date palms grown under Minia region conditions.

2. Material and Methods

This study was initiated during 2011 and 2012 seasons in a private date palm orchard situated at Dahmro village, Maghagha district, Minia Governorate on thirty 16- years old Zaghoul date palms (as soft

date palm cv.). These palms produced through conventional propagation by offshoots. The selected palms are uniform in vigour, healthy, good physical conditions, free from insects, diseases and damages. They are planted at 10 × 10 meters apart (42 palms/ feddan). The selected palms were irrigated with Nile water through surface irrigation system. The texture of soil is clay loam.

Hand pollination of all the selected palms was achieved by increasing ten fresh male strands into the center of one female spathae (according to El- Kosary and Soliman, 2003; El- Kosary, 2003 and Diab, 2006) using the same source of pollens (Zaghoul date palms males) to avoid residues of metaxenia (according to Saad, 2008).

Pollination was carried out throughout two days after female spathaes cracking at the day time of afternoon according to Omar (2007). Number of bunches per palm was adjusted to ten bunches by removing excess earliest, latest and small bunches and the leaf bunch ratio was maintained at 8: 1 (Sayed, 2002 and Diab, 2006). The texture of the tested soil is clay loam and with water table depth not less than two meters.

All the selected Zaghoul date palms received common horticultural practices that already applied in the orchard except those dealing with application of antioxidants.

The present experiment included the following ten treatments:

1. Control (untreated palms).
2. Spraying citric acid at 500 ppm (0.5 g/ L water).
3. Spraying citric acid at 1000 ppm (1.0 g/ L water).

4. Spraying citric acid at 2000 ppm (2.0 g/ L water).
5. Spraying ascorbic acid at 500 ppm (0.5 g/ L water).
6. Spraying ascorbic acid at 1000 ppm (1.0 g/ L water).
7. Spraying ascorbic acid at 2000 ppm (2.0 g/ L water).
8. Spraying amino acids acid at 500 ppm (0.5 g/ L water).
9. Spraying amino acids acid at 1000 ppm (1.0 g/ L water).
10. Spraying amino acids acid at 2000 ppm (2.0 g/ L water).

Each treatment was replicated three times, one palm per each. Therefore, thirty uniform in vigour Zaghoul date palms were selected for achieving of this study. The three amino acids used were tryptophane, methionene and cysteine. All antioxidants were sprayed three times at growth start (1st week of Mar.), after fruit setting (last week of April) and at one month later (last week of May). Triton B as a wetting agent was applied at 0.05 % for all antioxidant solutions. Spraying of the palms was done till runoff (5 L water/ palm). Untreated palms received water containing Triton B.

The present experiment was arranged in randomized complete block design with three replications, one palm per each.

During both seasons, the following parameters were recorded:-

- 1- Vegetative growth characters namely number of pinna, length, width and area of pinna and leaf, number of new leaves/ plant, number of spines/ leaf and spine length (**Ahmed and Morsy, 1999**).
- 2- Percentages of N, P, K, Mg and Ca (**Piper, 1950**).
- 3- Yield as well as physical and chemical characteristics of the fruits namely fruit weight (g.), average fruit dimensions (length and width in cm.), percentage of pulp and seeds, pulp/ seed, T.S.S %, percentages of total and reducing sugars according to **Lane and Eynon (1965)**, non-reducing sugars, total acidity %, percentages of total soluble tannins and total fibres according to **A.O.A.C., (1995)**.

Statistical analysis was done using new L.S.D at 5 % (**Mead et al., 1993**).

3.Results and Discussion

Growth characters:

It is clear from the data in Tables (1 & 2) that foliar applications of the three antioxidants namely citric acid, ascorbic acid and amino acids (tryptophane, methionene and cysteine) each at 500 to 2000 ppm significantly stimulated the ten growth characters namely number of pinna, length, width and area of

pinna and leaf, number of new leaves/ plant, number of spines/ leaf and spine length in relative to the check treatment. The best antioxidant was amino acids, followed by ascorbic acid and citric acid occupied the last position in this respect. No significant promotion on these growth traits was observed among the higher two concentrations of each antioxidant. Treating the palms three times with amino acids at 2000 ppm gave the maximum values. The untreated palms gave the lowest values.

Leaf content of N, P, K, Mg and Ca:

Data presented in Table (3) clearly reveal that the five nutrients N, P, K, Mg and Ca in the leaves were significantly enhanced in response to spraying the palms three times with citric acid, ascorbic acid or amino acids each at 500 to 2000 ppm, in relative to the check treatment. The promotion was associated with using citric acid, ascorbic acid and amino acids, in ascending order. Increasing concentrations of each antioxidant from 1000 to 2000 ppm failed significantly to promote these nutrients. The maximum values were recorded on the palms that treated three times with amino acids at 2000 ppm. The control palms produced the minimum values. These results were true during both seasons.

Bunch weight and yield/ palm:

Table (4) shows that foliar application of citric acid, ascorbic acid or amino acids each at 500 to 2000 ppm significantly was accompanied with improving bunch weight and yield per palm in comparison with the control treatment. The best antioxidant was amino acids. Negligible promotion on bunch weight and yield per palm was observed among the higher two concentrations of each antioxidant. Therefore, the recommended concentration from economical point of view for each antioxidant was 1000 ppm. Economically point of view, treating Zaghoul date palms three times with amino acids at 1000 ppm gave good results with regard to yield. Under such promised treatment, yield reached 160 and 161 kg while the yield of the control palms was 110 and 109 kg during both seasons, respectively. The percentage of yield increase due to using the promised treatment over the check treatment reached 45.5 and 47.7 % during both seasons, respectively. Similar trend was observed during both seasons.

Some physical and chemical characteristics of fruits:

Data presented in Tables (4 & 5 & 6) obviously reveal that spraying citric acid, ascorbic acid or amino acids each at 500 to 2000 ppm significantly was very effective in improving fruit quality in terms of increasing fruit weight and dimensions (length &

width), pulp %; pulp/ seeds, T.S.S % as well as total and reducing sugars % and decreasing seeds %; total acidity %, total soluble tannins and total crude fibre % as compared with the check treatment. The best antioxidant in this respect was amino acids followed by ascorbic acid. Increasing concentrations of each

antioxidant from 1000 to 2000 ppm had no significant promotion on quality parameters. Using three sprays of amino acids at 1000 ppm gave the best results with regard to quality from economical point of view. Similar trend was observed due both seasons.

Table (1): Effect of different concentrations of some antioxidants on some vegetative growth characters of Zaghoul date palms during 2011 and 2012 seasons.

Antioxidant treatments	No. of pinnae/ leaf		Pinnae length (cm.)		Pinnae width (cm.)		Pinnae area (cm ²)		Leaf length (m)	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Control (untreated date palms)	189.0	192.0	50.0	51.0	1.90	2.00	45.4	48.0	2.50	2.60
Citric acid at 500 ppm	195.0	199.0	53.0	55.0	2.05	2.17	50.5	54.4	2.71	2.70
Citric acid at 1000 ppm	198.0	206.0	56.0	59.0	2.20	2.32	55.9	60.9	2.82	2.85
Citric acid at 2000 ppm	199.0	207.0	57.0	60.0	2.22	2.34	57.1	62.2	2.83	2.86
Ascorbic acid at 500 ppm	206.0	214.0	61.0	65.0	2.35	2.48	63.3	69.9	2.95	3.06
Ascorbic acid at 1000 ppm	211.0	218.0	64.0	68.0	2.50	2.62	69.5	76.2	3.05	3.18
Ascorbic acid at 2000 ppm	212.0	219.0	65.0	69.0	2.53	2.65	71.1	77.9	3.06	3.20
Amino acids at 500 ppm	216.0	223.0	71.0	74.0	2.75	2.90	82.5	89.7	3.22	3.35
Amino acids at 1000 ppm	221.0	228.0	80.0	81.0	2.89	3.20	95.8	106.2	3.34	3.50
Amino acids at 2000 ppm	222.0	229.0	81.0	82.0	2.93	3.25	98.1	108.9	3.36	3.52
New L.S.D at 5 %	2.0	2.6	2.0	2.3	0.08	0.10	3.0	2.6	0.05	0.07

Table (2): Effect of different concentrations of some antioxidants on some vegetative growth characters of Zaghoul date palms during 2011 and 2012 seasons.

Antioxidant treatments	Leaf width (cm.)		Leaf area (m ₂)		No. of new leaves/ palm		No. of spines/ leaf		Spine length (cm.)	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Control (untreated date palms)	1.20	1.21	0.86	0.92	20.0	18.0	18.0	19.0	9.9	10.2
Citric acid at 500 ppm	1.25	1.25	0.98	1.08	21.0	20.0	19.0	21.0	10.5	10.7
Citric acid at 1000 ppm	1.30	1.31	1.11	1.25	21.0	22.0	20.0	23.0	11.2	11.5
Citric acid at 2000 ppm	1.31	1.32	1.14	1.29	21.0	22.0	20.0	23.0	11.3	11.6
Ascorbic acid at 500 ppm	1.35	1.37	1.30	1.50	21.0	24.0	22.0	25.0	12.0	12.3
Ascorbic acid at 1000 ppm	1.40	1.42	1.47	1.66	21.0	26.0	24.0	27.0	12.7	13.0
Ascorbic acid at 2000 ppm	1.41	1.43	1.51	1.71	21.0	26.0	24.0	27.0	12.8	13.1
Amino acids at 500 ppm	1.46	1.49	1.78	2.00	21.0	28.0	26.0	29.0	13.5	13.9
Amino acids at 1000 ppm	1.49	1.55	2.12	2.42	21.0	31.0	28.0	31.0	14.5	14.4
Amino acids at 2000 ppm	1.50	1.56	2.18	2.49	21.0	31.0	28.0	31.0	14.7	14.5
New L.S.D at 5 %	0.03	0.04	0.07	0.09	NS	2.0	1.0	1.0	0.5	0.4

Table (3): Effect of different concentrations of some antioxidants on the percentages of N, P, K, Mg and Ca in the leaves of Zaghoul date palms during 2011 and 2012 seasons.

Antioxidant treatments	Leaf N %		Leaf P %		Leaf K %		Leaf Mg %		Leaf Ca %	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Control (untreated date palms)	1.55	1.60	0.12	0.11	1.11	1.14	0.31	0.33	2.92	2.95
Citric acid at 500 ppm	1.65	1.71	0.15	0.16	1.020	1.22	0.37	0.40	3.07	3.10
Citric acid at 1000 ppm	1.76	1.82	0.18	0.19	1.30	1.33	0.44	0.45	3.22	3.26
Citric acid at 2000 ppm	1.80	1.84	0.19	0.19	1.32	1.34	0.46	0.47	3.23	3.27
Ascorbic acid at 500 ppm	1.91	1.98	0.22	0.23	1.44	1.45	0.51	0.55	3.35	3.40
Ascorbic acid at 1000 ppm	2.01	2.10	0.25	0.26	1.54	1.56	0.57	0.61	3.50	3.51
Ascorbic acid at 2000 ppm	2.03	2.11	0.26	0.27	1.55	1.57	0.59	0.62	3.52	3.53
Amino acids at 500 ppm	2.22	2.31	0.28	0.29	1.66	1.71	0.64	0.67	3.64	3.63
Amino acids at 1000 ppm	2.32	2.41	0.30	0.34	1.74	1.77	0.70	0.71	3.75	3.74
Amino acids at 2000 ppm	2.33	2.42	0.31	0.35	1.76	1.79	0.71	0.72	3.76	3.75
New L.S.D at 5 %	0.08	0.07	0.02	0.03	0.05	0.04	0.04	0.03	0.10	0.12

Table (4): Effect of different concentrations of some antioxidants on bunch weight, yield as well as weight, length and width of fruits of Zaghoul date palms during 2011 and 2012 seasons.

Antioxidant treatments	Average bunch weight (kg.)		Yield/ palm (kg.)		Fruit weight (g.)		Fruit length (g.)		Fruit width (cm.)	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Control (untreated date palms)	11.0	10.9	110.0	109.0	27.2	27.5	5.65	5.70	2.22	2.26
Citric acid at 500 ppm	11.8	11.9	118.0	119.0	27.8	28.0	5.73	5.79	2.30	2.33
Citric acid at 1000 ppm	12.6	12.6	126.0	126.0	28.3	28.6	5.82	5.88	2.36	2.40
Citric acid at 2000 ppm	12.7	12.8	127.0	128.0	28.4	28.7	5.84	5.90	2.37	2.41
Ascorbic acid at 500 ppm	13.5	13.5	135.0	135.0	29.0	29.4	6.00	6.10	2.45	2.55
Ascorbic acid at 1000 ppm	14.3	14.4	143.0	144.0	30.0	30.8	6.32	6.31	2.52	2.60
Ascorbic acid at 2000 ppm	14.4	14.5	144.0	145.0	30.2	31.0	6.35	6.33	2.55	2.61
Amino acids at 500 ppm	15.2	15.3	152.0	153.0	31.9	32.0	6.45	6.50	2.71	2.72
Amino acids at 1000 ppm	16.0	16.1	160.0	161.0	32.8	33.0	6.55	6.60	2.88	2.82
Amino acids at 2000 ppm	16.1	16.2	161.0	162.0	33.0	33.1	6.56	6.61	2.89	2.83
New L.S.D at 5 %	0.8	0.7	5.0	5.5	0.4	0.5	0.06	0.07	0.04	0.03

Table (5): Effect of different concentrations of some antioxidants on some physical and chemical characteristics of the fruits of Zaghoul date palms during 2011 and 2012 seasons.

Antioxidant treatments	Pulp %		Seeds %		Pulp/ seeds		T.S.S %		Total sugars %	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Control (untreated date palms)	80.0	80.5	20.0	19.5	4.0	4.1	26.0	26.9	19.5	19.9
Citric acid at 500 ppm	82.0	82.2	18.0	17.8	4.6	4.6	26.6	27.5	19.9	20.5
Citric acid at 1000 ppm	83.5	83.7	16.5	16.3	5.1	5.1	27.3	28.2	20.4	21.0
Citric acid at 2000 ppm	84.0	84.1	16.0	15.9	5.3	5.3	27.4	28.3	20.5	21.1
Ascorbic acid at 500 ppm	86.0	86.2	14.0	13.8	6.1	6.2	28.5	29.4	21.0	21.8
Ascorbic acid at 1000 ppm	87.3	87.4	12.6	12.6	6.9	6.9	29.6	30.5	21.6	22.9
Ascorbic acid at 2000 ppm	87.4	87.5	12.6	12.5	6.9	7.0	29.8	30.6	21.7	23.0
Amino acids at 500 ppm	88.9	89.2	11.1	10.8	8.0	8.3	30.9	31.9	22.6	23.6
Amino acids at 1000 ppm	90.0	90.5	10.0	9.5	9.0	9.5	32.0	33.0	23.0	24.1
Amino acids at 2000 ppm	90.2	90.7	9.8	9.3	9.2	9.8	32.2	33.1	23.1	24.2
New L.S.D at 5 %	1.0	1.2			0.4	0.5	0.5	0.4	0.3	0.4

Table (6): Effect of different concentrations of some antioxidants on some chemical characteristics of the fruits of Zaghoul date palms during 2011 and 2012 seasons.

Antioxidant treatments	Reducing sugars %		Non-reducing sugars %		Total acidity %		Total crude fibre %		Total soluble tannins %	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Control (untreated date palms)	13.5	13.1	6.0	6.8	0.355	0.365	0.74	0.76	0.66	0.69
Citric acid at 500 ppm	13.8	14.0	6.1	6.5	0.325	0.330	0.69	0.69	0.62	0.63
Citric acid at 1000 ppm	14.1	14.4	6.3	6.6	0.290	0.295	0.60	0.64	0.58	0.59
Citric acid at 2000 ppm	14.2	14.5	6.3	6.6	0.288	0.290	0.59	0.63	0.57	0.58
Ascorbic acid at 500 ppm	14.6	14.9	6.4	6.9	0.260	0.260	0.55	0.58	0.51	0.50
Ascorbic acid at 1000 ppm	15.0	15.3	6.6	7.6	0.230	0.231	0.50	0.52	0.46	0.45
Ascorbic acid at 2000 ppm	15.1	15.4	6.6	7.6	0.228	0.230	0.49	0.51	0.45	0.44
Amino acids at 500 ppm	15.5	15.8	6.2	7.2	0.201	0.204	0.41	0.46	0.39	0.37
Amino acids at 1000 ppm	16.1	16.4	6.5	7.2	0.171	0.174	0.37	0.40	0.35	0.32
Amino acids at 2000 ppm	16.2	16.5	6.8	7.6	0.170	0.173	0.63	0.39	0.34	0.31
New L.S.D at 5 %	0.2	0.3	NS	NS	0.022	0.026	0.03	0.04	0.03	0.03

Discussion

The beneficial of antioxidants on stimulating the biosynthesis of natural hormones, nutrient uptake, photosynthesis, biosynthesis of plant pigments and sugars as well as protecting the plants from various stresses could explain the present results. Antioxidants are responsible for increasing antioxidant defense systems through reducing reactive oxygen species. Their important role in enhancing cell division process did not neglect in this respect (Klesiig *et al.*, 2000 and Rao *et al.*, 2000). These results are in concordance with those obtained by Eshmawy (2010); Roshdy *et al.* (2011); Sayed *et al.* (2011); Hegab and Hegab (2011) and Al- Wasfy (2013).

Conclusion

For improving yield and fruit quality of Zaghoul date palms, it is advised to spray the three amino acids (tryptophane, methionene and cysteine) at 1000 ppm three times.

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