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Using some amino acids and silicon to promote yield quantitatively and quantitatively of superior grapevines

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Abstract: During 2020, 2021 seasons, Superior grapevines were treated three times with potassium silicate and / or Amino acids each at 0.05 to 0.2%. The merit of this study was examining the effect of single and combined application of K-silicate and Amino acids at different concentration on growth , yield and fruiting of superior grapevines.
Treating the vines with K-silicate and / or Amino acids three times at 0.05 to 0.2% was very effective in enhancing growth aspects , leaf pigments, nutrients, yield and both physical and chemical characteristics of the berries over the control treatment. The promotion was associated with increasing the concentration.
Negligible promotion on these parameters was observed among the higher tow concentrations namely 0.1 and 0.2%
Using Amino acids was greatly superior than using K-silicate in all parameters.
Conclusively: According to the obtained data It is suggested to use a mixture of k-silicate and Amino acids each at 0.1% three times at growth start, just after berry setting and at one month later gave the best results with regard to yield and berries quality of superior grapevines.
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Key words: Superior grapevines- K- silicate – Amino acids- yield- fruit quality.

1. Introduction

The decline of yield as well as the problem of shot berries in superior grapevines is the major problems that Faces grape growers. Unbalanced or malnutrition as well as undesirable environmental conditions and the incidence of pests are considered to the main causes for poor cropping (**Levitt, 1980**) Using Amino acids and silicon increased the tolerance of the trees to biotic and abiotic stress that succeeded in solving these problems.

Recently, Silicon is used for improved yield and quality of superior grapevines grown under different stresses. The favorable effect of silicon of fruiting seem to originate from its positive action on enhancing the tolerance of plant to biotic and abiotic stresses and drought tolerance . This is explained in the light of its impact on enhancing water retention and photosynthesis via formation of silicon cuticle double layers formed on leaf epidermal tissue.(**Matoh *et al.*, 1991; Ma, 2004 ; Hattori *et al.*, 2005 and Tahir *et al .*, 2006).**

The outstanding effect of using silicon on fruiting of fruit crops especially those grown under stress conditions was a wide field for may researchers such as (**Gad El-Kareem, 2012; Abdelaal and Oraby- Mona , 2013; Al-Wasfy, 2014; El-Khawaga and Mansour, 2014; Ibrahim and Al-Wasfy, 2014; Gad El –Kareem *et al.*, 2014; Omar, 2015 and Nagy-Dina 2016**).

Recently, there have been an increasing possibility of the application of some Amino acids for controlling shot berries in the clusters in superior grapevines cv. They proved to be very essential in protecting the cells from senescence as well as enhancing cell division endogenous natural hormones, photosynthesis, plant pigments, nutrient uptake. They also play an important role in plant defense against oxidative stresses (**Oertili, 1987**).

Previous studies confirmed the promotive effect of all amino acids on yield and quality in different grapevines cvs.(**Amin, 2007; Seleem- Basma and Abd El-Hameed, 2008; Sayed- Heba, 2010 and Ebrahiem- Asmaa, 2011**).

This study aimed to examine the effect of some amino acids and silicon on growth, vine nutritional status, yield and quality of superior grapevines.

2. Material and Methods

This investigation was carried out during 2020 and 2021 seasons on sixty uniform in vigour of 13 years –old superior grapevines. The experimental vines were grown in a private vineyard located at west Samalout district, Minia Governorate . Egypt. Where the soil is sandy soil analysis was done according to the procedures that outlined by (**Wilde *et al.*, 1985**).

The selected vines are planted at 3.0 x 2.0 meters a part (700 vines/ fedd.). The chosen vines were trained by cane pruning system leaving 84 eyes/vine (six fruiting canes x 12 eyes plus six renewal spurs x two eyes). Using Gable supporting method. Winter pruning was carried out at the last week of Dec. during 2020 and 2021 seasons . Drip irrigation system was followed.

Table (1): Analysis of the tested soil.

Constituent	Values
-Sand %	81.2
- Silt %	11.4
- Clay %	7.4
- Texture	Sandy
- O.M. %	0.08
- PH (1:2.5 extract)	7.96
- EC (1:2.5 extract)(mmhos/cm/25C)	1.80
- $CaCO_3$ %	4.3
- Total N %	0.009
- Available P (Olsen method ppm.)	1.1
- Available K (ppm.)	30.0

Common horticultural practices such as fertilization, twice hoeing, pinching, irrigation and pest management were carried out as usual.
This study consisted from the following ten treatments.
1- Control (vines sprayed with water)
2-Spraying potassium silicate at 0.05% (0.5 ml/L)
3- Spraying potassium silicate at 0.1% (1.0 ml/L)
4-Spraying potassium silicate at 0.2% (2.0 ml/L)
5- Spraying amino acids at 0.05% (0.5 g/l)
6- Spraying amino acids at 0.1% (1.0g/l)
7- Spraying amino acids at 0.2% (2.0 g/l)
8- Spraying potassium silicate and amino acids each at 0.05%
9- Spraying potassium silicate and amino acids each at 0.1%
10- Spraying potassium silicate and amino acids each at 0.2%
Each treatment was replicated three times, two vines per each.

The two compounds namely potassium silicate (25% SI and 10% K_2O) and Amino acids (tryptophane, methionine, Cysteine and Cystene) were sprayed three times. The first sprayed was carried out before bloom (first week of Mar.) and the other two sprays were conducted just after berry setting (first week of April) and at one month later (first week of May) Triton B as a wetting agent was applied at 0.05% to all solutions. Control vines were sprayed with water containing triton B. The selected vines were sprayed with these materials till run off.
Randomized complete block design (RCBO) was adopted where the experiment included ten treatments
- The following parameters were studied.
*main shoot length (cm)
*leaf area (cm) (**Ahmed and Morsy, 1999**)
*Cane thickness (cm.)
*Wood ripening coefficient (**Bourd, 1966**)
*Pruning wood weight (kg)/ vine
*Leaf pigments namely chlorophyll A, chlorophyll B, total chlorophylls and total carotenoids (mg/g Fw) (**Von-Wettstein, 1957**).
*Leaf contents nutrients namely N, P and K (as %) and Zn, Fe and Mn (as ppm) petioles of the same leaves (**Summer, 1985; Chapman and Prott, 1987 and Balo *et al.*, 1988**).
*Yield expressed in number of cluster / vine and weight (Kg) vine and weight of cluster (g)
*Cluster dimensions (length and shoulder) in (cm)
*Average berry weight (g)
*Percentage of short berry.
*Percentage of total soluble solids in the juice by using handy Refractometer.
*Percentage of total acidity in the juice (as g tartaric acid / 100 ml juice) by titration against 0.1 N NaoH using phenolphthalein indicator (**A.O.A.C., 2000**).
*TSS/acid ratio
*The percentage of reducing sugars in the juice (**Lane and Eynon, 1965**) as described by (**A.O.A.C., 2000**)
Statistical analysis was done and different treatments means were compared using new L.S.D at 5% (**Snedecor and Cochran, 1980 and Mead *et al.*, 1993**)

3. Results

1- Vegetative growth characteristics:

It is clear from the data in Table (2) that growth aspects namely main shoot length, leaf area , wood ripening coefficient, pruning wood weight and cane thickness were significantly stimulated in response to single and combined application of potassium silicate and some Amino acids each at 0.05 to 0.2% relative to the control treatment.

The stimulation was associated with increasing the concentrations. Using amino acids was significantly superior than using potassium silicate in this respect.

Also, combined application were significantly favorable than using each material alone in this respect. Using both materials together at 0.2% gave the highest values. These results were true in both seasons.

2- Chemical constituents of leaves:

It is evident from the obtained data in Tables (3 , 4) that eleven leaf chemical components namely chlorophyll a, chlorophyll b, total chlorophylls, total carotenoids, N, P, K, Mg, Fe, Zn and Mn were significantly varied among the nine K-silicate and Amino acids treatments. They were significantly enhanced with using potassium silicate and / or Amino acids relative to the control treatment.

There was a gradual promotion on these leaf chemical components with increasing concentrations of K- silicate and Amino acids.

Increasing concentrations of K-silicate and Amino acids each at 0.1 to 0.2 % failed to show significant promotion on these chemical constituents.

Using Amino acids was significantly superior to using K-silicate in enhancing these chemical components combined applications of K- silicate and Amino acids were significantly favorable for enhancing these chemical components relative to using each alone.

Spraying both materials together at 0.2% gave the highest values. These results were true in both seasons.

Table (2): Effect of spraying some amino acids and / or silicon on some growth characters of Superior grapevines during 2020 and 2021 seasons.

Characters / Treatments	Shoot length (cm)		Leaf area $(cm)^2$		Wood ripening coefficient		Pruning wood weight (kg.)		Cane thickness (cm)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Control (untreated vines)	111.0	1115	116.0	117.0	0.68	0.70	1.75	1.78	0.90	0.92
Potassium silicate at 0.05 %	114.0	115.0	118.5	119.0	0.73	0.74	1.82	1.83	0.96	0.98
Potassium silicate at 0.1 %	117.5	118.5	122.0	123.0	0.77	0.78	1.86	1.87	1.00	1.01
Potassium silicate at 0.2 %	119.0	119.5	123.5	124.5	0.79	0.80	1.89	1.90	1.02	1.03
Amino acids at 0.05%	118.5	119.0	123.0	124.0	0.78	0.79	1.90	1.91	1.01	1.02
Amino acids at 0.1 %	121.0	122.0	128.5	129.0	0.85	0.86	1.96	1.97	1.06	1.08
Amino acids at 0.2 %	124.0	125.0	129.5	130.0	0.87	0.88	1.99	2.00	1.11	1.12
Potassium silicate + amino acids each at 0.05%	123.0	125.0	130.0	131.0	0.87	0.88	2.00	2.01	1.15	1.17
Potassium silicate + amino acids each at 0.1 %	130.0	131.0	139.0	139.5	0.93	0.94	2.11	2.12	1.22	1.23
Potassium silicate + amino acids each at 0.2 %	132.5	133.0	142.0	143.5	0.95	0.96	2.13	2.14	1.24	1.25
New L.S.D. at 5%	1.1	1.2	1.3	1.4	0.03	0.04	0.08	0.09	0.04	0.05

Table (3): Effect of spraying some amino acids and / or silicon on some leaf pigments and percentages of N and P in the leaves of Superior grapevines during 2020 and 2021 seasons.

Characters / Treatments	Chlorophyll a (mg/g.F.W.)		Chlorophyll b (mg/g.F.W.)		Total chlorophylls (mg/g F.W.)		Total carotenoids (mg/g F.W.)		Leaf N %		Leaf P %	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Control (untreated vines)	2.6	2.8	1.1	1.2	3.7	4.0	1.3	1.4	1.62	1.63	0.14	0.16
Potassium silicate at 0.05 %	3.3	3.5	1.4	1.5	4.7	5.0	1.6	1.7	1..71	1.72	0.18	0.19
Potassium silicate at 0.1 %	3.9	4.0	1.7	1.8	5.6	5.8	1.9	2.0	1.76	1.77	0.22	0.23
Potassium silicate at 0.2 %	4.2	4.3	1.9	2.0	6.1	6.3	2.1	2.2	1.78	1.79	0.24	0.25
Amino acids at 0.05%	4.1	4.2	1.8	1.9	5.9	6.1	2.0	2.1	1.77	1.78	0.23	0.24
Amino acids at 0.1 %	4.6	4.7	2.2	2.3	6.8	7.0	2.5	2.6	1.82	1.83	0.28	0.29
Amino acids at 0.2 %	4.8	4.9	2.4	2.5	7.2	7.4	2.7	2.8	1.84	1.85	0.29	0.30
Potassium silicate + amino acids each at 0.05%	4.7	4.8	2.3	2.4	7.0	7.2	2.6	2.7	1.83	1.84	0.28	0.29
Potassium silicate + amino acids each at 0.1 %	5.0	5.1	2.7	2.8	7.7	7.9	2.9	3.0	1.88	1.89	0.34	0.35
Potassium silicate + amino acids each at 0.2 %	5.2	5.3	2.8	2.9	8.0	8.2	3.1	3.2	1.91	1.92	0.36	0.37
New L.S.D. at 5%0.5	0.5	0.6	0.4	0.5	0.6	0.7	0.5	0.6	0.04	0.06	0.02	0.03

3- The yield and cluster aspects:

It is evident from the obtained data in Table (5) that treating superior grapevines three times with K-silicate and / or Amino acids significantly improved the yield expressed in weight and number of clusters / vine as well as weight , length and shoulder of cluster relative to the check treatment. There was a gradual promotion on these parameters with increasing concentrations of K- silicate and Amino acids from 0.1 to 0.2% had no significant promotions on the yield, number of clusters/ vine, weight, length and shoulder of cluster.

Table (4): Effect of spraying some amino acids and / or silicon on the leaf content of K and Mg (as %) and Fe, Zn and Mn (as ppm) of Superior grapevines during 2020 and 2021 seasons.

Characters / Treatments	Leaf K %		Leaf Mg %		Leaf Fe (ppm)		Leaf Zn (ppm)		Leaf Mn (ppm)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Control (untreated vines)	1.16	1.17	0.49	0.51	55.1	56.2	51.1	52.0	48.2	49.0
Potassium silicate at 0.05 %	1.20	1.21	0.54	0.55	58.2	59.0	55.2	56.0	51.0	52.0
Potassium silicate at 0.1 %	1.26	1.27	0.58	0.59	62.5	63.0	58.4	59.0	54.5	55.0
Potassium silicate at 0.2 %	1.27	1.29	0.61	0.62	64.0	65.0	59.9	60.2	56.2	57.0
Amino acids at 0.05%	1.27	1.28	0.60	0.61	63.0	64.0	59.0	60.0	56.0	56.8
Amino acids at 0.1 %	1.32	1.33	0.66	0.67	67.5	68.0	63.0	64.0	59.5	60.0
Amino acids at 0.2 %	1.36	1.37	0.69	0.70	68.9	70.2	65.0	65.5	63.0	63.8
Potassium silicate + amino acids each at 0.05%	1.37	1.38	0.70	0.71	68.0	69.5	64.2	65.0	63.0	64.0
Potassium silicate + amino acids each at 0.1 %	1.41	1.42	0.77	0.78	73.0	74.0	67.2	68.0	66.4	67.0
Potassium silicate + amino acids each at 0.2 %	1.42	1.43	0.80	0.81	74.5	75.0	69.0	70.1	68.5	69.8
New L.S.D. at 5%	0.03	0.04	0.04	0.05	2.2	2.4	2.0	2.1	1.9	2.0

Table (5): Effect of spraying some amino acids and / or silicon on the yield as well as weight and dimensions of cluster of Superior grapevines during 2020 and 2021 seasons.

Characters / Treatments	No. of clusters / vines		Cluster weight (g)		Yield / vine (Kg.)		Cluster length (cm.)		Cluster shoulder (cm.)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Control (untreated vines)	23.0	24.0	350.0	355.0	8.05	5.52	18.6	18.5	10.5	10.8
Potassium silicate at 0.05 %	24.0	25.0	360.0	365.0	8.64	9.13	19.8	20.0	11.0	11.5
Potassium silicate at 0.1 %	24.0	26.0	375.0	380.0	9.00	9.88	22.0	22.8	12.5	12.8
Potassium silicate at 0.2 %	24.0	27.0	380.0	385.0	9.12	10.40	22.8	23.5	12.9	13.2
Amino acids at 0.05%	24.0	27.0	380.0	385.0	9.12	10.40	22.5	23.2	13.5	14.0
Amino acids at 0.1 %	24.0	28.0	395.0	400.0	9.48	11.20	24.0	24.4	14.2	15.0
Amino acids at 0.2 %	24.0	29.0	405.0	410.0	9.72	11.90	24.8	25.4	15.0	15.5
Potassium silicate + amino acids each at 0.05%	24.0	29.0	400.0	405.0	9.60	11.75	24.0	24.6	15.0	15.5
Potassium silicate + amino acids each at 0.1 %	24.0	30.0	425.0	430.0	10.20	12.95	26.0	26.8	16.8	17.5
Potassium silicate + amino acids each at 0.2 %	25.0	31.0	435.0	440.0	10.88	13.64	26.5	27.0	17.2	17.8
New L.S.D. at 5%	NS	1.1	10.4	10.8	0.3	0.7	0.4	0.5	0.2	0.3

Application of Amino acids was significantly preferable in improving these measurements than using K-silicate combined application significantly were accompanied with improving these parameter relative to using each material alone from economical point of view the best results with regard to yield and cluster aspects were obtained due to treating the vines three times with a medium concentration of K-silicate and Amino acids each at 0.1% under such promised treatment. Yield per vine reached 10.20, 12.90 Kg during both seasons, respectively. The untreated vines produced yield per vine reached 8.05 to 8.52 during both seasons, respectively. The percentage of increment of the yield / vine in the promised treatment over the control treatment reach 26.71, 51.41% during both seasons, respectively. Similar trend was noticed during 2020 and 2021 seasons. Number of clusters / vine in the first seasons was unsignificantly affected.

4- Percentage of shot berry:

It is clear from the data in Table (6) that single and combined applications of K-silicate and Amino acids significantly reduced the percentage of shot berry relative to the control treatment. The reducing was clearly associated with increasing the concentrations of K-silicate and Amino acids.

It is appeared that the reduction on shot berries occurred by Amino acids was higher than these occurred by K-silicate. The lowest values were recorded on the cluster harvested from vines treated with both materials together at 0.2%. These results were nearly the same during both seasons.

5- Quality of the berries:

One can state from the data of Table (6) that treating the vines with K-silicate and / or Amino acids each at 0.05 to 0.2 % was significantly very effective in enhancing quality of the berries in terms of increasing berry weight, TSS%, TSS/acid ratio and reducing sugars % and decreasing total acidity % relative to the control treatment .

The promotion was depended on increasing concentrations of each material. Application of Amino acids surpassed the application of K- silicate in this connection. Combined applications was significantly preferable than using each alone in enhancing fruit quality. These results were true in both seasons.

Table (6): Effect of spraying some amino acids and / or silicon on the percentage of the berries of shot berries as well as some physical and chemical characteristic of the berries of Superior grapevines during 2020 and 2021 seasons.

Characters / Treatments	Shot berries		Berry weight(g.)		TSS %		Total Acidity %		TSS/ acid		Reducing sugars %	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Control (untreated vines)	7.5	7.2	4.15	4.20	17.8	17.8	0.715	0.718	24.9	24.8	15.5	15.5
Potassium silicate at 0.05 %	6.9	6.6	4.33	4.35	18.5	18.6	0.680	0.670	27.2	27.7	16.2	16.3
Potassium silicate at 0.1 %	6.2	5.9	4.41	4.44	18.9	19.0	0.670	0.660	28.2	28.8	16.5	16.6
Potassium silicate at 0.2 %	5.8	5.7	4.50	4.5	19.2	19.3	0.655	0.650	29.3	29.7	17.0	17.1
Amino acids at 0.05%	5.7	5.6	4.50	4.60	19.0	19.1	0.650	0.650	29.2	29.4	16.9	17.0
Amino acids at 0.1 %	5.2	5.1	4.75	4.80	19.6	19.7	0.635	0.630	30.9	31.3	17.4	17.5
Amino acids at 0.2 %	4.9	4.8	4.90	4.92	19.8	19.9	0.620	0.615	31.9	32.4	17.7	17.9
Potassium silicate + amino acids each at 0.05%	4.5	4.4	4.92	4.95	19.5	19.6	0.610	0.605	32.0	32.4	17.8	18.0
Potassium silicate + amino acids each at 0.1 %	4.1	4.0	5.10	5.15	20.8	20.9	0.590	0.585	35.3	35.7	18.3	18.5
Potassium silicate + amino acids each at 0.2 %	3.8	3.5	5.25	5.30	20.8	21.0	0.570	0.560	36.5	37.5	18.6	18.7
New L.S.D. at 5%	0.3	0.2	0.15	0.18	0.3	0.4	0.025	0.020	0.8	0.9	0.3	0.4

4. Discussion

Previous studies showed that the favorable effects of K-silicate on growth , nutritional status of 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 tissue.

Silicon also responsible for water transport and root development as well as increasing the tolerance of plants to controlling 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. (**Matoh *et al.*, 1991; Ma, 2004; Hattori *et al.*, 2005 and Tahir *et al.*, 2006**)

The findings regarding the promoting effect of silicon on growth and fruiting of superior grapevines and other fruit crops are in harmony with those obtained by (**A-Wasfy 2014; El-Khawaga and Mansour, 2014; Uwakiem, 2015; Akl *et al.*, 2016; Nagy-Dina , 2016 and Farahat, 2017**).

Amino acids are the most important non-protein thiol present in plants. It is essential in sulfur metabolism and defense against most stresses it is important pool of reduced sulfur and it regulates sulfur uptake at root level.

Reduced Amino acids, the major water soluble antioxidant in photosynthetic and non-photosynthetic tissues, reacting directly or indirectly with reactive oxygen species, contribute to maintain the integrity of cell structure and the proper functions of various metabolic pathways. In addition to its effects on expression of defense genes amino acids may also be involved in redox control of cell division and enhanced growth of plant (**Mulleineaux and Rausch, 2005**).

These results are in harmony with those obtained by (**Amin, 2007; Seleem-Basma and Abd El-Hameed, 2008; Sayed- Heba, 2010; Ebrahiiem-Asmaa , 2011 and Gad El-kareem, 2012**).

Conclusion:

According to the obtained data, it is suggested to use a mixture of K-silicate and Amino acids each at 0.1% three times at growth start, just after berry setting and at one month later for promoting vegetative growth aspects, yield and fruit quality of superior grapevines.

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