Using Silicon for Alleviating Irregular Colouration Problem of Flame Seedless Grapes

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Abstract: This study was carried out during 2013 and 2014 seasons as a trail for overcoming the problem of irregular colouration of Flame seedless grapevines grown under Minia region by using potassium silicate once, twice, thrice or four times at 0.05 to 0.4%. Subjecting the vines to potassium silicate via foliage once, twice, thrice or four times at 0.05 to 0.4% was materially accompanied with enhancing growth characters, leaf pigments, N, P, K, Mg berry setting %, yield and fruit quality over the control treatment. The promotion was substantially associated with increasing concentrations and frequencies of potassium silicate. Berries colouration was remarkably enhanced due to using all potassium silicate treatments. No major differences on the investigated parameters were observed among the higher two concentrations (0.2 & 0.4%) and frequencies (thrice or four times). Carrying out three sprays of potassium silicate at 0.2% was responsible for enhancing yield and fruit quality of Flame seedless grapevines grown under Minia region conditions.

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1.Introduction

Many trials were accomplished for overcoming the problem of irregular colouration of berries of Flame seedless grapevines grown under Minia region conditions. The main reason of this problem is the unfavourable environmental conditions. Therefore, the idea of searching about the stimulants that responsible for increasing the tolerance of the vines to various stresses was arised. Previous studies showed that silicon plays an important role in this respect. **(Ma, 2004).**

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 and 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 in water transport and root development as well as increasing the tolerance of plants to producing mildew. The mechanical strength provided by silicon to the plants tissues increases their resistance to diseases and insects and is responsible for reducing the adverse effects of heavy metal toxicity (**Matoh, *et al.,* 1991; Lux *et al.,* 2003; Hattori, *et al.*, 2003; Rodrigues *et al.,* 2003; Ma, 2004 and Tahir*et al.*, 2006**).

The findings regarding the promoting effect of silicon on growth and fruiting of Manfalouty pomegranate trees are in harmony with those obtained by **Gad El- Kareem (2012)** on Taimour mango trees, **Ahmed *et al.,* (2013)** on Taimour mango trees; **Abdelaal and Oraby-Mona (2013)** on Ewaise mango trees, **Al - Wasfy , (2013)** on Sakkoti date palms; **Al-Wasfy (2014)** on Flame seedless grapevines; **El-Khawaga and Mansour (2014)** on Washington Navel orange trees; **Ibrahim and Al- Wasfy (2014)** on Valencia orange trees and **Gad El-Kareem *et al.,* (2014)** on Zaghloul date palms.

The target of this study was elucidating the effect of different concentrations and frequencies of potassium silicate as a source of silicon on growth, vine nutritional status irregular colouation of berries, yield and fruit quality of Flame seedless grapevines growth under Minia region conditions.

2. Material and Methods

This study was carried out during 2013 and 2014 seasons on one hundred and twenty uniform in vigour 9-years- old Flame seedless grapevines. The selected vines are grown in a private vineyard located at Kom El- Arab village, Matay district, Minia Governorate where the texture of the soil is clay (Table 2). Soil analysis was done according to the procedures that outlined by **Piper (1950) and Wilde *et al*., (1985).**

The selected vines are planted at 2 × 3 meters apart. The chosen vines were trained by spur pruning system (short pruning) leaving 72 eyes/vine (15 fruiting spurs × 4 eyes plus six replacement spurs / two eyes) using Gable supporting method. Winter pruning was carried out at the last week of December during both seasons. Surface irrigation system was followed using Nile water.

Table (1): Analysis of the tested soil.

Constituents	values
Sand %	4.0
Silt %	13.0
Clay %	83.0
Texture	Clay
O.M. %	2.41
pH (1:2.5 extract)	7.69
E.C (1: 2.5 extract) (mmhos/ 1 cm / 25^0 C)	0.91
$CaCO_3$ %	1.55
Total N %	0.09
Available P (ppm/ Olsen)	5.9
Available K (ppm, ammonium acetate)	4.90

1- Except those dealing with the present treatments (application of silicone complete) the selected vines (vines) received the usual horticultural practices that are commonly applied in the vineyard.

This study consisted from twenty treatments from two factors (A&B). The first factor included five concentrations of potassium silicate (25% Si + 10 %K_2O) namely (a1: 0.0%, a2:0.05%, a3:0.1%, a4:0.2% and a5:0.4%). The second factor (B) contains four frequencies of potassium silicate application namely [(b1: once at growth start (1st week of March), b2: twice at growth start and again just after berry setting (mid of April), b3: thrice at growth start, just after berry setting and at two weeks later (last week of April) and b4: four times at growth start just after berry setting and at two week intervals (last week of April and mid of May). Each treatment was replicated three times, two vines per each. Triton B as a wetting agent was added to all solutions of potassium silicate at 0.05%. Control vines (0.0% silicon) were sprayed with Nile water containing Triton B. Spraying was done till runoff.

During both seasons, the following parameters were recorded:

1- Vegetative growth characters namely main shoot length (cm), leaf area (cm^2) (**Ahmed and Morsy, 1999**), pruning wood weight (kg) / vine and cane thickness (cm).

2- Leaf pigments namely chlorophylls a & b, total chlorophylls and total carotenoids (mg/100g F.W) (**Von-Wettstein, 1957 and Hiscox and Isralstam, 1979**).

3- Percentages of N, P, K and Mg (as %) on dry weight basis (**Piper, 1950, Chapman and Pratt, 1965, Summer, 1985 and Wilde *et al.*, 1985**).

4- Percentage of berry set, yield as well as number of clusters /vine and cluster weight and dimensions (length & width, cm).

5- Berry weight (g) and dimensions (longitudinal and equatorial, cm) and berry shape index value.

6- Total soluble solides %, total acidity % (as g tartaric acid / 100ml juice), reducing sugars% and T.S.S/acid.(**A.O.A.C., 2000**).

Statistical analysis was done using new L.S.D at 5% for making all comparisons between various treatment means (**Mead *et al.,* 1993**).

3.Results

1- Vegetative Growth Characters:

It is clear from the data in Tables (2 & 3) that spraying potassium silicate once, twice thrice or four times at 0.05 to 0.4 % significantly stimulated main shoot length , leaf area, pruning wood weight and cane thickness over the check treatment. There was a gradual promotion on these growth characters with increasing concentrations from 0.0 to 0.4 and frequencies from once to four times. Significant differences on these growth aspects were observed among all concentrations and frequencies except among the higher two concentrations (0.2 & 0.4%) and frequencies (thrice or four times). The maximum values were observed on the vines that received potassium silicate four times at 0.4%. The untreated vines produced the lowest values. Similar results were announced during 2013 and 2014 seasons.

2- Leaf chemical composition:

Tables (4 to 7) show that leaf pigments namely chlorophylls a & b , total chlorophylls , total carotenoids as well as nutrients namely N, P, K and Mg were significantly enhanced in response to spraying potassium silicate once, twice, thrice or four times at 0.05 to 0.4% rather than non- application. A progressive promotion on these pigments and nutrients was observed with increasing concentrations from 0.05 to 0.4% and frequencies from once to four times. Meaningless promotion was observed among the higher two concentrations (0.0 & 0.4%) and frequencies (thrice or four times). Treating the vines four times with potassium silicate at 0.4% gave the maximum values of pigments and nutrients. The minimums values were recorded on untreated vines. These results were true during both seasons:

3- Berry setting%, yield, cluster weight and dimension (length & width) and cluster compactness:

It is obvious from the data in Tables (8 to 11) that treating Flame seedless grapevines once, twice, thrice or four times at 0.05 to 0.4% caused 'a significant promotion on the percentage of berry setting, yield, number of clusters per vine, weight, length and width of cluster and cluster compactness over the check treatment. The promotion was gradually related to the increase in concentrations and frequencies of potassium silicate. Increasing concentrations from 0.2 to 0.4% and frequencies from thrice to four times had no significant increase on these parameters. Therefore, from economical point of view, it is suggested to use three sprays, of potassium silicate at 0.2% for producing higher yield, cluster weight and cluster compactness. Under such promised treatment yield per vine reached 10.5 and 16.2 kg during both seasons, respectively. The yield/vine of the untreated vines reached 8.0 and 8.0 kg, during 2013 and 2014 seasons, respectively. The percentage of increase on the yield due to application of the previous promised treatment above the control treatment reached 31.3 and 102.5% during 2013 and 2014 seasons, respectively. These results were true during both seasons. Number of clusters/vine did not alter significantly with the present treatments in the first season of study.

4- Percentage of berries colouration:

Data in Table (11) clearly show that treating Flame seedless grapevines with potassium silicate, once, twice, thrice or four times at 0.05 to 0.4% significantly, was followed by enhancing the percentages of berries colouration over the check treatment. This promotion on colouration significantly was correlated to the increase in the percentages of concentrations and frequencies of potassium silicate.

A slight and unsignificant increment on such character was observed, with increasing concentrations from 0.2 to 0.4% and frequencies from thrice to four times. The best berries colouration % (88.9% & 93.9%) during both seasons, respectively was observed on the vines that received three sprays of potassium silicate at 0.2% from economical point of view. Berries colouration in the clusters of untreated vines reached 65.5 and 67.6% during both seasons, respectively. These results were true during both seasons.

5- Physical and chemical characteristics of the berries

Data in Tables (12 to 16) clearly show that treating the vines with potassium silicate once, twice, thrice or four times at 0.05 to 0.04% significantly was very effective in enhancing quality of the berries in terms of increasing berry weight and dimensions (longitudinal & equatorial), T.S.S% reducing sugars and T.S.S/ acid and reducing total acidity % over the control treatment. Berry shape index value did not alter significantly with the present treatments. There was a gradual promotion on quality-of the berries with increasing concentrations and frequencies of potassium silicate,. Increasing concentrations from 0.2 to 0.4% and frequencies from thrice or four times failed significantly to show any promotion on berries quality. Economically point of view, the best results with regard to quality of the berries were obtained due to subjecting the vines with potassium silicate three times at 0.2%. Unfavourable effects in quality were observed in the untreated vines. These results were true during both seasons.

Table (2): Effect of different concentrations and frequencies of potassium silicate on the main shoot length and leaf area of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Main shoot length (cm)										Leaf area (cm^2)									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
$A_1$0.0%	125.0	125.3	125.6	125.7	125.4	128.3	128.6	128.7	128.8	128.6	121.7	122.0	122.3	122.3	122.1	122.9	123.0	123.3	123.3	123.1
A_2 0.05%	127.9	130.0	132.0	132.6	130.6	131.3	129.0	131.3	131.6	130.8	123.0	125.3	127.0	127.3	125.7	124.2	124.9	128.2	128.7	126.5
A_3 0.1%	131.0	133.3	135.9	136.0	134.1	134.0	132.3	135.0	135.7	134.3	124.3	126.9	128.9	129.0	127.3	125.2	129.3	131.0	131.3	129.2
A_4 0.2%	135.9	138.9	145.0	145.6	141.4	136.6	136.0	142.9	143.0	139.6	126.3	129.0	132.9	133.0	130.3	127.7	131.7	133.9	134.0	131.8
$A_5$0.4%	136.1	139.0	145.3	146.0	141.6	137.0	136.3	143.0	143.3	139.9	127.0	129.3	133.0	133.3	130.7	128.0	131.9	134.0	134.3	132.1
Means (B)	131.2	133.3	136.8	137.2		133.4	132.4	136.2	136.5		124.5	128.1	128.8	129.0		125.6	128.2	130.1	130.3	
New L.S.D. at 5%	A 1.8	B 1.6	AB 3.6			A 1.9	B 1.6	AB 3.6			A 0.9	B 0.8	AB 1.8			A 1.0	B 0.9	AB 2.0		

Table (3): Effect of different concentrations and frequencies of potassium silicate on the pruning wood weight and cane thickness of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Pruning wood weight (kg/vine)										Cane thickness (cm)									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
$A_1$0.0%	1.31	1.32	1.33	1.33	1.32	1.40	1.41	1.41	1.41	1.41	1.00	1.01	1.01	1.01	1.01	0.99	1.00	1.00	1.00	1.00
A_2 0.05%	1.45	1.44	1.56	1.57	1.51	1.55	1.45	1.55	1.56	1.53	1.07	1.11	1.16	1.17	1.13	1.11	1.13	1.16	1.17	1.14
A_3 0.1%	1.60	1.69	1.82	1.83	1.74	1.70	1.59	1.82	1.83	1.74	1.11	1.21	1.25	1.26	1.21	1.15	1.22	1.26	1.26	1.22
A_4 0.2%	1.75	1.94	2.33	2.35	2.10	1.87	1.97	2.44	2.45	2.18	1.14	1.27	1.38	1.39	1.30	1.17	1.29	1.41	1.41	1.32
$A_5$0.4%	1.76	1.95	2.35	2.37	2.11	1.88	1.99	2.45	2.46	2.20	1.15	1.28	1.39	1.40	1.31	1.18	1.30	1.41	1.41	1.33
Means (B)	1.57	1.67	1.88	2.16		1.68	1.68	1.93	1.94		1.10	1.18	1.24	1.25		1.12	1.19	1.25	1.25	
New L.S.D. at 5%	A 0.08	B 0.07	AB 0.16			A 0.09	B 0.07	AB 0.16			A 0.02	B 0.02	AB 0.04			A 0.02	B 0.02	AB 0.04		

Table (4): Effect of different concentrations and frequencies of potassium silicate on the chlorophylls a & b (mg /100g F.W) in the leaves of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Chlorophylls a (mg /100g F.W)										Chlorophylls b (mg /100g F.W)									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
$A_1$0.0%	5.11	5.12	5.12	5.13	5.12	5.30	5.31	5.32	5.32	5.31	1.60	1.61	1.62	1.62	1.61	1.64	1.65	1.65	1.66	1.65
A_2 0.05%	5.31	5.71	6.01	6.03	5.76	5.51	5.92	6.22	6.23	5.97	1.85	2.00	2.17	2.18	2.06	1.91	2.05	2.22	2.22	2.10
A_3 0.1%	5.55	6.39	6.62	6.63	6.30	5.78	6.60	6.85	6.86	6.52	2.05	2.22	2.40	2.41	2.27	2.11	2.28	2.46	2.47	2.33
A_4 0.2%	5.80	6.80	7.61	7.63	6.96	6.02	7.01	7.71	7.72	7.12	2.30	2.55	2.95	2.96	2.69	2.40	2.61	3.01	3.01	2.76
$A_5$0.4%	5.82	6.83	7.64	7.66	6.99	6.03	7.03	7.72	7.75	7.13	2.32	2.57	2.97	2.97	2.71	2.42	2.62	3.02	3.03	2.77
Means (B)	5.52	6.17	6.60	6.62		5.73	6.37	6.76	6.78		2.02	2.19	2.42	2.43		2.10	2.24	2.47	2.48	
New L.S.D. at 5%	A 0.15	B 0.41	AB 0.31			A 0.14	B 0.13	AB 0.13			A 0.12	B 0.11	AB 0.25			A 0.12	B 0.11	AB 0.25		

Table (5): Effect of different concentrations and frequencies of potassium silicate on the total chlorophylls and total carotenoids (mg/100g F.W) in the leaves of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Total chlorophylls (mg /100g F.W)										Total carotenoids (mg /100g F.W)									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
$A_1$0.0%	6.71	6.73	6.74	6.75	6.73	6.94	6.96	6.97	6.98	6.96	1.41	1.41	1.41	1.42	1.41	1.52	1.52	1.53	1.53	1.53
A_2 0.05%	7.16	7.71	8.18	8.21	7.82	7.42	7.97	8.44	8.45	8.07	1.61	1.80	1.97	1.98	1.84	1.73	1.94	2.15	2.16	2.00
A_3 0.1%	7.60	8.61	9.02	9.04	8.57	7.89	8.88	9.31	9.33	8.85	1.82	1.98	2.11	2.12	2.01	1.94	2.14	2.26	2.27	2.15
A_4 0.2%	8.15	9.40	10.56	10.59	9.68	8.42	9.62	10.72	10.73	9.87	1.94	2.15	2.60	2.61	2.33	2.07	2.27	2.71	2.72	2.44
$A_5$0.4%	8.19	9.40	10.61	10.63	9.71	8.45	9.65	10.74	10.78	9.91	1.95	2.16	2.61	2.62	2.34	2.08	2.28	2.72	2.73	2.45
Means (B)	7.56	8.37	9.02	9.04		7.82	8.62	9.24	9.25		1.75	1.90	2.14	2.15		1.87	2.03	2.27	2.28	
New L.S.D. at 5%	A 0.16	B 0.14	AB 0.31			A 0.15	B 0.14	AB 0.31			A 0.11	B 0.10	AB 0.22			A 0.10	B 0.09	AB 0.22		

Table (6): Effect of different concentrations and frequencies of potassium silicate on the percentages of N and P in the leaves of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Leaf N %										Leaf P %									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
$A_1$0.0%	1.61	1.62	1.62	1.63	1.62	1.69	1.70	1.70	1.70	1.70	0.12	0.12	0.12	0.12	0.12	0.13	0.14	0.14	0.14	0.14
A_2 0.05%	1.71	1.77	1.85	1.86	1.80	1.75	1.85	1.95	1.95	1.88	0.16	0.19	0.22	0.22	0.20	0.17	0.20	0.23	0.24	0.21
A_3 0.1%	1.84	1.95	2.02	2.03	1.96	1.89	1.96	2.09	2.10	2.01	0.20	0.23	0.26	0.27	0.24	0.21	0.24	0.27	0.27	0.25
A_4 0.2%	1.97	2.09	2.31	2.32	2.17	2.03	2.12	2.39	2.40	2.24	0.24	0.28	0.33	0.33	0.30	0.25	0.29	0.36	0.36	0.32
$A_5$0.4%	1.98	2.10	2.31	2.32	2.18	2.04	2.12	2.40	2.41	2.24	0.25	0.29	0.33	0.34	0.30	0.25	0.30	0.36	0.37	0.32
Means (B)	1.82	1.91	2.02	2.03		1.88	1.95	2.11	2.11		0.19	0.22	0.25	0.26		0.20	0.23	0.27	0.28	
New L.S.D. at 5%	A 0.06	B 0.05	AB 0.11			A 0.06	B 0.05	AB 0.11			A 0.02	B 0.02	AB 0.04			A 0.02	B 0.02	AB 0.04		

Table (7): Effect of different concentrations and frequencies of potassium silicate on the percentages of K and Mg in the leaves of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Leaf K %										Leaf Mg %									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
$A_1$0.0%	1.11	1.11	1.12	1.12	1.12	1.14	1.14	1.14	1.14	1.14	0.50	0.51	0.51	0.51	0.51	0.52	0.52	0.52	0.52	0.52
A_2 0.05%	1.20	1.31	1.42	1.43	1.34	1.25	1.40	1.49	1.50	1.41	0.56	0.64	0.70	0.71	0.65	0.60	0.67	0.75	0.76	0.70
A_3 0.1%	1.29	1.44	1.55	1.56	1.46	1.35	1.50	1.56	1.57	1.50	0.62	0.70	0.77	0.78	0.72	0.64	0.74	0.80	0.80	0.75
A_4 0.2%	1.37	1.57	1.71	1.72	1.59	1.45	1.59	1.75	1.75	1.64	0.68	0.79	0.89	0.90	0.82	0.69	0.80	0.94	0.94	0.84
$A_5$0.4%	1.38	1.58	1.71	1.73	1.60	1.46	1.60	1.75	1.76	1.64	0.69	0.80	0.90	0.91	0.83	0.70	0.80	0.95	0.95	0.85
Means (B)	1.27	1.40	1.50	1.51		1.33	1.45	1.54	1.54		0.61	0.69	0.75	0.76		0.63	0.71	0.79	0.79	
New L.S.D. at 5%	A 0.04	B 0.04	AB 0.09			A 0.05	B 0.04	AB 0.09			A 0.03	B 0.03	AB 0.06			A 0.03	B 0.03	AB 0.06		

Table (8): Effect of different concentrations and frequencies of potassium silicate on the percentages of berry setting and yield expressed in number of clusters per vine of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Berry setting %										No. of cluster/vine									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
$A_1$0.0%	14.1	14.2	14.2	14.2	14.2	15.0	15.0	15.1	15.1	15.1	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	24.0	23.3
A_2 0.05%	14.8	15.4	16.0	16.1	15.6	15.7	16.1	16.9	17.0	16.4	23.0	23.0	23.0	23.0	23.0	26.0	28.0	30.0	30.0	28.5
A_3 0.1%	15.6	16.2	17.0	17.1	16.48	16.5	17.1	17.9	18.0	17.4	24.0	24.0	24.0	24.0	24.0	28.0	30.0	32.0	32.0	30.5
A_4 0.2%	16.2	17.3	18.2	18.3	17.5	17.1	18.2	19.1	19.2	18.4	24.0	24.0	24.0	24.0	24.0	31.0	32.0	36.7	37.0	34.2
$A_5$0.4%	16.3	17.4	18.3	18.4	17.6	17.2	18.3	19.2	19.3	18.5	24.0	24.0	24.0	24.0	24.0	31.0	32.0	37.0	37.3	34.3
Means (B)	15.4	16.1	16.7	16.8		16.3	16.9	17.6	17.7		23.6	23.6	23.6	23.6		27.8	29.0	31.7	32.1	
New L.S.D. at 5%	A 0.5	B 0.4	AB 0.9			A 0.5	B 0.5	AB 1.1			A NS	B NS	AB NS			A 2.0	B 2.0	AB 4.5		

Table (9): Effect of different concentrations and frequencies of potassium silicate on the yield /vine (kg) and average cluster weight of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Yield /vine (kg)										Average cluster weight (g)									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
A_1 0.0%	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.4	8.1	347.0	347.0	347.0	348.0	347.0	348.0	348.0	348.0	348.0	348.0
A_2 0.05%	8.3	8.7	9.1	9.1	8.8	9.4	10.6	11.8	11.9	10.9	361.0	377.0	394.0	395.0	382.0	362.7	378.0	395.0	396.0	382.9
A_3 0.1%	9.2	9.6	10.0	10.0	9.7	10.8	12.1	13.3	13.4	12.4	385.0	401.0	406.0	417.0	404.8	386.7	403.0	418.0	418.0	406.4
A_4 0.2%	9.8	10.1	10.5	10.6	10.2	12.7	13.6	16.2	16.4	14.7	407.0	422.0	439.0	440.0	427.0	408.6	424.0	441.0	442.0	428.9
A_5 0.4%	9.8	10.1	10.6	10.6	10.2	12.7	13.6	16.4	16.5	14.7	408.0	422.0	440.0	440.0	427.5	409.0	425.0	442.0	442.0	429.5
Means (B)	9.0	9.3	9.6	9.6		10.7	11.5	13.0	13.1		381.6	393.8	407.2	408		383.0	395.6	408.8	409.2	
New L.S.D. at 5%	A 0.5	B 0.3	AB 0.7			A 0.5	B 0.5	AB 1.1			A 15.0	B 14.2	AB 31.9			A 15.1	B 14.7	AB 32.9		

Table (10): Effect of different concentrations and frequencies of potassium silicate on the cluster dimensions namely length and width (cm) of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Cluster length (cm)										Cluster width (cm)									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
A_1 0.0%	16.1	16.1	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	10.6	10.6	10.7	10.7	10.7	10.4	10.5	10.5	10.5	10.5
A_2 0.05%	16.8	17.3	18.0	18.1	17.6	16.9	17.4	18.1	18.1	17.6	11.1	11.6	12.2	12.3	11.8	11.0	11.7	12.2	12.3	11.8
A_3 0.1%	17.4	18.0	18.5	18.6	18.1	17.5	18.1	18.7	18.8	18.3	11.7	12.2	12.9	13.0	12.5	11.8	12.3	13.0	13.0	12.5
A_4 0.2%	18.0	18.6	19.2	19.3	18.8	18.1	19.0	19.6	19.7	19.1	12.3	13.0	13.9	14.0	13.3	12.2	13.1	14.0	14.0	13.3
A_5 0.4%	18.1	18.7	19.3	19.4	18.9	18.2	19.0	19.7	19.8	19.2	12.4	13.0	14.0	14.0	13.4	12.3	13.1	14.0	14.1	13.4
Means (B)	17.3	17.7	18.2	18.3		17.4	17.9	18.5	18.5		11.6	12.1	12.7	12.8		11.5	12.1	12.7	12.9	
New L.S.D. at 5%	A 0.5	B 0.4	AB 0.9			A 0.5	B 0.4	AB 0.9			A 0.4	B 0.4	AB 0.9			A 0.4	B 0.4	AB 0.9		

Table (11): Effect of different concentrations and frequencies of potassium silicate on the cluster compactness and percentage of berries colouration of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Cluster compactness(cm)										Berries colouration %									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
A_1 0.0%	2.1	2.1	2.2	2.2	2.2	2.0	2.0	2.0	2.0	2.0	65.5	66.0	66.0	66.0	65.9	67.6	68.0	68.0	68.3	68.0
A_2 0.05%	2.5	2.9	3.3	3.3	3.0	2.6	3.0	3.4	3.4	3.1	68.0	72.0	74.9	75.0	72.5	71.0	75.0	78.0	78.0	75.5
A_3 0.1%	2.9	3.3	3.9	4.0	3.5	3.0	3.3	3.9	4.0	3.6	71.9	76.0	78.0	78.6	76.1	75.0	80.0	82.2	83.3	80.1
A_4 0.2%	3.3	3.6	4.2	4.2	3.8	3.5	3.7	4.3	4.3	3.9	74.0	79.0	88.9	89.0	82.7	77.0	82.3	93.3	94.0	86.7
A_5 0.4%	3.3	3.6	4.3	4.3	3.9	3.6	3.7	4.3	4.3	4.0	74.6	79.3	89.0	89.6	83.1	77.3	81.6	93.6	94.3	87.0
Means (B)	2.8	3.1	3.6	3.6		2.9	3.1	3.6	3.6		70.8	74.5	79.4	79.6		73.6	77.6	83.0	83.6	
New L.S.D. at 5%	A 0.3	B 0.3	AB 0.7			A 0.3	B 0.4	AB 0.9			A 1.0	B 1.0	AB 2.2			A 0.9	B 1.0	AB 2.2		

Table (12): Effect of different concentrations and frequencies of potassium silicate on the weight (g) and longitudinal of berry (cm) of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Berry weight (g)										Berry longitudinal (cm)									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
A_1 0.0%	2.55	2.56	2.56	2.56	2.56	2.60	2.60	2.61	2.61	2.61	1.99	2.00	2.00	2.00	2.00	2.06	2.06	2.06	2.06	2.06
A_2 0.05%	2.71	2.91	3.05	3.06	2.93	2.76	2.97	3.11	3.11	2.99	2.07	2.14	2.22	2.23	2.16	2.22	2.30	2.39	2.41	2.33
A_3 0.1%	2.94	3.05	3.20	3.21	3.10	2.99	3.16	3.25	3.26	3.17	2.14	2.22	2.29	2.30	2.24	2.29	2.39	2.50	2.51	2.42
A_4 0.2%	3.11	3.21	3.49	3.50	3.33	3.17	3.26	3.55	3.56	3.39	2.29	2.29	2.35	2.36	2.32	2.45	2.51	2.60	2.60	2.54
A_5 0.4%	3.13	3.21	3.50	3.51	3.34	3.18	3.26	3.55	3.56	3.39	2.30	2.30	2.36	2.37	2.33	2.45	2.51	2.60	2.60	2.54
Means (B)	2.89	2.99	3.16	3.17		2.94	3.05	3.12	3.28		2.16	2.19	2.24	2.25		2.29	2.35	2.43	2.43	
New L.S.D. at 5%	A 0.10	B 0.09	AB 0.20			A 0.09	B 0.09	AB 0.20			A 0.05	B 0.05	AB 0.11			A 0.05	B 0.05	AB 0.11		

Table (13): Effect of different concentrations and frequencies of potassium silicate on the berry equatorial and berry shape index value of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Berry equatorial (cm)										Berry shape index value									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
A_1 0.0%	1.85	1.86	1.87	1.88	1.86	1.90	1.91	1.91	1.92	1.91	1.08	1.08	1.07	1.06	1.08	1.08	1.08	1.08	1.07	1.08
A_2 0.05%	1.92	1.99	2.06	2.07	2.01	1.97	2.03	2.10	2.11	2.05	1.08	1.08	1.08	1.08	1.07	1.13	1.13	1.14	1.14	1.14
A_3 0.1%	2.00	2.07	2.13	2.14	2.08	2.06	2.11	2.17	2.18	2.13	1.07	1.07	1.08	1.07	1.08	1.11	1.13	1.15	1.15	1.14
A_4 0.2%	2.06	2.13	2.20	2.21	2.15	2.13	2.19	2.35	2.36	2.26	1.11	1.08	1.07	1.07	1.08	1.15	1.15	1.11	1.10	1.12
A_5 0.4%	2.07	2.14	2.21	2.22	2.16	2.14	2.20	2.36	2.37	2.27	1.11	1.07	1.07	1.07	1.08	1.14	1.14	1.10	1.10	1.12
Means (B)	1.98	2.04	2.09	2.10		2.04	2.09	2.18	2.19		1.09	1.07	1.07	1.07		1.12	1.12	1.11	1.11	
New L.S.D. at 5%	A 0.04	B 0.04	AB 0.09			A 0.04	B 0.04	AB 0.09			A NS	B NS	AB NS			A NS	B NS	AB NS		

Table (14): Effect of different concentrations and frequencies of potassium silicate on the percentages of total soluble solids and reducing sugars in the berries of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	T.S.S%										Reducing sugars %									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
$A_1$0.0%	18.0	18.0	18.0	18.1	18.02	18.1	18.1	18.1	18.1	18.1	16.3	16.4	16.4	16.4	16.37	16.5	16.5	16.5	16.5	16.5
A_2 0.05%	18.4	18.9	19.4	19.5	19.05	18.5	19.0	19.6	19.6	19.17	16.9	17.4	17.7	17.8	17.45	16.8	17.3	17.9	18.0	17.5
A_3 0.1%	19.0	19.5	19.9	20.0	19.6	19.1	19.6	19.9	20.0	19.65	17.5	17.7	18.0	18.1	17.82	17.4	18.0	18.4	18.5	18.07
A_4 0.2%	19.4	20.0	20.5	20.6	20.12	19.5	20.1	20.5	20.5	20.15	17.9	18.4	18.9	19.0	18.55	18.0	18.6	18.9	19.0	18.82
$A_5$0.4%	19.5	20.0	20.6	20.7	20.2	19.2	20.1	20.5	20.6	20.2	18.0	18.5	19.0	19.1	18.7	18.1	18.7	19.0	19.1	18.7
Means (B)	18.9	19.3	19.7	19.8		18.9	19.4	19.7	19.8		17.3	17.7	18.0	18.1		17.4	17.8	18.1	18.2	
New L.S.D. at 5%	A 0.2	B 0.2	AB 0.4			A 0.2	B 0.2	AB 0.4			A 0.2	B 0.2	AB 0.4			A 0.2	B 0.2	AB 0.4		

Table (15): Effect of different concentrations and frequencies of potassium silicate on the percentages of total acidity and T.S.S/acid in the berries of Flame seedless grapevines during 2013 & 2014 seasons.

Concentrations of Potassium Silicate (A)	Total acidity %										T.S.S/ acid									
	Frequencies of potassium silicate (B)																			
	2013					2014					2013					2014				
	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)	B_1 once	B_2 twice	B_3 thrice	B_4 four	Mean (A)
$A_1$0.0%	0.718	0.717	0.716	0.716	0.717	0.722	0.721	0.721	0.720	0.721	25.1	25.1	25.1	25.7	25.1	25.1	25.1	25.1	25.1	25.1
A_2 0.05%	0.680	0.650	0.620	0.619	0.642	0.675	0.645	0.615	0.614	0.637	27.1	29.1	31.5	31.5	29.7	27.4	27.5	31.9	31.9	30.1
A_3 0.1%	0.650	0.620	0.594	0.592	0.614	0.645	0.615	0.590	0.585	0.609	29.2	31.5	33.7	33.8	31.9	29.6	31.9	33.7	34.0	32.3
A_4 0.2%	0.620	0.590	0.560	0.558	0.582	0.615	0.585	0.555	0.554	0.577	31.3	33.9	36.6	36.9	34.6	31.7	34.4	36.9	37.0	34.9
$A_5$0.4%	0.618	0.588	0.558	0.557	0.580	0.614	0.583	0.554	0.553	0.576	31.6	34.0	36.9	37.2	34.8	31.8	34.5	37.0	37.3	35.0
Means (B)	0.657	0.633	0.610	0.608		0.654	0.630	0.606	0.605		28.8	30.5	32.3	32.6		28.9	30.8	32.5	32.7	
New L.S.D. at 5%	A 0.2	B 0.2	AB 0.4			A 0.022	B 0.019	AB 0.043			A 1.4	B 1.1	AB 2.4			A 1.1	B 1.1	AB 2.4		

4. Discussion

Previous studies showed that the favourable effects of silicon on growth, nutritional status of the vines 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 and erecting the structure of xylem Vessels. Previous studies explained these benefits to the formation of silica cuticle double layers formed on leaf epidermal tissues. Silicon also is responsible in enhancing water transport and root development as well as increasing the tolerance of plants to producing mildew. The mechanical strength provided by silicon to the plants tissues increases their resistance to diseases and insects and is responsible for reducing the adverse effects of heavy metal toxicity (**Matoh, *et al.*, 1991; Lux *et al.*, 2003; Hattori, *et al.*, 2003; Rodrigues *et al.*, 2003; Ma, 2004 and Tahir *el al.*, 2006**).

The findings regarding the promoting effect of, silicon on growth and fruiting of Flame seedling grapevines are in harmony with those obtained by **Gad El- Kareem (2012) Ahmed *et al.*, (2013b)** on Taimour mango trees; **Abdelaal and Oraby-Mona (2013)** on Ewaise mango trees, **Al-Wasfy,(2014)** on Flame seedless grapevines; **El-Khawaga and Mansour (2014)** oil Washington Navel orange trees; **Ibrahim and Al- Wasfy (2014)** on Valencia orange trees and **Gad El-Kareem *et al.*, (2014)** on Zaghloul date palms.

Conclusion

Under the experimental and resembling conditions, it, is suggested to spray potassium silicate thrice (at growth start, just after berry setting and at 14 days: later) at 0.2% for promoting yield, and fruit quality and at the same time decreasing, the problem of irregular berries colouration of berries in Flame seedless vineyards.

References

1. Abdelaal, A.A.M. and Oraby-Mona, M.M (2013): Using silicon for increasing the mango cv Ewaise transplants to drought. World Rural Observations 5(2):36-40.
2. Ahmed, F. F and Morsy, M. H. (1999): A new method for measuring leaf area in different fruit species. Minia. 1. of Agric .Rec. & Dev.19: 97-105.
3. Ahmed, F.F.; Mansour, A.E.M.; Mahmoud, A.Y.; Mostafa, E.A.M. and Ashour, N.E. (2013): Using silicon and salicylic acid for promoting production of Hindy Basinnara mango trees grown under sandy soil. Middle East J. of Agric. res. 2(2): 51-55.
4. Al- Wasfy, M.M. (2013): Response of Sakkoti date palms to foliar application of royal jelly, silicon and vitamins B. Nature of Sci. 9(5):315-321.
5. Al- Wasfy, M.M. (2014): The synergistic effects of using silicon with some vitamins on growth and fruiting of Flame seedless grapevines. Stem Cell 5(1): 8-13.
6. Association of Official Agriculture Chemists (A.O.A.C) (2000): Official Methods of Analysis (A.O.A.C), 12th Ed., Benjamin Franklin Station, Washington D.C., U.S.A. pp. 490-510.

7. Chapman, H.D. and Pratt, P.E. (1965): Methods of Analysis for Soil, Plant and Water. Univ. of Calif. Division of Agric. Sci. 172-173.
8. El-Khawaga, A.S. and Mansour, A.E.A. (2014): Promoting productively of Washington Navel orange trees by using some crop seed sprout extracts silicon and glutathione. Middle East J. of Applied Sci., 4(3):779-785.
9. Gad El- Kareem, M.R. (2012): Improving productively of Taimour mango trees by using glutathione, silicon and vitamin B. Minia J. of agric. Res.& Develop 32(7): 1105-1121.
10. Gad El- Kareem, M.R. and Abada, M.A.M. (2014): Trails for promoting productively of Flame seedless grapevines. J. Biol. Chem. Environ. Sci. 9(1):35-46.
11. Hattori, T;Inanaga, S.; Tanimot, E. Luxova, M. and Sugimoto, Y. (2003): Silicon induced changes in viscoelastic properties of sorghum root cell walls. Plant Cell Physiol. 44:743-749.
12. Hiscox, A. and Isralstam B. (1979): Method for the extraction of chlorophyll from leaf tissue without maceration. Can. J. Bot. 57:1332-1334.
13. Ibrahim, H.I.M. and Al- Wasfy, M.M. (2014): The promotive impact of using silicon and selenium with potassium and boron on fruiting of Valencia orange trees grown under Minia region conditions. World Rural Observations 6(2):28-36.
14. Lane, J. H. and Eynon, L. (1965): Determination of reducing sugars by means of Fehlings solution with methylene blue as indicator A.O.AC. Washington D.C.U.S.A. pp.490-510.
15. Lux, A.; Luxova, M.; Abe, J. Tanmoto, E. and Inanaga, S. (2003): The dynamic of silicon deposition in the sorghum root endodermis. New Physiol. 158:437-441.
16. Ma, J.F. (2004): Role of silicon in enhancing the resistance of plants to biotic and abiotic stresses. Soil Sci. Plant Nutr. 50:11-18.
17. Matoh, T.; Murata, S. and Takahashi, E. (1991): Effect of silicate application on photosynthesis of rice plants. Japan. J. Soil Sci. Plant Nutr. 62:248-251.
18. Mead, R.; Currow, R.N. and Harted, A.M. (1993): Statistical Methods in Agricultural and Experimental Biology. Second Ed. Chapman & Hall.London, pp.10-44.
19. Piper, G.S. (1950): Soil and Plant Analysis. Inter. Sci. New York. pp. 48-110.
20. Tahir, M.A.; Rahmatullah, A.; aziz, T.; Ashraf, M.; Kanwal, S. and Magsood, A. (2006): Beneficial effects of silicon in wheat (*Triticumaestivum* L.) under salinity stress. Pak. J. Bot. 38(5):1715-1727.
21. Rodrigues, F.A.; Vale, F.X.R.; Kerridorfar, G.H.; Prabhu, A.S.; Datnoff, L.E.; Oliveria, A.M.A. and Zambalim, L. (2003): Influence of silicon on Shealth blight of rice in Brazil. Crop.Prot; 22: 23-29.
22. Summer, M.E. (1985): Diagnosis and Recommendation Integrated System (DRIS) as a guide to orchard fertilization. Hort. Abs. 55(8): 7502.
23. Von-Wettstein, D.V.C. (1957): Clatale under Sumbmikro Skopisne Formwechsel de Plastids. Experimental Cell Research, 12:427.
24. Wilde, S.A.; Corey, R. B.; Layer, J. and Voigt, G. K. (1985): Soils and Plant Analysis for Tree Culture. 3rd Ed. Oxford and IBH publishing Co., New Delhi, India, pp. 490-510.

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