Effect of Spraying Seaweed Extract and Silicon on Fruiting of Alphonse Mango Trees

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Abstract: This study was conducted during 2013 and 2014 seasons to examine the effect of single and combined applications of seaweed extract and/or potassium silicate each at 0.0-0.2% on growth characters, percentages of N, P, K, and Mg, yield and fruit quality of Alphonse mango trees grown under Minia Region conditions. The selected mango trees received three sprays from each biostimulant treatment. Treating Alphonse mango trees three times with seaweed extract and/or potassium silicateeach at 0.05-0.2% proved to be very effective in improving leaf area, shoot length, N, P, K, and Mg, yield and fruit quality over the control treatment. These effects were concentration-dependent in both seasons. Meaningless promotion on these characters was observed when the concentrations of both materials were increased from 0.1 to 0.2%. The best results with regard to yield and fruit quality of Alphonse mango trees grown under Minia conditions were obtained due to spraying the trees three times with a mixture of seaweed extract and potassium silicateeach at 0.1%.
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Introduction

Low yield of Alphonse mango trees grown under Minia Region conditions is considered a major problem that faces mango growers. Thus, research is encouraged to find new techniques to solve this problem while avoiding environmental pollution that results from the excessive use of agrochemicals.

Silicon plays an important role in increasing and enhancing withstanding 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 (**Gad El-Kareem (2012), Al-Wasfy (2014), El-Khawaga (2014), El-Khawaga and Mansour (2014), Gad El-Kareem *et. al* (2014)** and **Abd El-Wahab (2015)**.

The application of seaweed extract which contains most nutrients, organic compounds, enzymes, vitamins antioxidants, amino acids and natural hormones is fast becoming an accepted practice. It increases 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-Aaty (2015)** and **Eshmawy (2015)** supported the beneficial effects of using seaweed extract on fruiting in different fruit crops.

The objective of this study was to test the effect of different concentrations of seaweed extractand potassium silicate on fruiting of Alphonse mango trees grown under Minia environmental conditions.

Material And Methods

This study was conducted during the two consecutive seasons of 2013 and 2014 on fortyeight 16-years old Alphonse mango trees onto polyembryonic mango seedling rootstock. The trees are grown in a private mango orchard located at Abo Korkas district, Minia Governorate. The uniform in vigour trees of Alphonse mango (48 trees) were planted at 7 x 7 meter apart. The soil texture of the tested orchard is silty clay (Table 2) with a water table depth not less than two meters. Drip irrigation system was followed using well water containing 200 ppm salinity.

The selected trees received a basal recommended fertilizer, in addition to the regular agricultural and horticultural practices which were followed in the orchard.

This study included two factors (A & B). The first factor (A) contained four concentrations of seaweed extract namely a1) 0.0, a2) 0.05 %, a3) 0.1, and a4) 0.2%. The second factor (B) consisted of four concentrations of potassium silicate (25% Si and 10% K_2O) namely b1) 0.0, b2) 0.05%, b3) 0.1%), and b4) 0.2%. Therefore, this experiment included sixteen treatments from single and combined applications of seaweed extract and potassium silicate. Each treatment was replicated three times, one tree per each. Seaweed extract and potassium silicate were sprayed three times; at growth start (1st week of March), just after fruit setting (Middle of March) and at one month later (Middle of April). Chemical analysis of seaweed

extract as reported by **James (1994)** is given in Table (3).

Table (1): Mechanical, physical and chemical analysis of the tested orchard soil.

Particle size distribution:	
Sand %	:11.1
Silt %	:52.7
Clay	:36.2
Texture	:Silty clay
pH(1:2.5 extract)	:7.44
EC (1: 2.5 extract) (mmhos/Icm/25^{o}C)	:0.66
O.M. %	:2.22
$CaCO_3$ %	:1.69
Total N %	:0.14
Available P (ppm, Olsen)	:26
Available K (ppm/ ammonium acetate)	:4.95
Available Mg (ppm)	:146.00
Available S (ppm)	:6.96
B (ppm) (hot water extractable)	:0.27
Available EDTA extractable micronutrients (ppm)	
Zn	:1.31
Fe	:11.21
Mn	:10.25
Cu	:1.88

Table (2): Analysis of seaweed extract (according to James, 1994).

Character	**Values**
Moisture %	6.0
O.M. %	45- 60
Inorganic matter %	45- 60
Protein %	6- 8
Carbohydrates %	5- 50
Aliginic acid %	10- 20
Mannitol %	4- 7
Total N %	1.0- 1.5
P %	0.02- 0.09
K %	1.0- 1.2
Ca %	0.2- 1.5
S %	3- 9
Mg %	0.5- 0.9
Cu (ppm)	1.0- 6.0
Fe (ppm)	50-200
Mn (ppm)	5- 12
Zn (ppm)	10- 100
B (ppm)	20- 100
Mo (ppm)	1- 5
Cytokinins %	0.02
IAA %	0.03
ABA %	0.01

Triton B as a wetting agent was added to all solutions of seaweed extract and potassium silicate at 0.05%. The untreated palms received water containing triton B. All the selected trees were sprayed till runoff.

This study was statistically analyzed using Randomized complete block design (RCBD) in split plot arrangement in which the four concentrations of seaweed extract and potassium silicate ranked the main and subplots, respectively.

Generally, the following measurements in the present study were recorded during the two seasons of the study:

1- Leaf area (cm^2) as reported by **Ahmed and Morsy (1999)** and shoot length (cm) in the Spring growth cycle.
2- Percentages of N, P, K, and Mg according to **Summer (1985)** and **Wilde *et al.*, (1985)**.
3- Yield per tree (Kg)
1- Fruit characteristics namely: fruit weight (g), and dimensions (cm), T.S.S.%, total sugars%, total acidity% as citric acid and fruit content of Vitamin C (mg/100 g pulp), (**A.O.A.C. 2000**).

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

Results and Discussion

1- Leaf area and shoot length:

It is clear from the data in Table (3) that the leaf area and shoot length were remarkably stimulated due to treating the Alphonse mango trees with seaweed extract and/or potassium silicate each at 0.05-0.2% relative to the check treatment. The promotion was materially associated with increasing concentration of each material. Meaningless stimulation was ascribed to increasing the concentration from 0.1 to 0.2%. Using seaweed extract and potassium silicate together at 0.2% gave the highest values. The same trend was observed during 2013 and 2014 seasons.

2- Percentages of N, P, K and Mg in the leaves:

Data in Tables (4&5) obviously reveal that carrying out three sprays of seaweed extract and/or potassium silicate each at 0.05-0.2% had significant effects on the percentages of N, P, K and Mg over the check treatment. The promotion was obviously related to the increase in concentrations. No significant promotion in these chemical parameters was observed among the higher two concentrations of each material. The maximum values were registered on the palms that were subjected to seaweed extract and potassium silicate combination, each at 0.2%. These results were similar in both seasons.

3- Yield:

A significant promotion on the yieldand the number of fruits per tree was observed in response to treating the trees with seaweed extract and/or potassium silicate each at 0.05-0.2% over the check treatment (Table 6). There was a gradual concentration-dependent promotion on these characters. A slight and insignificant promotion on these aspects was noticed among the higher two concentrations of each material. The best results from economical point of view were obtained when the palms received three sprays of seaweed extract plus potassium silicate each at 0.1%. These results were true during both seasons.

4- Fruit Quality:

It is evident from the data in Tables (7-10) that treating the mango trees three times with seaweed extract and/or potassium silicate, each at 0.05-0.2% succeeded in improving fruit quality in terms of increasing fruit weight and dimensions (length, width, and thickness), T.S.S. %,total sugars%, and vitamin C contentand decreasing total acidity % relative to the control treatment. The promotion on fruit quality was related to the increase in concentrations. The best results with regard to fruit quality were obtained when the palms were treated three times with a mixture of potassium silicate and seaweed extract each at 0.1%. These results were reproducible in both seasons.

Table (3): Effect of different concentrations of seaweed extract and potassium silicate on the shoot length and the leaf area in the spring growth cycle of Alphonse mango trees during 2013 & 2014 seasons.

Seaweed extract Conc. (A)	Shoot Length (cm)									
	2013					2014				
	Potassium silicate Conc. (B)									
	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)
A1 0.0% Seaweed	14.1	15.2	16.2	16.3	15.5	14.0	15.1	16.2	16.3	15.4
A2 0.05% Seaweed	15.3	16.2	17.3	17.4	16.6	15.1	16.3	17.4	17.5	16.6
A3 0.1% Seaweed	16.5	17.3	18.5	18.6	17.7	16.1	17.4	18.5	18.5	17.6
A4 0.2% Seaweed	16.6	17.4	18.6	18.7	17.8	16.2	17.5	18.6	18.6	17.7
Mean (B)	15.6	16.5	17.7	17.8		15.4	16.6	17.7	17.7	
New L.S.D. at 5%	A 0.9	B 1.0	AB 2.0			A 1.0	B 1.0	AB 2.0		
	Leaf Area (cm2)									
A1 0.0% Seaweed	59.0	61.0	62.5	63.0	61.4	60.0	61.5	63.0	63.3	62.0
A2 0.05% Seaweed	60.6	63.0	64.9	65.0	63.4	61.3	63.0	65.0	65.3	63.7
A3 0.1% Seaweed	62.0	65.0	67.0	67.3	65.3	63.0	65.0	67.0	67.3	65.6
A4 0.2% Seaweed	62.3	65.3	67.2	67.5	65.6	63.7	65.0	67.3	67.4	65.9
Mean (B)	61.0	63.6	65.4	65.7		62.0	63.6	65.6	65.8	
New L.S.D. at 5%	A 0.8	B 0.7	AB 1.4			A 0.7	B 0.7	AB 1.4		

Table (4): Effect of different concentrations of seaweed extract and potassium silicate on the percentages of N and P in the leaves of Alphonse mango trees during 2013 & 2014 seasons.

Seaweed extract Conc. (A)	Leaf N %									
	2013					2014				
	Potassium silicate Conc. (B)									
	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)
A1 0.0% Seaweed	1.59	1.68	1.77	1.78	1.71	1.63	1.70	1.80	1.81	1.74
A2 0.05% Seaweed	1.67	1.76	1.84	1.85	1.78	1.70	1.80	1.90	1.90	1.83
A3 0.1% Seaweed	1.76	1.83	1.90	1.91	1.85	1.77	1.90	1.97	1.98	1.91
A4 0.2% Seaweed	1.77	1.84	1.91	1.91	1.86	1.78	1.91	1.98	1.99	1.92
Mean (B)	1.70	1.78	1.86	1.86		1.72	1.83	1.91	1.92	
New L.S.D. at 5%	A 0.06	B 0.05	AB 0.10			A 0.05	B 0.05	AB 0.10		
	Leaf P %									
A1 0.0% Seaweed	0.15	0.18	0.20	0.20	0.18	0.15	0.18	0.21	0.22	0.19
A2 0.05% Seaweed	0.18	0.20	0.22	0.23	0.21	0.18	0.21	0.23	0.23	0.21
A3 0.1% Seaweed	0.21	0.23	0.25	0.25	0.24	0.21	0.24	0.26	0.26	0.24
A4 0.2% Seaweed	0.21	0.23	0.25	0.25	0.24	0.22	0.24	0.26	0.26	0.25
Mean (B)	0.19	0.21	0.23	0.23		0.19	0.22	0.24	0.24	
New L.S.D. at 5%	A 0.20	B 0.20	AB 0.40			A 0.20	B 0.20	AB 0.40		

Table (5): Effect of different concentrations of seaweed extract and potassium silicate on the percentages of potassium and magnesium in the leaves of Alphonse mango trees during 2013 & 2014 seasons.

Seaweed extract Conc. (A)	Leaf K %									
	2013					2014				
	Potassium silicate Conc. (B)									
	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)
A1 0.0% Seaweed	1.37	1.44	1.50	1.51	1.46	1.36	1.44	1.51	1.51	1.46
A2 0.05% Seaweed	1.43	1.50	1.56	1.57	1.52	1.44	1.51	1.57	1.57	1.52
A3 0.1% Seaweed	1.50	1.57	1.63	1.64	1.59	1.51	1.58	1.64	1.64	1.59
A4 0.2% Seaweed	1.51	1.58	1.64	1.65	1.60	1.52	1.59	1.65	1.65	1.60
Mean (B)	1.45	1.52	1.58	1.59		1.46	1.53	1.59	1.59	
New L.S.D. at 5%	A 0.04	B 0.05	AB 0.10			A 0.04	B 0.04	AB 0.08		
	Leaf Mg %									
A1 0.0% Seaweed	0.51	0.57	0.64	0.65	0.59	0.50	0.56	0.62	0.63	0.58
A2 0.05% Seaweed	0.55	0.63	0.70	0.71	0.65	0.57	0.62	0.70	0.71	0.65
A3 0.1% Seaweed	0.59	0.71	0.77	0.78	0.71	0.64	0.70	0.78	0.79	0.73
A4 0.2% Seaweed	0.60	0.71	0.78	0.79	0.72	0.65	0.70	0.78	0.80	0.73
Mean (B)	0.56	0.66	0.72	0.73		0.59	0.65	0.72	0.73	
New L.S.D. at 5%	A 0.03	B 0.03	AB 0.06			A 0.03	B 0.03	AB 0.06		

Table (6): Effect of different concentrations of seaweed extract and potassium silicate on the number of fruits/tree and yield (Kg) of Alphonse mango trees during 2013 & 2014 seasons.

Seaweed extract Conc. (A)	Number of Fruits/Tree									
	2013					2014				
	Potassium silicate Conc. (B)									
	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)
A1 0.0% Seaweed	470.0	484.0	500.0	500.0	488.5	500.0	518.0	530.0	532.0	520.0
A2 0.05% Seaweed	482.0	501.0	515.0	516.0	503.5	520.0	531.0	545.0	546.0	535.5
A3 0.1% Seaweed	500.0	518.0	530.0	531.0	519.8	541.0	547.0	560.0	562.0	552.5
A4 0.2% Seaweed	501.0	519.0	531.0	532.0	520.8	542.0	548.0	561.0	563.0	553.5
Mean (B)	488.3	505.5	519.0	519.8		525.8	536.0	549.0	550.8	
New L.S.D. at 5%	A 10.0	B 9.0	AB 18.0			A 9.0	B 9.0	AB 18.0		
	Yield (Kg)									
A1 0.0% Seaweed	80.4	87.1	94.5	94.5	89.1	87.0	93.8	100.2	101.1	95.5
A2 0.05% Seaweed	85.8	94.7	103.0	103.7	96.8	93.6	100.9	109.5	110.2	103.6
A3 0.1% Seaweed	92.5	103.6	112.4	113.1	105.4	101.7	110.5	119.2	119.8	112.8
A4 0.2% Seaweed	93.2	103.8	112.6	113.1	105.7	102.2	110.7	119.5	119.9	113.1
Mean (B)	88.0	97.3	105.6	106.1		96.1	104.0	112.1	112.8	
New L.S.D. at 5%	A 0.8	B 1.0	AB 2.0			A 1.0	B 1.0	AB 2.0		

Table (7): Effect of different concentrations of seaweed extract and potassium silicate on weight (g) and length (cm) of fruit of Alphonse mango trees during 2013 & 2014 seasons.

Seaweed extract Conc. (A)	Fruit Weight (g)									
	2013					2014				
	Potassium silicate Conc. (B)									
	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)
A1 0.0% Seaweed	171.00	180.00	188.00	189.00	182.00	174.00	181.00	189.00	190.00	183.50
A2 0.05% Seaweed	178.00	189.00	200.00	201.00	192.00	180.00	190.00	201.00	202.00	193.25
A3 0.1% Seaweed	185.00	200.00	212.00	213.00	202.50	188.00	202.00	212.90	213.00	203.98
A4 0.2% Seaweed	186.00	200.00	212.00	213.00	202.75	188.60	202.00	213.00	213.00	204.15
Mean (B)	180.00	192.25	203.00	204.00		182.65	193.75	203.98	204.50	
New L.S.D. at 5%	A 5.0	B 4.9	AB 9.8			A 4.9	B 4.9	AB 9.8		
	Fruit Length (cm)									
A1 0.0% Seaweed	7.91	8.00	8.10	8.11	8.03	7.90	8.03	8.15	8.16	8.06
A2 0.05% Seaweed	7.97	8.10	9.30	8.31	8.42	8.00	8.11	8.35	8.36	8.21
A3 0.1% Seaweed	8.05	8.30	8.49	8.50	8.34	8.08	8.31	8.51	8.52	8.36
A4 0.2% Seaweed	8.06	8.30	8.50	8.51	8.34	8.09	8.31	8.51	8.52	8.36
Mean (B)	8.00	8.18	8.60	8.36		8.02	8.19	8.38	8.39	
New L.S.D. at 5%	A 0.05	B 0.05	AB 0.10			A 0..05	B 0.05	AB 0.10		

Table (8): Effect of different concentrations of seaweed extract and potassium silicate on width and thickness of fruit (cm) of Alphonse mango trees during 2013 & 2014 seasons.

Seaweed extract Conc. (A)	Fruit Width (cm)									
	2013					2014				
	Potassium silicate Conc. (B)									
	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)
A1 0.0% Seaweed	6.50	6.58	6.66	6.67	6.60	6.52	6.61	6.70	6.71	6.64
A2 0.05% Seaweed	6.57	6.66	6.73	6.74	6.68	6.60	6.71	6.80	6.81	6.73
A3 0.1% Seaweed	6.65	6.75	6.83	6.83	6.77	6.66	6.82	6.95	6.95	6.85
A4 0.2% Seaweed	6.65	6.75	6.83	6.84	6.77	6.66	6.82	6.95	6.95	6.85
Mean (B)	6.59	6.69	6.76	6.77		6.61	6.74	6.85	6.86	
New L.S.D. at 5%	A 0.05	B 0.05	AB 0.10			A 0.04	B 0.04	AB 0.08		
	Fruit Thickness (cm)									
A1 0.0% Seaweed	5.71	5.80	5.88	5.89	5.82	5.72	5.82	5.90	5.91	5.84
A2 0.05% Seaweed	5.79	5.89	5.97	5.98	5.91	5.80	5.91	6.00	6.00	5.93
A3 0.1% Seaweed	5.85	5.98	6.05	6.06	5.99	5.87	6.00	6.10	6.11	6.77
A4 0.2% Seaweed	5.86	5.99	6.06	6.07	6.00	5.88	6.00	6.10	6.11	6.02
Mean (B)	5.80	5.92	5.99	6.00		5.82	5.93	6.03	6.03	
New L.S.D. at 5%	A 0.04	B 0.04	AB 0.08			A 0.04	B 0.04	AB 0.08		

Table (9): Effect of different concentrations of seaweed extract and potassium silicate on the percentages of total soluble solids and total sugars in the fruits of Alphonse mango trees during 2013 & 2014 seasons.

Seaweed extract Conc. (A)	T. S. S. %									
	2013					2014				
	Potassium silicate Conc. (B)									
	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)
A1 0.0% Seaweed	16.5	17.2	17.8	17.8	17.3	16.4	17.7	18.4	18.5	17.8
A2 0.05% Seaweed	17.2	17.8	18.4	18.5	18.0	17.0	18.5	19.0	19.0	18.4
A3 0.1% Seaweed	17.8	18.4	19.0	19.0	18.6	17.6	19.0	19.7	19.7	19.0
A4 0.2% Seaweed	17.9	18.5	19.0	19.0	18.6	17.6	19.0	19.7	19.7	19.0
Mean (B)	17.4	18.0	18.6	18.6		17.2	18.6	19.2	19.2	
New L.S.D. at 5%	A 0.6	B 0.6	AB 1.2			A 0.6	B 0.6	AB 1.2		
	Total Sugars %									
A1 0.0% Seaweed	14.9	15.6	16.2	16.3	15.8	15.0	15.6	16.1	16.1	15.7
A2 0.05% Seaweed	15.5	16.2	17.0	17.1	16.5	15.6	16.2	16.9	17.0	16.4
A3 0.1% Seaweed	16.0	17.0	17.5	17.5	17.0	16.2	17.0	17.5	17.5	17.1
A4 0.2% Seaweed	16.1	17.1	17.5	17.6	17.1	16.3	17.0	17.5	17.8	17.2
Mean (B)	15.6	16.5	17.1	17.1		15.8	16.5	17.0	17.1	
New L.S.D. at 5%	A 0.5	B 0.5	AB 1.0			A 0.5	B 0.5	AB 1.0		

Table (10): Effect of different concentrations of seaweed extract and potassium silicate on the percentage of total acidity and vitamin C content in the fruits of Alphonse mango trees during 2013 & 2014 seasons.

Seaweed extract Conc. (A)	Total Acidity %									
	2013					2014				
	Potassium silicate Conc. (B)									
	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)	B_1 0.0%	B_2 0.05%	B_3 0.1%	B_4 0.2%	Mean (A)
A1 0.0% Seaweed	0.400	0.361	0.330	0.329	0.355	0.395	0.355	0.325	0.323	0.350
A2 0.05% Seaweed	0.371	0.329	0.292	0.290	0.321	0.360	0.325	0.300	0.299	0.321
A3 0.1% Seaweed	0.330	0.212	0.260	0.259	0.265	0.327	0.300	0.275	0.275	0.294
A4 0.2% Seaweed	0.329	0.290	0.259	0.258	0.284	0.325	0.299	0.274	0.274	0.293
Mean (B)	0.358	0.298	0.285	0.284		0.352	0.320	0.294	0.293	
New L.S.D. at 5%	A 0.025	B 0.025	AB 0.050			A 0.024	B 0.025	AB 0.050		
	Vitamin C content (mg/100 g pulp)									
A1 0.0% Seaweed	29.9	32.0	36.0	36.3	33.6	30.0	32.9	36.0	36.1	33.8
A2 0.05% Seaweed	31.3	37.0	38.9	39.0	36.6	32.3	36.3	38.0	38.2	36.2
A3 0.1% Seaweed	33.6	39.0	41.9	42.0	39.1	34.6	38.9	41.9	42.0	39.4
A4 0.2% Seaweed	34.0	39.0	42.0	42.1	39.3	34.8	39.0	42.0	42.1	39.5
Mean (B)	32.2	36.8	39.7	39.9		32.9	36.8	39.5	39.6	
New L.S.D. at 5%	A 1.0	B 1.0	AB 2.0			A 1.0	B 1.0	AB 2.0		

Discussion

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 to its 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 leaf area, yield and fruit quality are in harmony with those obtained by **Abdelaal*et al.*, (2012), Mahmoud (2012), Gamal (2013), Abd El-Aaty (2015)** and **Eshmawy(2015).**

Previous studies showed that the favourable effects of silicon on growth, nutritional status of the 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 reduce powdery mildew. The mechanical strength provided by silicon to the plant tissues increases their resistance to diseases and insects and is responsible for reducing the adverse effects of heavy metal toxicity (**Epstein, 1999** and **Ma, 2004**).

The 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)** and **Abd El-Wahab (2015).**

Conclusion:

Under the present and resembling conditions, it is suggested to spray Alphonse mango trees with a mixture of seaweed extract and potassium silicate each at 0.1% three times; at growth start, just after fruit setting, and at one month later for improving yield and fruit quality.

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