

## Overcoming Poor Yield and Irregular Berries Colouration in Flame Seedless Grapevines Growth under Upper Egypt Conditions.

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**Abstract:** During 2013 and 2014 seasons, Flame seedless grapevines grown under Luxor region condition subjected to one, two, three or four sprays of salicylic acid at 0.0, 50, 100, 200 or 400 ppm. The impact of different concentrations and frequencies of salicylic acid application on overcoming the problems of poor yield and berries colouration was investigated. Carrying out one to four sprays of salicylic acid at 50 to 400 substatistically succeeded in stimulating all growth characters, vine nutritional status, yield and fruit quality and at the same time enhancing colouration of the berries over the check treatment. These effects were in proportional to the increase in concentrations and frequencies of salicylic acid application. No. measurable effects on all the investigated parameters were observed among the higher two concentrations (200 & 400 ppm) and frequencies (thrice & four times) of salicylic acid application. For promotion yield and berries quality and at the same time overcoming irregular colouration of the berries in Flame seedless grown under Upper Egypt condition, it is advised to spray salicylic acid three times (growth start, just after berry setting and two weeks later) at 200 ppm.

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### 1. Introduction

Poor yield and irregular berries colouration in grapevine cv. Flame seedless grown under Upper Egypt conditions are considered the major problems facing grape growers in this region. The main reason for these problems was the unsuitable environmental conditions. Finding out the compounds capable of reducing the adverse effects of all stresses on the yield and fruit colourations is very essential from the practical point of view.

Salicylic acid as reported by many authors has definite roles in enhancing cell division, and the tolerance of the trees to biotic and abiotic stresses through producing the protective compounds such as polyamines, plant pigments, photosynthesis as well as uptake and transport of nutrients. It is biosynthesized from phenylalanine (Janda *et al.*, 2007 and Van-Huijsduijnen, 2009).

The promoting effect of salicylic acid on growth, nutritional status of the trees, yield and fruit quality was emphasized by the results of Madian (2004); Abd El- Kareem (2009); El- Hanafy (2011); El- Kady-Hanaa (2011); Bondok – Sawsan *et al.*, (2011) and Osman (2014).

The objective of this study was examining the impact of different concentrations and frequencies of salicylic acid application on vegetative growth characters, vine, nutritional status, berry setting, berries

colouration as well as physical and chemical characteristics of the Flame seedless grapevines grown under Luxor governorate conditions.

### 2. Material and Methods

This study was carried out during 2013 and 2014 seasons on one- hundred and twenty uniform in vigour of 8 years- old Flame seedless grapevines. The selected vines are grown in a private vineyard namely Wady El-Nesseem located at El- Gabaleen village, Esna district, Luxor Governorate where the texture of the soil is sandy (Table 1). Soil analysis was done according to the procedures that outlined by Black (1965). The selected vines are planted at 2 x 3 meters apart and trained by spur pruning system (short pruning) leaving 72 eyes/ vine (15 fruiting spurs x 4 eyes plus six replacement spurs X two eyes) using Baroun supporting method. Winter pruning was conducted at the middle of January during both seasons. Drip irrigation system was followed using well water containing 556 ppm EC.

The selected vines (120 vines) received the same horticultural practices that already applied in the vineyard.

This experiment included twenty treatments from two factors (A & B). The first factor (A) included the five concentrations of salicylic acid namely:

a<sub>1</sub>) 0.0 ppm salicylic acid

- a<sub>2</sub>) 50 ppm salicylic acid  
 a<sub>3</sub>) 100 ppm salicylic acid  
 a<sub>4</sub>) 200 ppm salicylic acid  
 a<sub>5</sub>) 400 ppm salicylic acid

**Table (1): Analysis of the tested soil**

Constituent	Values
Sand %	80.9
Silt %	10.1
Clay %	9.0
Texture	Sandy
O.M. %	0.90
pH ( 1 : 2.5 extract)	7.8
EC ( 1 :2.5 extract) (mmhos/cm/25°C)	1.01
CaCO <sub>3</sub> %	1.39
Total N %	0.05
Available P (Olsen method, ppm)	1.11
Available K ( ammonium acetate, ppm)	91.2
EDTA extractable micronutrients (ppm)	
Zn	0.9
Fe	1.1
Mn	0.9
Cu	0.3

The second factor (B) evolved the following four frequencies of salicylic acid application:

- b<sub>1</sub>) Once at growth start (3<sup>rd</sup> week of February)  
 b<sub>2</sub>) Twice at growth start and again just after berry setting ( last week of march).  
 b<sub>3</sub>) thrice at the same previous two stages and at two weeks later (second week of April)  
 b<sub>4</sub>) Four times at the same previous three dates and at two weeks later (last weeks of April).

Each treatment was replicated three times, two vine/ each. All solutions of salicylic were adjusted to pH 6.0 by using 1.0 N NaOH. Triton B as a wetting agent was added at 0.05% to all salicylic acid treatments including the control treatment. All the selected vines received salicylic acid solution till runoff.

Randomized complete block design (RCBD) in split plot arrangement was followed. The five concentrations of salicylic acid namely 0.0, 50, 100, 200 or 400 ppm ranked the main plots. While the four frequencies of applications namely, once, twice, thrice or four times occupied the subplots.

During both seasons, the following measurements were recorded:

- 1- Leaf area (**Ahmed and Morsy, 1999**), number of leaves/ shoot, pruning wood weight (kg.) per vine and cane thickness.
- 2- Chlorophylls a & b and total chlorophylls (**Von-Wettstein, 1957 and Hiscox and Isralstam, 1979**).

- 3- Percentages of N, P, K, Mg and Ca ( on dry weight basis) in the petioles (**Summer, 1985 and Cottenie et al., 1982**).
- 4- Berry setting % and yield expressed in weight (kg.) and number of clusters per vine.
- 5- Weight(g.), length and width (cm.) of cluster.
- 6- Berries colouration %.
- 7- Weight (g.), longitudinal and equatorial (cm) of berry.
- 8- Chemical characteristics of the berries namely, T.S.S., reducing sugars (**Lane and Eynon, 1965 and A.O.A.C., 2000**), total acidity % ( as g tartaric acid/ 100 ml juice, **A.O.A.C., 2000**) and total anthocyanins (mg/ 100 ml juice) ( **Fulcki and Francis, 1968**).

The proper statistical analysis was done using New L.S.D. at 5% test for making all differences among the different treatment means (**Mead et al., 1993**).

### 3. Results and Discussion

#### 1-Growth characters:

It is clear from the data in Table (2) that using salicylic acid once, twice, thrice or four times at 50 to 400 ppm significantly was accompanied with enhancing the leaf area number of leaves/ shoot, pruning wood weight and cane thickness over the control treatment. The promotion on these growth aspects was in proportional to the increase in concentrations from 0.0 to 400 ppm and frequencies from one to four sprays. Meaningless promotion on these growth characters was attributed to increasing concentrations from 200 to 400 ppm and frequencies from thrice to four times. The maximum values were recorded on the vines that received four sprays of salicylic acid at 400 ppm. Untreated vines produced the minimum values. These results were true during both seasons.

The beneficial effects of using salicylic acid on enhancing the tolerance of fruit crops to all stresses cell division, photosynthesis and uptake of nutrients (**Janda et al., 2007**) surely reflected on stimulating growth characters.

These results are in agreement with those obtained by **Madian(2014) and Osman (2014)** on various grapevine cvs.

#### 2- Leaf chemical composition:

Data in Tables ( 3 & 4) clearly show that chlorophylls a & b, total chlorophylls, N, P, K, Mg and Ca in the leaves were significantly stimulated due to using 50 to 400 ppm salicylic acid once, twice, thrice or four times comparing to the check treatment. The promotion on these pigments and nutrients was associated with increasing concentrations and frequencies of salicylic acid. Increasing concentration from 200 to 400 ppm and frequencies from thrice to

four times failed significantly to increase these pigments and nutrients. Treating the vines four times with 400 ppm salicylic acid gave the highest values. The lowest values were recorded on untreated vines.

These results were nearly the same during 2013 and 2014 seasons.

These results might be ascribed to the essential role of salicylic acid on enhancing root development, uptake and transport of nutrients and plant pigments.

Table (2): Effect of different concentrations and frequencies of salicylic acid on some vegetative growth characters of Flame seedless grapevines during 2013 and 2014 seasons.

Concentrations of salicylic acid (A)	Leaf area (cm <sup>2</sup> )					Number of leaves / shoot														
	2013					2014					2013					2014				
	Frequencies of application (B)					Frequencies of application (B)					Frequencies of application (B)					Frequencies of application (B)				
	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)
a <sub>1</sub> 0.0 ppm	130.0	130.0	130.6	130.9	130.4	131.0	131.0	131.0	131.0	131.0	29.0	30.0	30.0	30.0	29.8	28.0	29.0	29.0	29.0	28.8
a <sub>2</sub> 50 ppm	131.7	133.0	134.9	135.0	133.7	132.0	134.0	136.9	137.0	135.0	31.0	33.0	36.0	36.0	34.0	31.0	34.0	37.0	37.0	34.8
a <sub>3</sub> 100 ppm	134.3	136.6	138.0	138.3	136.8	135.1	137.0	139.0	139.0	137.5	33.0	36.0	40.0	40.0	37.3	33.0	37.0	39.0	39.0	37.0
a <sub>4</sub> 200 ppm	135.9	137.0	139.0	139.0	137.7	138.0	140.0	143.0	143.0	141.0	36.0	40.0	42.0	42.0	40.0	35.0	38.0	40.0	40.0	38.3
a <sub>5</sub> 400 ppm	136.0	137.0	139.3	139.7	138.0	138.3	140.3	143.9	144.0	141.6	36.0	40.0	42.0	42.0	40.0	35.0	38.0	40.0	40.0	38.3
Mean (A)	133.6	134.6	136.4	136.6		134.9	136.5	138.9	138.9		33.0	35.8	38.0	38.0		32.4	35.2	37.0	37.0	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	1.1	1.0	2.2			1.0	0.9	2.0			2.0	2.0	2.5			2.0	2.0	2.5		
Character	Pruning wood weight / vine (kg.)					Pruning wood weight / vine (kg.)					Cane thickness (cm)					Cane thickness (cm)				
a <sub>1</sub> 0.0 ppm	1.88	1.89	1.90	1.90	1.89	2.00	2.00	2.01	2.01	2.01	0.81	0.81	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
a <sub>2</sub> 50 ppm	2.07	2.25	2.52	2.53	2.34	2.15	2.39	2.66	2.67	2.47	0.89	1.08	1.18	1.19	1.09	0.90	1.10	1.19	1.20	1.10
a <sub>3</sub> 100 ppm	2.22	2.52	2.69	2.70	2.53	2.35	2.66	2.81	2.82	2.66	0.99	1.18	1.30	1.31	1.20	1.01	1.20	1.31	1.31	1.21
a <sub>4</sub> 200 ppm	2.35	2.85	3.15	3.16	2.88	2.50	2.99	3.29	3.30	3.02	1.05	1.41	1.50	1.50	1.37	1.06	1.42	1.53	1.54	1.39
a <sub>5</sub> 400 ppm	2.36	2.87	3.17	3.20	2.90	2.52	3.00	3.30	3.31	3.03	1.06	1.42	1.52	1.53	1.38	1.06	1.43	1.55	1.56	1.40
Mean (A)	2.18	2.48	2.69	2.70		2.30	2.61	2.81	2.82		0.96	1.18	1.26	1.27		0.97	1.19	1.28	1.29	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	0.12	0.11	0.25			0.11	0.10	0.24			0.05	0.05	0.11			0.05	0.04	0.11		

Table (3): Effect of different concentrations and frequencies of salicylic acid on chlorophylls a & b, total chlorophylls and percentage of N in the leaves of Flame seedless grapevines during 2013 and 2014 seasons.

Concentrations of salicylic acid (A)	Chlorophyll a (mg/100 g F.W.)					Chlorophyll b (mg/100 g F.W.)														
	2013					2014					2013					2014				
	Frequencies of application (B)					Frequencies of application (B)					Frequencies of application (B)					Frequencies of application (B)				
	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)
a <sub>1</sub> 0.0 ppm	6.0	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	1.7	1.8	1.8	1.8	1.8	1.9	1.9	1.9	1.9	1.9
a <sub>2</sub> 50 ppm	6.7	7.5	8.9	9.0	8.0	7.0	7.8	9.3	9.3	8.4	2.3	3.0	3.7	3.8	3.2	2.5	3.1	3.7	3.8	3.3
a <sub>3</sub> 100 ppm	7.5	9.0	9.7	9.8	9.0	7.9	9.3	10.0	10.0	9.3	2.7	3.9	4.4	4.5	3.9	2.9	4.0	4.5	4.5	4.0
a <sub>4</sub> 200 ppm	8.9	10.0	11.0	11.1	10.3	9.2	10.5	11.3	11.4	10.6	3.1	4.4	4.9	5.0	4.4	3.3	4.5	5.0	5.1	4.5
a <sub>5</sub> 400 ppm	9.0	10.1	11.1	11.1	10.3	9.3	10.6	11.4	11.5	10.7	3.2	4.5	5.0	5.1	4.5	3.4	4.5	5.1	5.2	4.6
Mean (A)	7.6	8.5	9.4	9.4		7.9	8.9	9.6			2.6	3.5	4.0	4.0		2.8	3.6	4.0	4.1	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	0.4	0.4	0.9			0.4	0.3	0.7			0.2	0.2	0.4			0.3	0.2	0.4		
Character	Total Chlorophylls (mg/100 g F.W.)					Total Chlorophylls (mg/100 g F.W.)					Leaf N %					Leaf N %				
a <sub>1</sub> 0.0 ppm	7.7	7.9	7.9	7.9	7.9	8.0	8.0	8.0	8.0	8.0	1.64	1.65	1.65	1.65	1.65	1.66	1.66	1.67	1.68	1.67
a <sub>2</sub> 50 ppm	9.0	10.5	12.6	12.8	11.2	9.5	10.9	13.0	13.1	11.6	1.75	1.88	1.98	1.99	1.90	1.77	1.99	2.11	2.12	2.00
a <sub>3</sub> 100 ppm	10.2	12.9	14.1	14.3	12.9	10.8	13.3	14.5	14.5	13.5	1.87	1.98	2.11	2.12	2.02	1.90	2.05	2.17	2.18	2.08
a <sub>4</sub> 200 ppm	12.0	14.4	15.9	16.1	14.6	12.5	15.0	16.3	16.5	15.1	2.00	2.11	2.21	2.22	2.14	2.06	2.14	2.29	2.30	2.20
a <sub>5</sub> 400 ppm	12.2	14.6	16.1	16.2	14.8	12.7	15.1	16.5	16.7	15.3	2.02	2.12	2.22	2.23	2.15	2.06	2.15	2.30	2.31	2.21
Mean (A)	10.2	12.1	13.3	13.5		10.7	12.5	13.7	13.8		1.86	1.95	2.03	2.04		1.89	2.00	2.11	2.12	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	0.4	0.4	0.9			0.4	0.4	0.9			0.05	0.05	0.11			0.05	0.05	0.11		

Table (4): Effect of different concentrations and frequencies of salicylic acid on the percentages of P, K, Mg and Ca in the leaves of Flame seedless grapevines during 2013 and 2014 seasons.

Concentrations of salicylic acid (A)	Leaf P %					Leaf K %														
	2013					2014					2013					2014				
	Frequencies of application (B)					Frequencies of application (B)					Frequencies of application (B)					Frequencies of application (B)				
	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)
a <sub>1</sub> 0.0 ppm	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.12	1.15	1.16	1.16	1.16	1.16	1.17	1.17	1.18	1.18	1.18
a <sub>2</sub> 50 ppm	0.15	0.18	0.21	0.21	0.19	0.17	0.20	0.24	0.25	0.22	1.21	1.27	1.33	1.34	1.29	1.22	1.30	1.36	1.36	1.31
a <sub>3</sub> 100 ppm	0.17	0.19	0.22	0.23	0.20	0.21	0.28	0.31	0.31	0.28	1.29	1.35	1.40	1.41	1.36	1.31	1.38	1.43	1.44	1.39
a <sub>4</sub> 200 ppm	0.19	0.25	0.29	0.30	0.26	0.23	0.31	0.36	0.37	0.32	1.33	1.41	1.50	1.51	1.44	1.35	1.45	1.55	1.56	1.48
a <sub>5</sub> 400 ppm	0.19	0.36	0.30	0.31	0.27	0.23	0.31	0.36	0.37	0.32	1.34	1.42	1.51	1.52	1.45	1.36	1.45	1.56	1.57	1.49
Mean (A)	0.16	0.20	0.23	0.23		0.19	0.24	0.28	0.28		1.26	1.32	1.38	1.39		1.28	1.35	1.42	1.42	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	0.02	0.02	0.04			0.02	0.02	0.04			0.04	0.04	0.09			0.04	0.04	0.09		
Character	Leaf Mg %					Leaf Mg %					Leaf Ca %					Leaf Ca %				
a <sub>1</sub> 0.0 ppm	0.50	0.50	0.51	0.52	0.51	0.51	0.51	0.51	0.51	0.51	2.01	2.02	2.02	2.02	2.02	2.06	2.06	2.06	2.06	2.06
a <sub>2</sub> 50 ppm	0.55	0.61	0.66	0.67	0.62	0.60	0.70	0.79	0.80	0.72	2.15	2.31	2.41	2.42	2.32	2.17	2.35	2.43	2.44	2.35
a <sub>3</sub> 100 ppm	0.60	0.68	0.71	0.72	0.68	0.69	0.80	0.87	0.88	0.81	2.30	2.39	2.50	2.51	2.43	2.33	2.44	2.51	2.51	2.45
a <sub>4</sub> 200 ppm	0.66	0.71	0.79	0.80	0.74	0.76	0.88	0.99	0.99	0.91	2.41	2.55	2.70	2.71	2.59	2.42	2.59	2.73	2.74	2.61
a <sub>5</sub> 400 ppm	0.67	0.71	0.80	0.80	0.75	0.77	0.88	0.99	0.99	0.91	2.41	2.55	2.71	2.72	2.60	2.42	2.60	2.73	2.75	2.63
Mean (A)	0.60	0.64	0.69	0.70		0.67	0.75	0.83	0.83		2.26	2.36	2.47	2.48		2.28	2.41	2.49	2.50	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	0.03	0.03	0.07			0.03	0.03	0.07			0.07	0.06	0.13			0.07	0.06	0.13		

Table (5): Effect of different concentrations and frequencies of salicylic acid on berry setting % and No. of clusters / vine as well as yield / vine (kg.) and cluster weight (g.) of Flame seedless grapevines during 2013 and 2014 seasons.

Concentration of salicylic acid (A)	Berry setting %					No. of clusters / vine														
	2013					2014														
	Frequencies of application (B)					Frequencies of application (B)														
	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)
a <sub>1</sub> 0.0 ppm	10.1	10.2	10.2	10.2	<b>10.2</b>	10.2	10.2	10.3	10.3	<b>10.3</b>	22.0	22.0	22.0	22.0	<b>22.0</b>	24.0	24.0	24.0	24.0	<b>24.0</b>
a <sub>2</sub> 50 ppm	12.0	13.5	15.6	15.8	<b>14.2</b>	11.9	13.6	15.7	15.8	<b>14.3</b>	23.0	23.0	23.0	23.0	<b>23.0</b>	26.0	28.0	30.0	30.0	<b>28.5</b>
a <sub>3</sub> 100 ppm	13.5	14.9	16.5	16.6	<b>15.4</b>	13.6	15.0	16.6	16.7	<b>15.5</b>	23.0	23.0	23.0	23.0	<b>23.0</b>	28.0	30.0	30.0	30.0	<b>29.5</b>
a <sub>4</sub> 200 ppm	14.8	16.6	17.9	18.0	<b>16.8</b>	15.0	16.9	18.6	18.7	<b>17.3</b>	23.0	23.0	24.0	24.0	<b>23.5</b>	28.0	30.0	33.0	33.0	<b>31.0</b>
a <sub>5</sub> 400 ppm	15.0	16.7	18.0	18.1	<b>17.0</b>	15.1	17.0	18.7	18.8	<b>17.4</b>	23.0	23.0	24.0	24.0	<b>23.5</b>	28.0	3.0	33.0	33.0	<b>31.0</b>
Mean (A)	13.1	14.4	15.6	15.7		13.2	14.5	16.0	16.1		22.8	22.8	23.2	23.2		26.8	28.4	30.0	30.0	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	1.2	1.1	2.5			1.1	1.0	2.2			NS	NS	NS			1.7	1.6	3.6		
Character	Yield/ vine (kg.)					Cluster weight (g.)														
a <sub>1</sub> 0.0 ppm	8.6	8.6	8.6	8.6	<b>8.6</b>	9.5	9.5	9.5	9.5	<b>9.5</b>	390.0	390.0	391.0	392.0	<b>390.8</b>	395.0	396.0	396.0	397.0	<b>396.0</b>
a <sub>2</sub> 50 ppm	9.1	9.5	9.7	9.7	<b>9.5</b>	10.4	11.6	12.8	12.8	<b>11.9</b>	396.0	411.0	422.0	423.0	<b>413.0</b>	400.0	413.0	427.0	427.0	<b>416.8</b>
a <sub>3</sub> 100 ppm	9.3	9.9	10.1	10.2	<b>9.9</b>	11.4	13.0	13.4	13.4	<b>12.8</b>	405.0	431.0	441.0	442.0	<b>429.8</b>	407.0	433.0	445.0	446.0	<b>432.8</b>
a <sub>4</sub> 200 ppm	9.5	10.4	11.3	11.3	<b>10.6</b>	11.6	13.7	15.7	15.7	<b>14.2</b>	412.0	450.0	471.0	472.0	<b>451.3</b>	413.0	455.0	475.0	476.0	<b>454.8</b>
a <sub>5</sub> 400 ppm	9.5	10.4	11.3	11.4	<b>10.7</b>	11.6	13.7	15.8	15.8	<b>14.2</b>	413.0	451.0	472.0	474.0	<b>452.5</b>	414.0	456.0	478.0	478.0	<b>456.5</b>
Mean (A)	<b>9.2</b>	<b>9.8</b>	<b>10.2</b>	<b>10.2</b>		<b>10.9</b>	<b>12.3</b>	<b>13.4</b>	<b>13.4</b>		<b>403.2</b>	<b>426.6</b>	<b>439.4</b>	<b>440.6</b>		<b>405.8</b>	<b>430.6</b>	<b>444.2</b>	<b>444.8</b>	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	0.4	0.4	0.9			0.7	0.6	1.3			5.0	4.9	11.0			5.0	5.0	11.2		

Table (6): Effect of different concentrations and frequencies of salicylic acid on length and width of cluster as well as weight and equatorial of berry of Flame seedless grapevines during 2013 and 2014 seasons.

Concentrations of salicylic acid (A)	Cluster length (cm.)					Cluster width (cm.)														
	2013					2014														
	Frequencies of application (B)					Frequencies of application (B)														
	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)
a <sub>1</sub> 0.0 ppm	22.8	22.9	23.0	23.0	<b>22.9</b>	23.0	23.1	23.1	23.1	<b>23.1</b>	11.8	11.9	12.0	12.0	<b>11.9</b>	12.0	12.0	12.0	12.1	<b>12.0</b>
a <sub>2</sub> 50 ppm	23.3	24.0	24.7	24.8	<b>24.2</b>	23.5	24.3	25.1	25.1	<b>24.5</b>	12.3	13.1	14.0	14.1	<b>13.4</b>	12.4	13.2	14.0	14.0	<b>13.4</b>
a <sub>3</sub> 100 ppm	24.0	25.1	26.0	26.0	<b>25.3</b>	24.3	26.0	26.3	26.4	<b>25.8</b>	14.0	14.7	15.2	15.3	<b>14.8</b>	14.1	15.0	15.9	16.0	<b>15.3</b>
a <sub>4</sub> 200 ppm	24.6	26.0	28.0	28.0	<b>26.7</b>	25.1	26.6	29.6	29.7	<b>27.8</b>	14.6	15.2	16.1	16.2	<b>15.5</b>	14.9	15.6	16.3	16.4	<b>15.8</b>
a <sub>5</sub> 400 ppm	24.7	26.1	28.1	28.1	<b>26.8</b>	25.2	26.7	29.7	29.8	<b>27.9</b>	14.7	15.3	16.2	16.3	<b>15.6</b>	15.0	15.7	16.4	16.5	<b>15.9</b>
Mean (A)	23.9	24.8	26.0	26.0		24.2	25.3	26.7	26.8		13.5	14.0	14.7	14.8		13.7	14.3	14.9	15.0	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	0.3	0.3	0.7			0.3	0.3	0.7			0.2	0.2	0.4			0.2	0.2	0.4		
Character	Berry weight (g.)					Berry equatorial (cm.)														
a <sub>1</sub> 0.0 ppm	3.01	3.02	3.02	3.02	<b>3.02</b>	3.06	3.06	3.06	3.06	<b>3.06</b>	1.11	1.11	1.11	1.11	<b>1.11</b>	1.15	1.15	1.15	1.15	<b>1.15</b>
a <sub>2</sub> 50 ppm	3.11	3.26	3.41	3.42	<b>3.30</b>	3.15	3.31	3.46	3.47	<b>3.35</b>	1.18	1.25	1.36	1.37	<b>1.29</b>	1.22	1.30	1.41	1.42	<b>1.34</b>
a <sub>3</sub> 100 ppm	3.22	3.41	3.59	3.60	<b>3.46</b>	3.29	3.60	3.71	3.72	<b>3.58</b>	1.24	1.36	1.41	1.42	<b>1.36</b>	1.29	1.41	1.47	1.48	<b>1.41</b>
a <sub>4</sub> 200 ppm	3.31	3.61	3.95	3.95	<b>3.71</b>	3.39	3.75	3.85	3.86	<b>3.71</b>	1.30	1.41	1.59	1.60	<b>1.48</b>	1.34	1.47	1.64	1.65	<b>1.53</b>
a <sub>5</sub> 400 ppm	3.33	3.62	3.96	3.96	<b>3.72</b>	3.41	3.76	3.86	3.87	<b>3.72</b>	1.31	1.42	1.60	1.61	<b>1.49</b>	1.35	1.47	1.65	1.66	<b>1.53</b>
Mean (A)	<b>3.20</b>	<b>3.38</b>	<b>3.59</b>	<b>3.44</b>		<b>3.26</b>	<b>3.50</b>	<b>3.59</b>	<b>3.60</b>		<b>1.23</b>	<b>1.31</b>	<b>1.41</b>	<b>1.42</b>		<b>1.29</b>	<b>1.36</b>	<b>1.46</b>	<b>1.47</b>	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	0.06	0.05	0.11			0.05	0.05	0.11			0.04	0.03	0.07			0.03	0.03	0.07		

Table (7): Effect of different concentrations and frequencies of salicylic acid on some physical and chemical characteristics of the berries of Flame seedless grapevines during 2013 and 2014 seasons.

Concentrations of salicylic acid (A)	Berry longitudinal (cm.)					Berries colouration %														
	2013					2014														
	Frequencies of application (B)					Frequencies of application (B)														
	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)
a <sub>1</sub> 0.0 ppm	1.41	1.42	1.42	1.42	<b>1.42</b>	1.42	1.42	1.42	1.42	<b>1.42</b>	60.0	61.0	61.0	61.0	<b>60.8</b>	60.9	61.0	61.0	61.0	<b>61.0</b>
a <sub>2</sub> 50 ppm	1.48	1.58	1.66	1.66	<b>1.60</b>	1.50	1.60	1.68	1.68	<b>1.62</b>	63.7	66.0	68.0	68.3	<b>66.5</b>	65.0	68.0	70.0	70.3	<b>68.3</b>
a <sub>3</sub> 100 ppm	1.59	1.64	1.71	1.72	<b>1.67</b>	1.61	1.65	1.72	1.72	<b>1.68</b>	66.9	71.0	73.0	73.0	<b>71.0</b>	68.6	73.0	75.0	75.0	<b>72.9</b>
a <sub>4</sub> 200 ppm	1.66	1.68	1.76	1.76	<b>1.72</b>	1.67	1.71	1.78	1.79	<b>1.74</b>	70.0	74.0	77.5	79.6	<b>75.5</b>	71.9	76.9	82.0	82.0	<b>78.2</b>
a <sub>5</sub> 400 ppm	1.67	1.69	1.77	1.77	<b>1.73</b>	1.67	1.71	1.79	1.80	<b>1.74</b>	70.5	74.3	80.0	80.3	<b>76.3</b>	72.0	77.0	82.0	82.3	<b>78.3</b>
Mean (A)	1.56	1.60	1.66	1.67		1.57	1.62	1.68	1.68		66.2	69.3	72.2	72.3		67.7	71.2	74.0	74.1	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	0.03	0.03	0.07			0.03	0.03	0.07			1.5	1.5	5.6			1.5	1.5	5.6		
Character	T.S.S. %					Reducing sugars %														
a <sub>1</sub> 0.0 ppm	18.0	18.1	18.1	18.1	<b>18.1</b>	17.9	18.0	18.0	18.0	<b>18.0</b>	16.1	16.1	16.1	16.1	<b>16.1</b>	16.0	16.0	16.0	16.0	<b>16.0</b>
a <sub>2</sub> 50 ppm	18.3	18.6	19.0	19.1	<b>18.8</b>	18.5	18.8	19.1	19.1	<b>18.9</b>	16.6	17.0	17.4	17.5	<b>17.1</b>	16.5	17.1	17.5	17.6	<b>17.2</b>
a <sub>3</sub> 100 ppm	18.5	19.0	19.4	19.5	<b>19.1</b>	18.8	19.1	19.4	19.5	<b>19.2</b>	17.0	17.5	17.8	17.9	<b>17.6</b>	17.1	17.6	17.9	18.0	<b>17.7</b>
a <sub>4</sub> 200 ppm	18.8	19.2	19.8	19.9	<b>19.3</b>	18.9	19.4	19.9	20.0	<b>19.6</b>	17.6	17.9	18.4	18.5	<b>18.1</b>	17.6	18.0	18.4	18.5	<b>18.1</b>
a <sub>5</sub> 400 ppm	18.9	19.3	19.8	19.9	<b>19.5</b>	19.0	19.5	20.0	20.0	<b>19.6</b>	17.6	18.0	18.5	18.5	<b>18.2</b>	17.7	18.1	18.5	18.6	<b>18.2</b>
Mean (A)	<b>18.5</b>	<b>18.8</b>	<b>19.2</b>	<b>19.3</b>		<b>18.6</b>	<b>19.0</b>	<b>19.3</b>	<b>19.3</b>		<b>17.0</b>	<b>17.3</b>	<b>17.6</b>	<b>17.7</b>		<b>17.0</b>	<b>17.4</b>	<b>17.7</b>	<b>17.7</b>	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	0.3	0.2	0.4			0.3	0.2	0.4			0.3	0.2	0.4			0.3	0.2	0.4		

Table (8): Effect of different concentrations and frequencies of salicylic acid on some chemical characteristics of the berries of Flame seedless grapevines during 2013 and 2014 seasons.

Concentrations of salicylic acid (A)	Total acidity %					Total anthocyanins (100 g F.W.)														
	2013					2014														
	Frequencies of application (B)					Frequencies of application (B)														
	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)	b <sub>1</sub> once	b <sub>2</sub> twice	b <sub>3</sub> thrice	b <sub>4</sub> four times	Mean (A)
a <sub>1</sub> 0.0 ppm	0.719	0.718	0.718	0.717	<b>0.718</b>	0.717	0.717	0.717	0.717	<b>0.716</b>	4.1	4.4	4.1	4.1	<b>4.1</b>	4.5	4.5	4.5	4.5	<b>4.5</b>
a <sub>2</sub> 50 ppm	0.691	0.660	0.625	0.623	<b>0.650</b>	0.689	0.658	0.623	0.623	<b>0.622</b>	4.6	5.1	5.7	5.8	<b>5.3</b>	5.0	6.2	7.0	7.1	<b>6.3</b>
a <sub>3</sub> 100 ppm	0.660	0.624	0.601	0.600	<b>0.621</b>	0.657	0.635	0.622	0.599	<b>0.598</b>	5.1	6.0	6.6	6.7	<b>6.1</b>	6.0	7.0	7.7	7.8	<b>7.1</b>
a <sub>4</sub> 200 ppm	0.625	0.601	0.570	0.569	<b>0.591</b>	0.623	0.601	0.600	0.568	<b>0.567</b>	5.9	7.9	8.9	9.0	<b>7.9</b>	7.1	7.6	9.5	9.6	<b>8.5</b>
a <sub>5</sub> 400 ppm	0.621	0.600	0.569	0.568	<b>0.590</b>	0.622	0.601	0.599	0.567	<b>0.566</b>	6.0	8.0	9.0	9.1	<b>8.0</b>	7.2	7.6	9.6	9.7	<b>8.5</b>
Mean (A)	0.663	0.641	0.617	0.616		0.662	0.642	0.615	0.614		5.1	6.2	6.9	6.9		6.0	6.6	7.7	7.7	
New L.S.D. at 5%	A	B	AB			A	B	AB			A	B	AB			A	B	AB		
	0.022	0.021	0.047			0.021	0.021	0.047			0.2	0.2	0.4			0.2	0.2	0.4		

These results are in agreement with those obtained by **Abd El- Kareem (2009)** and **El- Hanafy (2011)** on various grapevine cvs.

### 3- Berry setting %, yield and cluster characters:

Data in Table (5) materially show that treating the vines once, twice, thrice or four times with salicylic acid at 50 to 400 ppm significantly improved berry setting %, yield expressed in weight and number of clusters/ vine and weight and dimensions ( length & width) of cluster over the control treatment. The promotion was depended on increasing concentration and frequencies of salicylic acid application. No significantly promotion on these parameters was attributed to increasing concentration from 200 to 400 ppm and frequencies from thrice to four times. Therefore, the recommended concentration and frequencies of salicylic acid were 200 ppm and three times, respectively. From economical point of view treating the vines three times with salicylic acid at 200 ppm gave an economical yield. Under such promised treatments, yield per vine reached 11.3 and 15.7 kg during both seasons, respectively. The untreated vines produced 8.6 and 9.5 kg during the two seasons, respectively. The percentage of increase on the yield of the promised treatment over the control treatment reached 31.4 and 65.3 % during 2013 and 2014 seasons, respectively. The present salicylic acid treatments had no significant effect on the number of clusters / vine in the first season of study.

The previous positive action of salicylic acid on growth and vine nutritional status surely reflected on enhancing berry setting. The promotive effect of salicylic acid on the yield may be ascribed to its essential action on improving berry setting, number of clusters per vine and cluster weight and dimensions.

The same trend was announced by **El- Hanafy (2011)**; **El- Kady- Hanaa(2011)** and **Osman (2014)** on different grapevine cvs.

### 4- Fruit quality:

It is clear from the date in Tables ( 6 to 8) that spraying the vines once, twice, thrice or four times with

salicylic acid at 50 to 400 ppm was significantly very effective in enhancing weight, longitudinal and equatorial of berry, berries colouration %, T.S.S. %, reducing sugars % and total anthocyanins and decreasing total acidity over the check treatment. These was a gradual promotion on fruit quality with increasing concentrations from 0.0 to 400 ppm and frequencies from once and four times. A slight and unsignifiant promotion on these quality parameters was observed among the higher two concentrations (200& 400 ppm) and frequencies ( thrice or four times of salicylic acid. The best results from economical point of view were obtained owing to spraying the vines three times with salicylic acid at 200 ppm.

Unfvaurable effects on fruit quality were attributed to the neglection of using salicylic acid (control treatment). These results were true during both seasons.

The outstanding effect of salicylic acid on enhancing plant pigments especially anthocyanins, photosynthesis as well uptake and translocation of nutrients (**Janda et al., 2007**) surely reflected on advancing maturity and enhancing fruit quality.

The results of **Madian (2004)**; **Abd El- Kareem (2009)** and **Bondok – Sawsan et al., (2011)** confirmed the present regarding the beneficial effect of salicylic acid on quality of the berries

### Conclusion:

For promotion yield and berries quality and at the same time overcoming irregular colouration of the berries in Flame seedless grown under Upper Egypt condition, it is advised to spray salicylic acid three times (growth start, just after berry setting and two weeks later) at 200 ppm.

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