

## Yield and Berries Quality of Superior Grapevines As affected by Application of Silicon and Vitamins B

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**Abstract:** Yield and both physical and chemical characteristics of Superior grapes in response to single and combined applications of single and combined applications of potassium silicate at 0.05 to 0.2 % and vitamins B at 25 to 100 ppm were investigated during 2016 and 2017 seasons. Using potassium silicate at 0.05 to 0.2 % and/or vitamins B at 25 to 100 ppm was very effective in improving yield and quality of the berries relative to the control. Using potassium silicate was superior than using vitamins B in this respect. Combined applications were favourable than using each material alone in this connection. Carrying out three sprays at growth start, just after berry setting and 21 days later with a mixture of potassium silicate at 0.1 % and vitamins B (B<sub>1</sub>+ B<sub>2</sub>+B<sub>6</sub>+B<sub>12</sub>) at 50 ppm was suggested to be beneficial for promoting yield and berries quality of Superior grapevines.

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### 1. Introduction

Recently, many trails were accomplished for improving yield and berries quality of Superior grapevines by using silicon and vitamins B. The application of silicon and vitamins B had an announced promotion on yield and quality of different grapevines cvs.

Many attempts were carried out for enhancing growth and vine nutritional status of Superior grapevines by using silicon and vitamins B (Samiullahet *al.*, 1988 and Ma, 2004).

Using silicon (Al-Wasfy, 2014; Aklet *al.*, 2016; Farahat, 2017 and Metwally, 2017) and vitamins B (El-Kady-Hanaa, 2011; Mohamed-Ebtesam, 2012; Abdelaal, 2012 and Al-Wasfy, 2014) was very essential for enhancing yield and berries quality of different grapevine cvs.

The target of this study was examining the effect of single and combined applications of silicon and vitamins B on yield and berries quality of Superior grapevines.

### 2. Materials and Methods

This study was carried out during 2016 and 2017 seasons on 60 uniform in vigour 12 years old Superior grapevines grown in a private vineyard located at Kom Wally village, Matay district, Minia Governorate where the texture of the soil is clay, well drained and water table not less than two meters deep. All the selected vines are planted at 2 x 3 m apart. The chosen vines (60 vines) were pruned during the first week of January in the two seasons using cane pruning method with the assistance of Gable supporting system. Vine load was 72 eyes for all the selected vines on the basis of six fruiting canes X ten eyes plus six renewal spurs

X two eyes. Surface irrigation system was followed using Nile water.

Mechanical, physical and chemical analysis of the tested soil were carried out at the start of the experiment according to the procedures of Black *et al.* (1965) and the data are shown in Table (1).

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

Constituents	Values
<b>Particle size distribution:</b>	
Sand %	11.0
Silt %	22.5
Clay %	68.5
Texture	Clay
pH ( 1:2.5 extract)	8.05
EC (1:2.5 extract) ( dsm <sup>-1</sup> ) 1 cm / 25°C.	1.03
O.M. %	1.88
CaCO <sub>3</sub> %	2.55
Total N %	0.10
Available P ( Olsen, ppm)	2.22
Available K ( ammonium acetate, ppm)	400

Except those dealing with the present treatments (application of silicon and vitamins B via foliage), all the selected vines (96 vines) received the usual horticultural practices which are commonly used in the vineyard.

This study included the following ten treatments from application of single and combined sprays of silicon and vitamins B, in addition to the control treatment:

- 1- Control (untreated vines).
- 2- Spraying potassium silicate at 0.05 %

- 3- Spraying potassium silicate at 0.1 %
- 4- Spraying potassium silicate at 0.2 %
- 5- Spraying vitamins B (B1, B6, B12) at 25 ppm
- 6- Spraying vitamins B (B1, B6, B12) at 50 ppm
- 7- Spraying vitamins B (B1, B6, B12) at 100 ppm
- 8- Spraying potassium silicate and vitamins B at low concentrations
- 9- Spraying potassium silicate and vitamins B at medium concentrations
- 10- Spraying potassium silicate and vitamins B at high concentrations

Each treatment was replicated three times, two vines per each (60 vines). Silicon (pure %) and the four vitamins (Vit B: Vitamin B complex (B1: Thiamine; B2: Riboflavin; B6: Pyridoxine; B12: Cyanocobalamine); were sprayed three times at growth start (1<sup>st</sup> week of March, just after berry setting (mid. of April) and at three weeks later (1<sup>st</sup> week of May).

Triton B as a wetting agent was used with all vitamins treatments at 0.05 % (0.5 ml/L). Spraying was done till run off (2 litres/ vine). Control treatment was carried out by spraying water and Triton B (0.05%).

Randomized complete block design was followed where the experiment consisted of ten treatments, each treatment was replicated three times, two vines per each.

Harvesting took place when T.S.S./ acid in the berries of the check treatment reached at least 25:1 (at the last week of June in the two seasons). The yield per vine expressed in weight (kg.) and number of clusters per vine was recorded.

Five clusters from each vine were taken at random for determination of the following physical and chemical characteristics.

- 1- Cluster dimensions (length and width, cm.)
- 2- Shot berries % by dividing number of shot berries cluster by the total number of berries cluster and multiplying the product x 100.
- 3- Average berry weight (g.)
- 4- Average berry dimensions (longitudinal and equatorial, cm).
- 5- Percentage of total soluble solids in the juice by using handy refractometer.
- 6- Percentage of reducing sugars in the juice by Lane and Eynon (1965) volumetric method as described in A.O.A.C. (2000).
- 7- Percentage of titratable acidity (as a tartaric acid/ 100 ml juice) by titration against 0.1N NaOH using phenolphthalein as an indicator A.O.A.C. (2000).

#### Statistical analysis:

The obtained data were tabulated and significantly analyzed according to Mead *et al.*, (1993). Differences between treatment means were

compared during new L.S.D. test at 5% level of probability.

### 3. Results and Discussion

#### 1- Effect of single and combined applications of silicon and vitamins B on yield and cluster aspects:-

It is quite clear from the obtained data in Table (2) that yield expressed in weight and number of clusters/vine as well as weight, length and shoulder of cluster were significantly improved in response to treating the vines singly or in combinations with potassium silicate at 0.05 to 0.2 % and vitamins B at 25 to 100 ppm relative to the control. There was a gradual stimulation on these characteristics with increasing concentrations of each material. Significant differences on these parameters were noticed among all treatments except between the higher two concentrations of each material.

Using both materials together was significantly favourable than using each material alone in improving the yield and cluster aspects. From economical point of view, the best results with regard to yield and cluster aspects were recorded on the vines that received potassium silicate at 0.1 % plus vitamins B at 50 ppm. The yield per vine in such promised treatment reached 10.7 & 12.8 kg compared with the yield of the untreated vines that reached 8.6 and 8.7 kg during both seasons, respectively. The percentage of increment on the yield due to using the previous promised treatment above the control reached 24.4 & 42.5 % during both seasons, respectively. The present treatments had no significant effect on the number of clusters/vine in the first season of study. These results were true during both seasons.

#### 2- Effect of single and combined applications of silicon and vitamins B on the percentage of shot berries:-

Data in Table (2) show the percentage of shot berries was significantly reduced in response to using potassium silicate and/or vitamins B relative to the control treatment. The reduction on shot berries was related to the increase in concentrations of each material. Increasing concentrations of potassium silicate from 0.1 to 0.2 % and vitamins B from 50 to 100 ppm had no significant reduction on the percentage of shot berries. Using potassium silicate was significantly favourable in reducing shot berries than using vitamins B. Combined applications were superior than using each material alone in controlling shot berries in the clusters. The lowest shot berries (4.7 & 4.8 %) were recorded on the vines that received both materials together at the highest concentrations during both seasons, respectively. The highest values (11.5 & 11.6 %) were recorded on untreated vines

during both seasons, respectively. These results were true during both seasons.

### 3- Effect of single and combined applications of silicon and vitamins B on quality of the berries:-

It is clear from the obtained data in Table (3) that treating Superior grapevines three times with potassium silicate at 0.05 to 0.2 % and/or vitamins B at 25 to 100 ppm was significantly very effective in improving quality of the berries in terms of increasing berry weight and dimensions (longitudinal and equatorial), T.S.S.% and reducing sugar % and decreasing total acidity % relative to the control. The promotion on both physical and chemical characteristics of the berries was in proportional to the increase in concentrations of each material. Using

potassium silicate was significantly favourable than using vitamins B in improving quality of the berries. Combined applications of such two materials were significantly preferable than using each material alone in this respect. Increasing concentrations of potassium silicate from 0.1 to 0.2 % and vitamins B from 50 to 100 ppm failed to show significant promotion on fruit quality. From economical of view, the best results with regard to quality of the berries were recorded on the vines that received both materials together at the medium concentrations. Unfavourable effects on quality of the berries were recorded on untreated vines. Similar results were announced during both seasons.

**Table (2): Effect of spraying silicon and/or vitamins B on yield, cluster weight and dimensions and shot berries % of Superior grapevines during 2016 and 2017 seasons**

Treatments	No. of clusters/vine		Yield/vine (kg)		Av. Cluster weight (g.)		Av. Cluster length (cm)		Av. Cluster shoulder (cm)		Shot berries %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	24	24	8.6	8.7	360	361	15.7	15.6	11.5	11.6	11.5	11.6
K. Silicate at 0.05 %	24	25	9.4	9.9	395	396	17.3	17.4	12.8	12.9	7.0	6.9
K. Silicate at 0.1 %	24	26	9.7	10.6	406	407	17.8	18.0	13.2	13.2	6.0	5.9
K. Silicate at 0.2 %	24	26	9.7	10.6	406	408	17.9	18.0	13.3	13.3	5.9	5.8
Vitamins B at 25 ppm	24	25	8.9	9.3	371	371	16.2	16.3	11.9	12.0	10.8	10.7
Vitamins B at 50 ppm	24	25	9.2	9.6	383	384	16.7	16.8	12.3	12.4	10.0	9.9
Vitamins B at 100 ppm	24	25	9.2	9.6	384	385	16.8	16.9	12.4	12.5	9.9	9.8
Both at low conc.	24	27	10.0	11.3	417	418	18.4	18.5	13.7	13.8	5.5	5.4
Both at medium conc.	25	29	10.7	12.4	427	428	18.9	19.0	14.0	14.2	5.0	4.9
Both at high conc.	25	30	10.7	12.8	428	428	19.0	19.1	14.1	14.3	4.7	4.8
New L.S.D. at 5%	NS	1.0	0.4	0.6	10.0	10.5	0.4	0.4	0.3	0.3	0.4	0.5

Vitamins B = (B<sub>1</sub>+B<sub>2</sub>+B<sub>6</sub>+B<sub>12</sub>)

**Table (4): Effect of spraying silicon and/or vitamins B on some physical and chemical characteristics of the berries of Superior grapevines during 2016 and 2017 seasons**

Treatments	Av. Berry weight (g.)		Av. Berry equatorial (cm)		Av. Berry longitudinal (cm)		T.S.S. %		Reducing sugars %		Total acidity %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	2.94	2.99	2.00	2.03	2.22	2.25	17.5	17.8	15.5	15.4	0.700	0.705
K. Silicate at 0.05 %	3.26	3.31	2.17	2.20	2.40	2.42	19.3	19.6	17.1	17.0	0.630	0.629
K. Silicate at 0.1 %	3.36	3.41	2.20	2.23	2.44	2.47	19.9	21.1	17.6	17.5	0.614	0.613
K. Silicate at 0.2 %	3.37	3.42	2.21	2.24	2.45	2.48	20.0	21.1	17.7	17.6	0.613	0.612
Vitamins B at 25 ppm	3.04	3.10	2.06	2.05	2.29	2.31	18.0	18.3	16.0	15.9	0.681	0.681
Vitamins B at 50 ppm	3.15	3.21	2.11	2.14	2.34	2.36	18.6	18.8	16.6	16.6	0.660	0.659
Vitamins B at 100 ppm	3.16	3.22	2.12	2.15	2.35	2.37	18.7	18.9	16.7	16.8	0.659	0.657
Both at low conc.	3.49	3.55	2.27	2.30	2.50	2.55	20.5	21.6	18.2	18.3	0.591	0.585
Both at medium conc.	3.61	3.66	2.31	2.54	2.55	2.60	21.0	22.2	18.7	18.8	0.570	0.560
Both at high conc.	3.62	3.67	2.32	2.35	2.56	2.61	21.2	22.3	18.8	18.8	0.569	0.559
New L.S.D. at 5%	0.08	0.05	0.03	0.03	0.04	0.04	0.4	0.5	0.4	0.4	0.015	0.013

Vitamins B = (B<sub>1</sub>+B<sub>2</sub>+B<sub>6</sub>+B<sub>12</sub>)

#### 4. Discussion

The outstanding effect of silicon on growth and fruiting of the various fruit crops is mainly attributed to its essential roles in enhancing the tolerance of fruit crops to biotic (pests) and abiotic (climatic and soil environmental conditions) stresses, the biosynthesis of organic foods (proteins, fats and carbohydrates), uptake of water and essential nutrients, plant organ strength, plant development, enzyme activities and the retained water. The beneficial effects of silicon on forming double layers on plant tissues could explain its effect on protecting the trees from higher transpiration rate and the incidence of different disorders. Previous studies supported the important roles of silicon as antioxidant on protecting the plant cells from aging and senescence through chelating free radicals namely OH and O<sub>3</sub> as well as preventing the formation of reactive oxygen species (ROS) from destroying the permeability of cell walls. Consequently, oxidation process is stopped (Ma, 2004).

The positive action of vitamins on fruiting of Superior grapevine might be attributed to their essential roles on protecting the plant cells from senescence and disorders as well as enhancing cell division, the biosynthesis of natural hormones such IAA and ethylene, nutrient and water uptake, photosynthesis, building of plant pigments and proteins, amino acids and plant metabolism. These important functions of vitamins were surely reflected on enhancing growth and vine nutritional status in favour of enhancing yield and fruit quality. (Samiullah *et al.*, 1988).

These results are agreement with those obtained by Al-Wasfy, 2014; Akl *et al.*, 2016; Farahat, 2017 and Metwally, 2017) worked in silicon and (El-Kady-Hanaa, 2011; Mohamed-Ebtesam, 2012; Abdelaal, 2012 and Al-Wasfy, 2014) worked on vitamins.

#### Conclusion

Carrying out three sprays at growth start, just after berry setting and at 21 days later with a mixture of potassium silicate at 0.1 % and vitamins B (B<sub>1</sub>+B<sub>2</sub>+B<sub>6</sub>+B<sub>12</sub>) at 50 ppm was suggested to be beneficial for improving yield and berries quality of Superior grapevines.

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