

## Relation of Yield and Berries Quality of Thompson Seedless Grapevines to Foliar Application of Some Vitamins

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**Abstract:** This study was carried out during 2012 and 2013 seasons to examine the effect of single and combined application of three vitamins namely A at 100 ppm, B (B<sub>1</sub>+B<sub>2</sub>+B<sub>6</sub>+ B<sub>12</sub>) at 50 ppm and C at 500 ppm on growth , vine nutritional status , yield and quality of Thompson seedless grapes. The vines received four sprays of these vitamins at growth start, just before bloom and berry setting and at one month later. Single and combined application of these vitamins namely A at 100 ppm, B- complex at 50 ppm and C at 500 ppm four times was very effective in enhancing shoot length, leaf area, chlorophylls a & b, total chlorophylls, total carotenoids, leaf content of N, P, K, berry setting %, yield and quality of the berries in relative to the check treatment This promotion was associated with using vitamins A, B and C , in ascending order . in all cases, Combined applications of these vitamins were favourable in enhancing growth, vine nutritional status, yield and berries quality comparing with using each vitamin alone. Four sprays of a mixture of vitamins A at 100 ppm, B ((B<sub>1</sub>+B<sub>2</sub>+B<sub>6</sub>+ B<sub>12</sub>) at 50 ppm and C at 500 ppm succeeded in promoting yield and quality of Thompson seedless grapes.

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### 1. Introduction

Nowadays, there is a widespread use of vitamins as antioxidants for protecting plant cells from senescence and disorders (**Robinson, 1973**) as well as enhancing cell division, the biosynthesis of natural hormones such as IAA , GA<sub>3</sub> and cytokinins, nutrient and water uptake, photosynthesis, biosynthesis of plant pigments and proteins as well as the biosynthesis of alpha keto glutaric acid which is united with amino to form amino acids and proteins (**Oretili, 1987; Samiullah et al., 1988, Foyer and Lelandias, 1993; Rao et al., 2000 and Singh, et al., 2001**).

Using different vitamins was responsible for promoting growth vine nutritional status, yield as well as physical and chemical characteristics of the grapes in Thompson seedless grapevines (**Seleem – Basma and Abd El- Hameed (2008); Abada and Abd El- Hameed (2009) and (2010); Uwakiem (2011); Reffai (2011); Ahmed et al. (2011a) and (2011b); El- Kady- Hanaa (2011); Abdelaal (2012); Ibrahiem-Rehab (2012); Mekawy (2012), Ahmed et al. (2012a) and (2012b) and Mohamed – Ebtasam (2012)**).

The target of this study was examining the effect of spraying three vitamins namely A, B (B<sub>1</sub>+ B<sub>2</sub>+ B<sub>6</sub>+B<sub>12</sub>) and ascorbic acid on growth traits, nutritional status of the vines, yield and quality of Thompson seedless grapes.

### 2. Material and Methods

This study was carried out during 2012 and 2013 seasons on seventy - two uniform in vigour 10- years old Thompson seedless grapevines grown in Seds Experimental Station located at Seds village , Beni Suef 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 1.5 x 3.0 m apart. The chosen vines (72 vines) were pruned during the first week of January in both seasons using cane pruning method with the assistance of T supporting system. Vine load was 84 eyes vines for all the selected vines on the basis of seven fruiting canes X ten eyes plus seven renewal spurs X two eyes. Surface irrigation system was followed using Nile water containing 280 ppm EC.

This study included the following eight treatments from application of single and combined sprays of vitamins A & B (B<sub>1</sub>+B<sub>2</sub>+B<sub>6</sub>+B<sub>12</sub>) and ascorbic acid in addition to the control treatment :

- 1- Control ( untreated vines)
- 2- Spraying vitamin A at 100 ppm ( 0.1 g/ l)
- 3- Spraying vitamin B complex (B<sub>1</sub>+B<sub>2</sub>+B<sub>6</sub>+B<sub>12</sub>) at 50 ppm (0.05 g/ l)
- 4- Spraying vitamin ascorbic acid at 500 ppm ( 0.5 g / l)
- 5- Spraying vitamin A + B at the previous concentrations.
- 6- Spraying vitamin A + ascorbic acid at the previous concentrations.

7- Spraying vitamins B + ascorbic acid at the previous concentrations.

8- Spraying all vitamins namely A & B & ascorbic acid at the previous concentrations.

Each treatment was replicated three times, three vines per each. The two investigated vitamins B & ascorbic acid were dissolved in water. Vitamin was dissolved in few drops of Ethyl alcohol before application. The selected vines received four sprays of these vitamins at growth start (1<sup>st</sup> week of March), just before bloom (1<sup>st</sup> week of April); just after berry setting (1<sup>st</sup> week of May) and at one month later (1<sup>st</sup> week of June).

Triton B as a wetting agent was used with all vitamins at 0.05 % (0.5 ml/ l) . Spraying was done till runoff ( 2 litres/ vine)

The investigated vitamins were applied at fixed concentrations according to the previous studies carried out by **Abada and Abd El- Hameed, 2009 and 2010**. Randomized complete block design (RCBD) was followed.

At the last week of June, the following aspects were recorded:

1-Average main shoot length (cm.) as a result of measuring the length of the ten main shoots per vine and then the average was estimated.

2- Average leaf area (cm<sup>2</sup>) as a result of measuring the diameter of twenty mature leaves from those opposite to the basal clusters on the main shoot/ vine.

Leaf area (cm<sup>2</sup>) was measured using the following equation that outlined by **Ahmed and Morsy (1999)**.

Leaf area (cm<sup>2</sup>) = 0.45 ( 0.79 x maximum diameter of leaf) + 17.77 then average leaf area was registered.

Samples of five mature and fresh leaves from those leaves opposite to the basal clusters on each shoot were taken at the last week of May during both seasons and cut into small pieces and 0.05 g weight from each sample was taken, homogenized and extracted by 25% acetone in the presence of little amounts of Na<sub>2</sub>CO<sub>3</sub> then filtered. The residue was washed several times with acetone until the filtrate became colorless. The extract was completed to a known volume (20 ml) with acetone 85% A portion of this extract was taken for the determination of chlorophylls A & B as well as total carotenoids coulometrically and acetone (85 % V/V) was used as a blank ( as mg/ 100 g F.W). The optical density of the filtrate was determined at the wave length of 662, 664 and 440 nm to determine chlorophylls A & B and total carotenoids, respectively concentration of each pigment was calculated by using the following equation according to **Wettstein (1975)**.

Cl. A = (9.784 x E 662) – (0.99x E 644) = mg / g/ FW

Cl. B = (21.426 x E 644) – (4.65 x E 622) = mg / g/ FW

Total carotenoids = (4.965 x E 4460- 0.268 (chlorophylls A + B)

Where E = optical density at a given wave length. Total chlorophylls was estimated by summation of chlorophyll a plus chlorophyll b (mg/ 100 g. / F.W)

Twenty leaves picked from main shoots opposite to the basal clusters (according to **Balo et al., 1988**) for each vine were taken at the last week of May in both seasons. Blades of the leaves were discarded and petioles were saved for determining of N, P, and K (as percentages). Petioles were oven dried at 70°C and grounded then Cu (as ppm). Petioles were oven dried at 70°C and grind then 0.5 g weight of each sample was digested using H<sub>2</sub>SO<sub>4</sub> and H<sub>2</sub>O<sub>2</sub> until clear solution was obtained (according to **Wilde et al. 1985**). The digested solutions were quantitatively transfer to 100 ml volumetric flask and completed to 100 ml by distilled water. Thereafter, leaf contents of N, P, and K, were determined as follows:

1-N % by the modified microkjeldahl method as described by **Chapman and Pratt (1965)**.

2- P % by using Olsen method as reported by **Wilde et al., (1985)**.

3- K % by using flame photometer as outlined by (**Chapman and Pratt (1965)**).

Percentage of berry setting was calculated by caging five clusters per vine in perforated white paper bags before blooming state. At the end of berry setting stage, the bags were removed for counting the following:

a) The number of attached berries.  
b) The number of dropped berries.  
c) The number of dropped flowers.  
d) The number of total flowers (a+ b + c) per cluster. Berry setting % was estimated by dividing number of attached berries by total number of flowers per cluster and multiplying the product by 100.

Harvesting took place when T.S.S./ acid in the berries of the check treatment reached at least 25 :1 (at the middle of July in both seasons) (according to **Weaver, 1976**). 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 of the grapes:

1- Cluster dimensions (length and width, cm.)  
2- Average berry weight (g.)  
3- Average berry dimensions (longitudinal and equatorial, in cm).  
4- Percentage of total soluble solids in the juice by using Hand refractometer.

5- Percentage of total sugars in the juice by **Lane and Eynon (1965)** volumetric method as described in **A.O.A.C. (1995)**.

6- Percentage of total acidity (as g tartaric acid/ 100 ml juice) by titration against 0.1 NaOH using phenolphthalein as an indicator **A.O.A.C. (1995)**.

All the obtained data were tabulated and statistically analyzed using New L.S.D. at 5 % for made all comparisons among the investigated treatment means (according to **Gomez and Gomez, 1984 and Mead et al., 1993**).

### 3. Results

#### 1-Main shoot length and leaf area:

It is evident from the data in Table (1) that single and combined applications of vitamins A at 100 ppm, B ( $B_1 + B_2 + B_6 + B_{12}$ ) at 50ppm and ascorbic acid at 500 ppm was accompanied with simulating main shoot length and leaf area in relative to the control treatment. The highest values were recorded on the vines that treated with ascorbic acid, B and A vitamins, in descending order. Using all vitamins together effectively maximized such two growth traits.

#### 2- Plant pigments and various nutrients in the leaves:

Foliar application of the three vitamins (A & B and ascorbic acid) either singly or in all combinations significantly enhanced chlorophylls a & b, total chlorophylls, total carotenoids and percentages of N, P and K in the leaves rather than non- application. The

stimulation was associated with using vitamins A & B and ascorbic acid, in ascending order. The maximum values were recorded on the vines that treated with all vitamins together (Tables 2 to 5).

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

Berry setting %, yield and cluster characters were positively affected with using all vitamins either alone or in different combinations in relative to the check treatment. The maximum values were recorded on the vines that supplied with ascorbic acid, B and A vitamins, in descending order. Treating the vines with all vitamins maximized the yield. Number of clusters did not change due to variation of vitamin treatments in the first season of study (Tables 5 & 6).

#### 4- Some physical and chemical characteristics of the grapes:

It is clear from the data in Tables (7 to 9) that single and combined applications of vitamins A, B and ascorbic acid was very effective in improving quality of the berries in terms of increasing berry weight and dimensions, T.S.S. %, T.S.S./ acid and total sugars % and decreasing total acidity rather than non-application. The best results with regard to fruit quality were recorded with using ascorbic acid followed by vitamin B and vitamin A ranked the last position in this respect. Using all vitamins together gave the best favourable effects on fruit quality.

Table (1): Effect of single and combined applications of vitamins A, B and C (ascorbic acid) on the main shoot length and leaf area of Thompson seedless grapevines during 2012 and 2013 seasons.

Treatment	Main shoot length (cm.)		Leaf area (cm <sup>2</sup> )	
	2012	2013	2012	2013
Control ( untreated vines)	98.9	101.7	110.7	112.0
Vitamin A at 100 ppm	101.3	103.6	114.0	115.3
Vitamins B( $B_1+B_2+ B_6+ B_{12}$ ) at 50ppm	105.0	107.3	117.0	118.4
Vitamin C at 500 ppm	107.7	110.3	120.0	121.3
Vitamins A + B	110.3	112.3	122.6	124.0
Vitamins A + C	113.8	115.3	125.3	126.7
Vitamins B + C	118.9	121.6	127.7	129.0
Vitamins A + B+C	122.3	127.0	130.0	131.4
New L.S.D. at 5%	1.8	2.0	1.9	1.7

Table (2): Effect of single and combined applications of vitamins A, B and C (ascorbic acid) on chlorophylls a & b in the leaves of Thompson seedless grapevines during 2012 and 2013 seasons.

Treatment	Chlorophyll a (mg /100gFw)		Chlorophyll b (mg/100gFw)	
	2012	2013	2012	2013
Control ( untreated vines)	9.11	9.20	4.22	4.32
Vitamin A at 100 ppm	10.20	10.30	5.30	5.40
Vitamins B( $B_1+B_2+ B_6+ B_{12}$ ) at 50ppm	11.41	11.52	6.41	6.51
Vitamin C at 500 ppm	12.55	12.66	7.52	7.63
Vitamins A + B	13.71	13.82	8.50	8.61
Vitamins A + C	14.80	15.82	9.49	9.60
Vitamins B + C	16.00	16.11	10.51	10.62
Vitamins A + B+C	17.50	18.00	11.52	11.63
New L.S.D. at 5%	1.02	0.91	0.81	0.71

Table (3): Effect of single and combined applications of vitamins A, B and C (ascorbic acid) on total chlorophylls and total carotenoids of Thompson seedless grapevines during 2012 and 2013 seasons.

Treatment	Total chlorophylls (mg/100gFw)		Total carotenoids (mg/100gFw)	
	2012	2013	2012	2013
Control ( untreated vines)	13.33	13.52	3.11	3.20
Vitamin A at 100 ppm	15.50	15.70	3.91	4.00
Vitamins B(B <sub>1</sub> +B <sub>2</sub> + B <sub>6</sub> + B <sub>12</sub> ) at 50ppm	17.82	18.03	4.88	4.97
Vitamin C at 500 ppm	20.07	20.29	5.88	5.97
Vitamins A + B	22.21	22.43	6.90	6.99
Vitamins A + C	24.29	25.42	7.99	8.09
Vitamins B + C	26.51	26.73	9.00	9.00
Vitamins A + B+ C	29.02	29.63	9.99	9.89
New L.S.D. at 5%	1.11	1.17	0.61	0.59

Table (4): Effect of single and combined applications of vitamins A, B and C (ascorbic acid) on the percentages of N,P and K in the leaves of Thompson seedless grapevines during 2012 and 2013 seasons.

Treatment	Leaf N%		Leaf P%		Leaf K%	
	2012	2013	2012	2013	2011	2013
Control ( untreated vines)	1.71	1.81	0.11	0.12	1.24	1.25
Vitamin A at 100 ppm	1.80	1.90	0.13	0.16	1.31	1.32
Vitamins B(B <sub>1</sub> +B <sub>2</sub> + B <sub>6</sub> + B <sub>12</sub> ) at 50ppm	1.87	1.97	0.16	0.20	1.38	1.40
Vitamin C at 500 ppm	1.95	2.05	0.19	0.25	1.45	1.47
Vitamins A + B	2.02	2.12	0.21	0.28	1.52	1.55
Vitamins A + C	2.10	2.19	0.24	0.31	1.60	1.63
Vitamins B + C	2.16	2.25	0.27	0.34	1.66	1.71
Vitamins A + B+ C	2.23	2.33	0.30	0.37	1.73	1.81
New L.S.D. at 5%	0.05	0.06	0.02	0.03	0.04	0.05

Table (5): Effect of single and combined applications of vitamins A, B and C (ascorbic acid) on the percentage of berry setting number of clusters/vine and yield (kg)per vine of Thompson seedless grapevines during 2012 and 2013 seasons.

Treatment	Berry setting%		No. of clusters/vine		Yield/vine (kg)	
	2012	2013	2012	2013	2012	2013
Control ( untreated vines)	9.1	8.9	21.0	22.0	6.6	6.8
Vitamin A at 100 ppm	10.4	10.5	21.0	24.0	6.8	7.7
Vitamins B(B <sub>1</sub> +B <sub>2</sub> + B <sub>6</sub> + B <sub>12</sub> ) at 50ppm	11.5	11.6	22.0	25.0	7.7	8.3
Vitamin C at 500 ppm	11.7	11.8	22.0	26.0	7.9	8.8
Vitamins A + B	12.8	13.0	22.0	28.0	8.1	9.8
Vitamins A + C	13.9	14.1	22.0	29.0	8.6	10.5
Vitamins B + C	15.1	15.3	22.0	30.0	8.6	11.1
Vitamins A + B+ C	16.5	16.7	22.0	30.0	8.8	11.4
New L.S.D. at 5%	1.0	1.1	NS	2.0	0.2	0.3

Table (6): Effect of single and combined applications of vitamins A, B and C (ascorbic acid) on weight (g.), length and width (cm.) of cluster of Thompson seedless grapevines during 2012 and 2013 seasons.

Treatment	Cluster weight (g.)		Cluster length (cm.)		Cluster width (cm.)	
	2012	2013	2012	2013	2012	2013
Control ( untreated vines)	315.0	310.0	21.9	22.1	10.1	10.3
Vitamin A at 100 ppm	324.0	320.0	23.0	23.0	10.7	11.0
Vitamins B(B <sub>1</sub> +B <sub>2</sub> + B <sub>6</sub> + B <sub>12</sub> ) at 50ppm	351.0	330.0	23.9	24.0	11.5	11.7
Vitamin C at 500 ppm	361.0	340.0	25.0	24.9	11.5	12.5
Vitamins A + B	366.0	351.0	25.8	25.9	12.3	13.3
Vitamins A + C	389.0	361.0	26.9	27.0	13.6	14.0
Vitamins B + C	391.0	371	28.0	27.8	14.2	14.7
Vitamins A + B+ C	401	380	29.9	29.3	15.0	15.3
New L.S.D. at 5%	8.2	9.1	0.8	0.7	0.5	0.6

Table (7): Effect of single and combined applications of vitamins A, B and C (ascorbic acid) on the weight (g.), equatorial and longitudinal (cm.) of the berry of Thompson seedless grapevines during 2012 and 2013 seasons.

Treatment	Berry weight (g.)		Berry equatorial (cm.)		Berry longitudinal (cm.)	
	2012	2013	2012	2013	2012	2013
Control ( untreated vines)	1.55	1.60	1.30	1.40	1.60	1.66
Vitamin A at 100 ppm	1.62	1.68	1.37	1.48	1.66	1.72
Vitamins B(B <sub>1</sub> +B <sub>2</sub> + B <sub>6</sub> + B <sub>12</sub> ) at 50ppm	1.69	1.75	1.45	1.56	1.72	1.78
Vitamin C at 500 ppm	1.77	1.84	1.52	1.63	1.78	1.85
Vitamins A + B	1.85	1.91	1.60	1.71	1.85	1.91
Vitamins A + C	1.91	1.97	1.66	1.77	1.91	1.97
Vitamins B + C	1.99	2.06	1.72	1.83	1.96	2.03
Vitamins A + B+ C	2.15	2.14	1.89	2.01	2.01	2.10
New L.S.D. at 5%	0.07	0.08	0.06	0.07	0.05	0.06

Table (8): Effect of single and combined applications of vitamins A, B and C (ascorbic acid) on the percentages of total soluble solids and total acidity in the grapes of Thompson seedless grapevines during 2012 and 2013 seasons.

Treatment	T.S.S %		Total acidity%	
	2012	2013	2012	2013
Control ( untreated vines)	17.8	18.0	0.711	0.715
Vitamin A at 100 ppm	18.0	18.3	0.684	0.694
Vitamins B(B <sub>1</sub> +B <sub>2</sub> + B <sub>6</sub> + B <sub>12</sub> ) at 50ppm	18.2	18.7	0.660	0.671
Vitamin C at 500 ppm	18.5	19.0	0.637	0.650
Vitamins A + B	18.7	19.3	0.615	0.637
Vitamins A + C	19.0	19.6	0.595	0.615
Vitamins B + C	19.2	19.9	0.571	0.591
Vitamins A + B+ C	19.5	20.2	0.555	0.566
New L.S.D. at 5%	0.2	0.3	0.021	0.020

Table (9): Effect of single and combined applications of vitamins A, B and C (ascorbic acid) on the ratio between T.S.S and acid as well as total sugars% in the grapes of Thompson seedless grapevines during 2012 and 2013 seasons.

Treatment	T.S.S./ acid		Total sugars%	
	2012	2013	2012	2013
Control ( untreated vines)	25.0	25.2	15.5	15.9
Vitamin A at 100 ppm	26.3	26.4	15.8	16.2
Vitamins B(B <sub>1</sub> +B <sub>2</sub> + B <sub>6</sub> + B <sub>12</sub> ) at 50ppm	27.6	27.9	16.1	16.4
Vitamin C at 500 ppm	29.0	29.2	16.3	16.7
Vitamins A + B	30.4	30.3	16.6	16.8
Vitamins A + C	31.9	31.9	16.7	17.0
Vitamins B + C	33.6	33.7	17.0	17.2
Vitamins A + B+ C	35.1	35.7	17.5	17.6
New L.S.D. at 5%	1.0	1.2	0.3	0.2

#### 4. Discussion

The previous beneficial effects of the three vitamins namely vitamins A & B and ascorbic acid on growth characters, vine nutritional status, yield as well as physical and chemical characteristics of the fruits might be attributed to their positive action on avoiding all active oxygen species from reducing cell sensences and destroying all membrances as well as enhancing cell division, the biosynthesis of plant pigments and organic foods, the resistance of plants to unfavourable conditions beyond the trees, the biosynthesis of natural hormones, building of amino acids and proteins and

uptake of water and different nutrients. These merits were happened through the effect of these vitamins on catching the free radicals namely signlet oxygen, superoxide anion, H<sub>2</sub>O<sub>2</sub> and hydroxyle and preventing the oxidation of lipids and death of cells (Robinson, 1973; Oretili, 1987; Samiullah *et al.* 1988; Foyer and Lelandias, 1993; Rao *et al.* 2000 and Singh *et al.* 2001).

These results are in harmony with those obtained by Ahmed and Seleem – Basma (2008); Abada and Abd El- Hameed (2009) and (2010); Uwakiem (2011); Reffai (2011); Ahmed *et al.* (2011a) and

(2011b); El- Kady- Hanaa (2011); Abdelaal (2012); Ibrahiem- Rehab (2012); Mekawy (2012), Ahmed *et al.* (2012a) and (2012b) and Mohamed – Ebtesam (2012) on Thompson seedless grapevines.

### Conclusion

Under the conditions of this study and the resembling conditions it is advised to treat Thompson seedless grapevines four times with a mixture of three vitamins namely A at 100 ppm & B (B<sub>1</sub> + B<sub>2</sub> + B<sub>6</sub> + B<sub>12</sub>) at 50 ppm and ascorbic acid at 500 ppm for improving yield quantitatively and qualitatively.

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