Physiological Studies on Fertilization of Superior Grapevines by Nano Technology System

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Abstract: This study was carried out during 2016 and 2017 seasons to examine the effect of normal NPK and boron versus nano fertilizers on growth, vine nutritional status and fruiting of Superior grapevines. Using nano NPK and boron fertilizers was superior than using normal ones in enhancing growth, vine nutritional status, yield and berries quality. Increasing concentrations of nano- boron from 0.005 to 0.01 % and nano-NPK from 0.05 to 0.1 % failed to show measurable promotionon all investigated parameters. Supplying Superior grapevines with NPK via nano systems at 0.05 % was suggested to be beneficial for promoting yield and berries quality.

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1. Introduction

Modern technologies have been developed to create slow release fertilizers with the old of the development of nano technology. Hence, many trails have been attempted to create nano fertilizers to increase element utilization efficiency of fertilizers by the plants (**Hu *et al.*, 2013 and Canali *et al.*, 2014**).

Using nano fertilizers had an obvious promotion on growth, vine nutritional status, yield and fruit quality of fruit crops (**Rai *et al.*, 2012 and Prasad *et al.*, 2014).**

The effects of using nutrients via nano technology on promoting growth, yield and fruit quality of Zaghloul date palms was reported by **Sabir *et al* (2014); Refaai (2014) and Roshdy and Refaai (2016).**

The promoting effect of using nutrients via traditional methods was reported by **Etman *et al* (2007)** on Zaghloul date palms; **El-Sayed-Esraa (2010)** on Ewaise mangoes; **Hamed-Mona (2011)** on Balady mandarin; **Yousef-Aml *et al* (2011)** on chemlali olives; **Mohamed and Mohamed (2013)** on Sewy data palms; **Hassan- Huda (2014)** on Valencia oranges; and **Sayed- Ola (2014)** on El-Saidy date palms.

The target of this study was examining the effects of normal and nano NPK and boron fertilizers on fruiting of Superior grapevines.

2. Materials and Methods

This study was carried out during the two consecutive seasons of 2016 and 2017 on 60 uniform in vigour 10-years old Superior grapevines grown in a private vineyard located at El-Makhadma Village, Qena district, Qena Governorate where the soil texture is clay and well drained water since water table depth is not less than two meters (Table 2). The chosen vines are planted at 2 x 3 meters apart. Cane pruning system was followed at the first week of Jan. leaving 84 eyes per vine (on the basis of six fruiting canes x 12 eyes plus six renewal spurs x two eyes) with the assistance of Gabel shape supporting system. The vines were irrigated through drip irrigation system using Nile water.

The main target of this study was examining the effect of spraying normal NPK and boron versus nano fertilizers on some growth traits, nutritional status of the vines, yield and quality of Superior grapes.

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

Table (1): Analysis of the tested soil:

Constituents	Values
Particle size distribution:	
Sand %	11.0
Silt %	22.5
Clay %	68.5
Texture	Clay
pH (1:2.5 extract)	8.05
EC (1:2.5 extract) (dsm^{-1}) 1 cm / 25^{o}C.	1.03
O.M. %	1.88
$CaCO_3$ %	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
2- Nano-boron at 0.0025 %
3- Nano-boron at 0.005 %
4- Nano-boron at 0.01 %
5- Normal-boron at 0.025 %
6- Normal -boron at 0.05 %
7- Normal -boron at 0.1 %
8- Normal NPK at 0.5 %
9- Nano NPK at 0.05 %
10- Nano NPK at 0.1 %

Each treatment was replicated three times, two vines per each (60 vines). Normal and nano NPKB fertilizers were sprayed three times at growth start (1st week of Mar.), just after berry setting (2nd week of April) and three weeks later (1st week of May). Normal NPKB fertilizers were added via urea orhtophosphoric acid, potassium sulphate and boric acid sources, respectively.

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 **(Rangaswamy, 1995)**.

The following measurements were recorded during the two experimental seasons:

At the middle of June, the following growth aspects were recorded:

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

1. Average leaf area (cm^2) as a result of measuring the diameter of twenty mature leaves from those opposite to the basal clusters on the main shoots (**Balo *et al.*, 1985**). Leaf area (cm^2) was measured using the following equation as outlined by **Ahmed and Morsy (1999)**. Leaf area (cm^2) = $0.45 (0.79 \times d^2) + 17.77$, where d is the maximum diameter of leaf, then the average leaf area was registered.

2. Wood ripening coefficient was measured by dividing the length of brownish part of the cane by the total length of cane just before pruning date (1st week of January) (**Bourad, 1966**).

3. Just after carrying out winter pruning, the weight removal of 1-year old pruning wood per each vine was recorded (kg/ vine).

4. For each vine five canes were selected just before Winter pruning (1st week of January) for measuring the cane thickness (mm) by using Vernier caliper.

2- Number of leaves/ shoot.

3- Average leaf area (cm^2) 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^2) was measured using the following equation that outlined by **Ahmed and Morsy (1999)**.

Leaf area (cm^2) = 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 middle of June during the three 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_2CO_3 then filtered. The residue was washed several times with acetone until the filtrate became colourless. 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 and B colourimetrically 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 and 664 nm to determine chlorophylls A and B, respectively. Concentration of each pigment was calculated by using the following equations according to **Von-Wettstein (1957)**.

Cl. A = (9.784 x E 662) – (0.99 x E 644) = mg / 100 g FW

Cl. B = (21.426 x E 644) – (4.65 x E 622) = mg /100 g FW

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

Total carotenoids = (4.965 x E440- 0.268 (chl.a + chl.b)

Where E = optical density at a given wave length. Total chlorophylls was calculated by summation of chl. a and chl. b. These plant pigments were calculated as (mg/100 g F.W.)

Twenty leaves picked from the main shoots opposite to the basal clusters (according to **Balo *et al.*, 1988**) for each vine were taken at the middle of June during the three seasons. Blades of the leaves were discarded and petioles were saved for determining different nutrients. Petioles were oven dried at 70^oC and grind then 0.5 g weight of each sample was digested using H_2SO_4 and H_2O_2 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, K, Mg, Ca, Zn, Fe, Mn and Cu were determined as follows:

1. N % by the modified micro Kejldahl 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)**.

4- Mg and Ca by titration against EDTA (Versene method).

4. Micronutrients namely Zn, Fe, Mnand Cu (as ppm) by using atomic absorption spectrophotometer according to **Jones *et al.*, (1991)**.

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) (according to **Winkler *et al.*, 1974 and 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.

1- Cluster dimensions (length and width, cm.)

2- Shoot 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 titretable acidity (as a tartaric acid/ 100 ml juice) by titration against 0.1N NaOH using phenolphthalein as an indicator **A.O.A.C. (2000)**.

The obtained data were tabulated and significantly analyzed according to **Snedecor and Cochran (1967) and Mead *et al.*, (1993).** Differences between treatment means were compared during new L.S.D. test at 5% level of probability according to **Steel and Torrie (1984).**

3. Results

1- Effect of spraying normal and nano fertilization of NPKB on some vegetative growth aspects:

Data in Table (2) show the effect of spraying normal and nano fertilization of NPKB on main shoot length, number of leaves/shoot, leaf area, wood ripening coefficient, cane thickness and pruning wood weight of Superior grapevines during 2016 and 2017 seasons.

It is clear from the obtained data that fertilizing Superior grapevines with normal boron at 0.025 to 0.1 %, nano boron at 0.0025 to 0.01 %, normal NPK at 0.5 % and nano-NPK at 0.05 to 0.1 % significantly stimulated the six growth aspects namely main shoot length, number of leaves/shoot, leaf area, wood ripening coefficient, cane thickness and pruning wood weight relative to the control. The stimulation was related to increasing concentrations of each fertilizer. Using boron and NPK via nano fertilization system significantly was superior than using these fertilizers via normal fertilization on enhancing these characteristics. Increasing concentrations of normal-boron from 0.05 to 0.1 %, nano-boron from 0.005 to 0.01 % and nano-NPK from 0.05 to 0.1 % failed to show significant promotion on these aspects. The maximum values were recorded on the vines that fertilized with NPK via nano system at 0.1 %. The minimum values were recorded on the untreated vines. Similar trend was noticed during 2016 and 2017 seasons.

2- Effect of spraying normal nano fertilization of NPKB on chemical composition:-

Data in Tables (3 & 4) show the effect of spraying normal and nano fertilization of NPKB on chlorophylls a & b, chlorophylls, total chlorophylls, total carotenoids, N, P, K, Mg, Ca, Zn, Mn, Fe and Cu in the leaves of Superior grapevines during 2016 and 2017 seasons.

It is clear from the obtained that chlorophylls a & b, total chlorophylls, total carotenoids, N, P, K, Mg, Ca, Zn, Fe, Mn and Cu in the leaves were significantly increased with using normal and nano NPK and boron at all concentrations relative to the control. There was a gradual promotion on these pigments and nutrients with increasing concentrations of normal and nano fertilizers. Using NPK and boron via nano system was significantly favourable than using these fertilizers in normal source in enhancing these chemical components. No significant differences on these leaf chemical components among the higher two concentrations of each fertilizers applied via normal or nano system. Treating the vines with NPK via nano system at 0.1 % gave the maximum values. The lowest values were recorded on untreated vines. These results were true during both seasons. Leaf content of Cu was significantly unaffected by the present treatments.

3- Effect of spraying normal nano fertilization of NPKB on the yield and cluster aspects:

Data in Table (5) show the effect of spraying normal and nano fertilization of NPKB on the yield expressed in weight and number of clusters per vine as well as weight, length and shoulder of cluster of Superior grapevines during 2016 and 2017 seasons.

Table (2): Effect of spraying normal and nano fertilizers of NPK and Boron on some vegetative growth characteristics of Superior grapevines during 2016 and 2017 seasons

Treatments	Main shoot length (cm)		No. of leaves / shoot		Leaf area $(cm)^2$		Wood ripening coefficient		Cane thickness (cm)		Pruning wood weight (kg)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	109.1	109.4	16.0	16.0	106.3	107.0	0.66	0.65	1.14	1.14	1.61	1.59
Nano-boron at 0.0025 %	111.1	111.4	20.0	22.0	112.0	112.7	0.80	0.81	1.30	1.29	1.91	1.90
Nano-boron at 0.005 %	113.0	113.3	22.0	23.0	114.0	114.8	0.83	0.85	1.35	1.34	2.01	2.00
Nano-boron at 0.01 %	113.3	113.8	22.0	23.0	114.4	115.0	0.84	0.84	1.36	1.35	2.03	2.03
Normal-boron at 0.025 %	110.1	110.4	18.0	18.0	108.0	109.0	0.70	0.70	1.19	1.18	1.71	1.71
Normal -boron at 0.05 %	111.1	111.5	19.0	20.0	110.0	111.0	0.74	0.75	1.24	1.23	1.80	1.81
Normal -boron at 0.1 %	111.4	111.6	19.0	21.0	110.3	111.3	0.75	0.76	1.25	1.24	1.81	1.82
Normal NPK at 0.5 %	113.0	113.5	24.0	25.0	116.6	118.0	0.87	0.88	1.41	1.41	2.14	2.16
Nano NPK at 0.05 %	115.0	115.3	26.0	26.0	118.9	120.0	0.90	0.92	1.46	1.47	2.24	2.27
Nano NPK at 0.1 %	115.2	115.5	26.0	26.0	119.0	120.3	0.91	0.93	1.47	1.48	2.25	2.28
New L.S.D. at 5%	**1.0**	**1.1**	**1.0**	**1.0**	**1.4**	**1.3**	**0.03**	**0.03**	**0.03**	**0.02**	**0.04**	**0.05**

Table (3): Effect of spraying normal and nano fertilizers of NPK and Boron on some photosynthetic pigments and percentages of N and P in the leaves of Superior grapevines during 2016 and 2017 seasons

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 %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	4.90	4.81	1.00	1.02	5.90	5.83	1.03	1.07	1.57	1.59	0.117	0.119
Nano-boron at 0.0025 %	5.19	5.09	1.21	1.24	6.40	6.33	1.24	1.29	1.83	1.88	0.147	0.150
Nano-boron at 0.005 %	5.30	5.20	1.27	1.30	6.57	6.50	1.30	1.35	1.90	1.95	0.155	0.158
Nano-boron at 0.01 %	5.31	5.21	1.28	1.31	6.59	6.52	1.32	1.36	1.91	1.96	0.156	0.159
Normal-boron at 0.025 %	4.97	4.96	1.07	1.10	6.04	6.06	1.11	1.15	1.68	1.68	0.127	0.130
Normal -boron at 0.05 %	5.05	4.95	1.14	1.18	6.19	6.13	1.18	1.23	1.75	1.76	0.137	0.140
Normal -boron at 0.1 %	5.06	4.96	1.15	1.19	6.21	6.15	1.19	1.24	1.76	1.77	0.138	0.141
Normal NPK at 0.5 %	5.41	5.44	1.38	1.41	6.79	6.85	1.42	1.46	2.00	2.05	0.166	0.176
Nano NPK at 0.05 %	5.52	5.55	1.45	1.48	6.97	7.03	1.53	1.55	2.06	2.12	0.175	0.185
Nano NPK at 0.1 %	5.53	5.56	1.46	1.49	6.99	7.05	1.54	1.56	2.07	2.13	0.176	0.186
New L.S.D. at 5%	**0.05**	**0.06**	**0.05**	**0.04**	**0.05**	**0.07**	**0.05**	**0.04**	**0.05**	**0.07**	**0.008**	**0.007**

It is obvious from the obtained data that supplying the vines with normal-boron at 0.025 to 0.1 %, nano-boron at 0.0025 to 0.01 %, normal – NPK at 0.5% and nano-NPK at 0.05 to 0.1 % was significantly very effective in improving the yield as well as cluster weight and dimensions relative to the control. The promotion was associated with increasing concentrations of normal and nano fertilizers. Meaningless promotion on yield and clusters aspects was observed among the higher two concentrations of each fertilizers. Using nano NPK and boron fertilizers was significantly preferable than using normal ones in improving the yield and cluster aspects. The maximum yield (10.7 & 12.4 kg) from economical point of view was detected on the vines that received NPK via nano system at 0.05 % during both seasons, respectively. The untreated vines produced yield reached 8.6 & 8.7 kg during both seasons, respectively. The percentage of increment on the yield due to using promised treatment over the control reached 24.4 and 42.5% during both seasons, respectively. Number of clusters per vine was significantly unaffected by the present treatments. These results were true during both seasons.

Table (4): Effect of spraying normal and nano fertilizers of NPK and Boron on the leaf content of K, Mg and Ca (as %) and Zn, Mn, Fe and Cu (as ppm) of Superior grapevines during 2016 and 2017 seasons

Treatments	**Leaf K %**		**Leaf Mg %**		**Leaf Ca %**		**Leaf Zn (ppm)**		**Leaf Mn (ppm)**		**Leaf Fe (ppm)**		**Leaf Cu (ppm)**	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Control	1.10	1.14	0.49	0.51	2.00	1.99	49.1	50.0	52.9	53.0	46.1	45.1	0.89	0.91
Nano-boron at 0.0025 %	1.36	1.40	0.67	0.67	2.23	2.22	57.0	57.8	60.5	60.6	51.1	50.1	0.91	0.91
Nano-boron at 0.005 %	1.44	1.48	0.74	0.73	2.30	2.29	59.5	60.4	63.0	63.9	53.3	52.5	0.91	0.91
Nano-boron at 0.01 %	1.45	1.50	0.75	0.74	2.31	2.30	59.6	60.5	63.3	63.0	53.4	52.6	0.92	0.91
Normal-boron at 0.025 %	1.18	1.22	0.55	0.55	2.07	2.06	51.5	52.4	55.5	55.4	47.6	46.6	0.92	0.92
Normal -boron at 0.05 %	1.26	1.30	0.60	0.60	2.15	2.14	54.0	55.0	58.0	57.9	49.0	48.2	0.92	0.92
Normal -boron at 0.1 %	1.27	1.31	0.61	0.62	2.16	2.15	54.3	55.2	58.3	58.0	49.1	49.1	0.92	0.92
Normal NPK at 0.5 %	1.52	1.55	0.80	0.80	2.41	2.40	63.0	63.9	66.0	66.1	56.0	55.9	0.92	0.92
Nano NPK at 0.05 %	1.60	1.63	0.84	0.85	2.48	2.47	65.6	66.5	68.9	96.0	58.0	57.9	0.92	0.92
Nano NPK at 0.1 %	1.61	1.64	0.85	0.86	2.49	2.48	65.7	66.6	68.9	69.1	58.3	58.0	0.92	0.92
New L.S.D. at 5%	**0.05**	**0.06**	**0.03**	**0.04**	**0.06**	**0.07**	**2.0**	**2.1**	**1.9**	**2.0**	**1.3**	**1.4**	**NS**	**NS**

Table (5): Effect of spraying normal and nano fertilizers of NPK and Boron 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
Nano-boron at 0.0025 %	24	25	9.4	9.9	395	396	17.3	17.4	12.8	12.9	7.0	6.9
Nano-boron at 0.005 %	24	26	9.7	10.6	406	407	17.8	18.0	13.2	13.2	6.0	5.9
Nano-boron at 0.01 %	24	26	9.7	10.6	406	408	17.9	18.0	13.3	13.3	5.9	5.8
Normal-boron at 0.025 %	24	25	8.9	9.3	371	371	16.2	16.3	11.9	12.0	10.8	10.7
Normal -boron at 0.05 %	24	25	9.2	9.6	383	384	16.7	16.8	12.3	12.4	10.0	9.9
Normal -boron at 0.1 %	24	25	9.2	9.6	384	385	16.8	16.9	12.4	12.5	9.9	9.8
Normal NPK at 0.5 %	24	27	10.0	11.3	417	418	18.4	18.5	13.7	13.8	5.5	5.4
Nano NPK at 0.05 %	25	29	10.7	12.4	427	428	18.9	19.0	14.0	14.2	5.0	4.9
Nano NPK at 0.1 %	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**

4- Effect of spraying normal nano fertilization of NPKB on the percentage of shot berries:-

Data in Table (5) show the effect of spraying normal and nano fertilization of NPKB on the percentage of the shot berries of Superior grapevines during 2016 and 2017 seasons.

It is evident from the obtained data that percentage of shot berries was significantly decreased with using normal and nano fertilization systems relative to the control. These was a gradual reduction on the percentage of shot berries with increasing concentrations of nano and normal fertilizers. Using nano NPK and boron fertilizers was significantly preferable than using normal NPK and boron in controlling the percentage of shot berries. The reduction on the percentage of shot berries was slight among the higher two concentrations of each normal and nano NPK and boron fertilizers. The lowest values of shot berries % (4.7 & 4.8 %) was noticed on the vines that received NPK via nano system at 0.1 % during both seasons, respectively. The untreated vines produced the highest values (11.5 & 11.6 %) during both seasons, respectively. These results were true during both seasons.

5- Effect of spraying normal nano fertilization of NPKB on some physical and chemical characteristics of the berries:-

Data in Table (6) show the effect of spraying normal and nano fertilization of NPKB on berry weight and dimensions (longitudinal and equatorial), T.S.S.%, reducing sugars % and total acidity of the berries of Superior grapevines during 2016 and 2017 seasons.

It is noticed from the obtained data that treating Superior grapevines with nano-boron at 0.0025 to 0.01 %, normal-boron at 0.025 to 0.1%, nano-NPK at 0.05 to 0.1 % and normal –NPK at 0.5% was significantly very effective in improving quality of the berries in terms of increasing weight, longitudinal and equatorial of berries, T.S.S.% and reducing sugars %, and decreasing total acidity % over the control. The promotion on quality of the berries was associated with increasing nano and normal NPK and boron fertilizers. Increasing concentrations of nano-boron from 0.005 to 0.01 %, normal-boron from 0.05 to 0.1 % and nano-NPK from 0.05 to 0.1 %had no significant promotion on quality of the berries. Using NPK via nano-system was significantly superior than using these fertilizers via normal system in improving quality of the berries. The best results with regard to quality of the berries were obtained due to supplying the vines with NPK via nano system at 0.1 %. The untreated vines produced unfavourble effects on quality of the berries. These results were true during both seasons.

Table (6): Effect of spraying normal and nano fertilizers of NPK and Boron 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
Nano-boron at 0.0025 %	3.26	3.31	2.17	2.20	2.40	2.42	19.3	19.6	17.1	17.0	0.630	0.629
Nano-boron at 0.005 %	3.36	3.41	2.20	2.23	2.44	2.47	19.9	21.1	17.6	17.5	0.614	0.613
Nano-boron at 0.01 %	3.37	3.42	2.21	2.24	2.45	2.48	20.0	21.1	17.7	17.6	0.613	0.612
Normal-boron at 0.025 %	3.04	3.10	2.06	2.05	2.29	2.31	18.0	18.3	16.0	15.9	0.681	0.681
Normal -boron at 0.05 %	3.15	3.21	2.11	2.14	2.34	2.36	18.6	18.8	16.6	16.6	0.660	0.659
Normal -boron at 0.1 %	3.16	3.22	2.12	2.15	2.35	2.37	18.7	18.9	16.7	16.8	0.659	0.657
Normal NPK at 0.5 %	3.49	3.55	2.27	2.30	2.50	2.55	20.5	21.6	18.2	18.3	0.591	0.585
Nano NPK at 0.05 %	3.61	3.66	2.31	2.54	2.55	2.60	21.0	22.2	18.7	18.8	0.570	0.560
Nano NPK at 0.1 %	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

4. Discussion

The beneficial effects of using nano micronutrients on growth and fruiting of Zaghloul data palms might be attributed to their positive action on synchronizing the release of micronutrients and preventing undesirable nutrient losses to soil, water and air via direct internalization by crops and avoiding the interaction nutrients with soil, microorganisms of water and air as well as increasing their efficiency and reducing soil toxic. The potential negative effects associated with over dosage and frequency of application. They main delay the release of the nutrients and extend the fertilizer effect period (**Prasad *et al*., 2014; Mukhopadhyay, 2014 and Manjunatha *et al*., 2016**).

The important regulatory effect of Fe in building chlorophylls and plant pigments and regulating reduction and oxidants reactions (**Devlin and Withdam, (1983): Nijjar, 1985**), Mn in enhancing co-enzymes that are responsible for enhancing the activity of respiration and oxidation enzymes and the biosynthesis of organic acids, N metabolism, nitrate reduction and the biosynthesis of IAA (**Marschner, 2012)** and Zn in activating metabolism enzymes, biosynthesis of organic foods, IAA, cell division and enlargement, water absorption and nutrient transport (**Mengel and Kirkby, 1987 and Yagodin, 1990**).

These results regarding the effect of using nutrients via nano technology on promoting growth, yield and fruit quality of Zaghloul date palms are in agreement with those obtained by **Sabir*et al* (2014); Refaai (2014) and Roshdy and Refaai (2016).**

These results concerning the promoting effect of using nutrients via traditional methods are in harmony with those obtained by **Etman *et al* (2007)** on Zaghloul date palms; **El-Sayed-Esraa (2010)** on Ewaise mangoes; **Hamed-Mona (2011)** on Balady mandarin; **Yousef-Aml *et al* (2011)** on chemlali olives; **Mohamed and Mohamed (2013)** on Sewy data palms; **Hassan- Huda (2014)** on Valencia oranges; and **Sayed- Ola (2014)** on El-Saidy date palms.

The different functions of boron for fruit trees are listed as follows According to **(Stile, 1961 and Mengel, 1985).**

1- Enhancing the germination of pollen grains, thereby enhancing the efficiency of pollination, fertilization and fruit retention.

2- Translocation and adsorption of sugars, since sugars may be moved in the form of borate complexes.

3- Activating the formation of meristems.

4- Preventing the abortion of flowers.

5- Preventing the accumulation of polyphenolic compounds.

6- Incouraging cell development and the elongation of cells through controlling of polysaccharide synthesis.

7- Controlling the formation of starch and preventing the excessive concersion of sugars into starch.

8- Incouraging root development.

9- Reducing at the lower extent the different disorders un the fruit crops.

5. Conclusion

Supplying Superior grapevines with NPK via nano systems at 0.05 % was suggested to be beneficial for promoting yield and berries quality.

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