Minia J. of Agric. Res. & Develop.
Vol. (40), No. 2, pp. 197-205, 2020

FACULTY OF AGRICULTURE

RESPONSE OF FLAME SEEDLESS GRAPEVINES TO SPRAY BORON PREPARED BY NANOTECHNOLOGY

Wassel Abd El- Hameed, M. M.[(1)]***; H. H. M. Saied***[(2)] ***and Salama, M. I. Abd El- Wahab***[(3)]

[(1)] Hort. Dept. Fac. of Agric. Minia Univ. Egypt.
[(2)] Hort. Dept. Fac. of Agric. and Natural Resources, Aswan Univ. Egypt
[(3)] Postgraduate student.

Received: 20 September (2020) Accepted: 27 October (2020)

ABSTRACT

This study was conducted during 2015 and 2016 seasons to examine the effect of nano versus normal boron on yield and quality of the berries of Flame seedless grapevines grown under Minia region conditions.

Treating Flame seedless grapevines three times by nano boron at 0.0125 to 0.05 % or by normal boron at 0.025 to 0.1% considerably improved berry setting %, yield per vine, cluster weight as well as physical and chemical characteristics of the berries relative to the control. Using boron prepared by nanotechnology was superior than using it through normal methods in this respect. The best results in regard to yield and berries quality of flame seedless grapevines were obtained by treating the vines three times by nano boron at 0.025%.

Keywords: nanotechnology –boron – yield – berries quality- Flame seedless grapevines.

INTRODUCTION

In Egypt, plantation of grapevines cv. Flame faces some problems. The decline of the yield and the inferior of quality aspects due to uneven colouration of the berries in the clusters are considered the main drawbacks.

Boron is essential micronutrients for all plants growth. It is important to be available for the new reproductive development tissues and vegetative growth. Deficiency of boron in grapevines has many symptoms including shot berries, incidence, dieback of the shoot tip, and yellow parts of the vines (Marshner, 1995).

During flowering time boron, deficiencies can results in poor set since it plays a main role in early seasons, shoot growth and pollen growth and tube germination which are needed for fertilization process and berry set (Mengel *et al.,* 2001 and Marschner,1995). Vines that suffer from boron deficiency will have cluster that set large number of shot berries; also, low boron supply inhibit flowering and seed development (Mengel *et al.,* 2001).

Boron had an outstanding and promising impact on growth, flowering, berry setting, yield as well as physical and chemical characteristics of the berries in various grapevine cvs. (Ali, 2000; Farahat, 2008, Abd El-Gaber-Nermean, 2009; El- Kady- Hanaa, 2011; and Abdelaal, 2012).

Nanotechnology is a promising field of interdisciplinary research. It opens up a wide array of opportunities in various fields like medicine pharmaceuticals, electronics and agriculture.

The potential uses and benefits of nanotechnology are enormous. Investments in agriculture and food nanotechnologies carry increasing weight because of their potential benefits range from improving food quality and safety to reducing agricultural inputs and improving processing and nutrition (Rai *et al.,* 2012).

While most investment is primarily made in developed countries, research advancements provide glimpses of potential applications in agricultural food and water safety that could have significant impacts on rural populations in developing countries. This study is concentrated on modern strategies and potential of nano-materials in sustainable agriculture management as modern approaches of nanotechnology (Prasad *et al.,* 2014).

Previous studies showed that using boron via nanotechnology increased yield production. (Wassel *et al.,* 2017).

The aim of this study was elucidating the effect of using nano versus normal boron on yield and quality of berries of Flame seedless grapevines under Minia conditions.

MATERIALS AND METHODS

This study was carried out on during two consecutive seasons 2015 and 2016 using 42 Flame seedless grapevines, uniform in vigour 7- years old and grown in a private vineyard located at Bartbat village, Maghagha district, Minia Governorate where the soil texture is clay and well drained with a water table not less than two meters.

The chosen vines were planted 2.0 x 2.5 meters apart. Spur pruning system was followed at the last week of December. Leaving 72 buds per vine on the basis (20 fruiting spurs x 3buds plus six replacement spurs x two buds) using gable supporting methods.

The vines were irrigated through drip irrigation system using Nile water.

The main aim of this study was examining the effect of spraying nano versus normal boron on some growth traits, nutritional status of the vines, berry setting %, yield and quality of the vines.

This study included seven treatments from nano and normal boron in addition to the control.

1. Control.
2. Spraying normal- boron at 0.025%.
3. Spraying normal- boron at 0.05%.
4. Spraying normal- boron at 0.1%.
5. Spraying nano- boron at 0.0125%.
6. Spraying nano- boron at 0.025%.
7. Spraying nano- boron at 0.05%.

Each treatment was of three replicates, two vines per each (42 vines). Spraying of boron (either applied via nano or normal method) was done three times. The first spray at growth start (first week of Mar.) the second just after berry setting (first week of April) and third after three weeks later (last week of April).

Triton B as a wetting agent was added to all spraying solution of boron at 0.05% and spraying was done till run off.

Complete randomized block design (CRBD) was adopted. Each experiment alseason included seven treatments. each was of three replicates two vines per every replicate.

The following measurements were recorded during the two experimental seasons.

1. Percentage of berry setting, vine yield, number of clusters/ or as weight were measured, length and shoulder of cluster (cm) were measured.
2. Percentage of berries colouration.

Berry weight and dimensions (longitudinal and equatorial) T.S.S.%, total sugars %, total acidity %as g tartaric acid/ 100 ml juice (A.O.A.C., 2000), Statistical analysis of data was done using new L.S.D. at 5% (Mead, *and Harted*, 1993).

RESULTS AND DISCUSSIONS

1-The percentage of berry setting, yield and cluster aspects:

It was evident from the obtained data in Table (1) that percentage of berry setting, yield, weight, length and shoulder cluster were significantly ($p<0.05$) improved in response to treating the vines with nano- boron at 0.0125 to 0.05 % or normal boron at 0.025 to 0.1% compared to the control. There was a gradual promotion on such berry setting %m, yield as well as weight length and shoulder cluster with increasing concentrations of nano boron from 0.0125 to 0.05 % and normal boron from 0.025 to 0.1%. No significant ($p>0.05$) promotion on the percentages of berry setting%, yield as well as cluster aspects was observed among the highst two concentrations of nano or normal boron. Therefore, from economical point of view, it was suggested to use medium concentration of nano or normal boron, namely 0.025 % and 0.05 % respectively. The maximum values of berry setting % (13.3, 13.7 %) , yield per vine (9.2 , 11.9 kg) , weight cluster (355.0 , 360.0 g) , cluster length (22.2, 23.0 cm) and cluster shoulder (14.3, 14.5 cm) were recorded on the vines that were received nano boron at 0.05 % during both seasons, respectively. The minimum values of berry setting % (9.5, 9.8 %), yield per vine (7.3 , 7.5 kg), weight cluster (290.0, 300.0 g), cluster length (16.0 , 16.5 cm), an cluster shoulder (11.0 , 11.4 cm) were recorded for the untreated vine (control) during both seasons. The percentage of increment on the yield due to application of nano boron at 0.05 % over the control treatment reached 23.3 and 49.3 % during 2015 and 2016 seasons respectively.

2-The percentage of berries colouration:

It was clear from the obtained data in Table (2), the percentage of berries colouration was significantly ($p<0.05$) improved due to treating the vines three times with nano boron at 0.0125 to 0.05 % or with normal boron at 0.025 to 0.1% three times over the control. All parameters were gradually increased by increasing concentrations of nano or normal boron. Increasing concentrations of nano boron from 0.025 to 0.05% had no significant promotion on the percentage of berries colouration, also berries colouration % was insignificantly increased with increasing normal boron concentrations from 0.05 tom 0.1% . Using boron prepared by nanotechnology at 0.0125 to 0.05% was significantly superior than using boron via traditional methods in improving the percentages of berries colouration.

3-Physical and chemical characteristics of the berries

It was noticed from the obtained data in Tables (2, 3) that treating the vines three times with nano – boron at 0.0125 to 0.05% or normal boron at 0.025 to 0.1% was significantly very effective in improving berries characteristics in terms of increasing weight, longitudinal and equatorial of berry, T.S.S. %, reducing sugars %, total acidity % and T.S.S./ acid in the berries compared to the control.

Table (1): Effect of spraying normal or nano boron on berry setting %, yield, cluster weight and cluster dimensions of Flame seedless grapevines during 2015 and 2016 seasons.

Treatments	Berry setting %		Yield / vine (kg)		Av. Cluster weight (g.)		Av. Cluster length (cm)		Av. Cluster shoulder (cm)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Control	9.5	9.8	7.3	7.5	290.0	300.0	16.0	16.5	11.0	11.4
Normal – Boron at 0.025%	11.2	11.5	7.8	8.4	300.0	310.0	18.2	18.5	11.8	12.0
Normal – Boron at 0.05%	11.9	12.6	8.3	9.4	320.0	325.0	18.9	19.5	12.5	13.0
Normal – Boron at 0.1%	12.5	13.0	8.8	10.7	340.0	345.0	19.5	21.0	13.2	13.8
Nano – Boron at 0.0125%	12.2	12.7	8.6	10.2	330.0	340.0	19.2	20.7	13.0	13.5
Nano – Boron at 0.025%	13.1	13.4	9.0	11.2	345.0	350.0	21.4	21.9	13.8	14.1
Nano – Boron at 0.05%	13.3	13.7	9.2	11.9	355.0	360.0	22.2	23.0	14.3	14.5
New L.S.D. at 5%	0.6	0.7	0.4	0.6	9.1	8.9	1.0	1.1	0.6	0.8

Table (2): Effect of spraying normal or nano boron on berries colouration %, Av. Berry weight (g.) Av. Berry longitudinal and berry equatorial(cm.) of Flame seedless grapevines during 2015 and 2016 seasons.

Treatments	Berries colouration %		Av. Berry weight (g.)		Av. Berry longitudinal (cm)		Av. Beery equatorial (cm)	
	2015	2016	2015	2016	2015	2016	2015	2016
Control	66.0	66.5	3.10	3.15	1.62	1.65	1.33	1.35
Normal – Boron at 0.025%	68.0	68.3	3.18	3.22	1.69	1.71	1.40	1.42
Normal – Boron at 0.05%	69.0	69.8	3.25	3.33	1.72	1.74	1.43	1.45
Normal – Boron at 0.1%	71.2	72.0	3.40	3.44	1.77	1.80	1.48	1.50
Nano – Boron at 0.0125%	70.5	71.5	3.35	3.41	1.75	1.78	1.46	1.48
Nano – Boron at 0.025%	73.0	74.0	3.46	3.50	1.79	1.81	1.50	1.51
Nano – Boron at 0.05%	74.2	75.0	3.55	3.60	1.84	1.85	1.53	1.55
New L.S.D. at 5%	1.0	1.0	0.06	0.08	0.03	0.04	0.03	0.04

Table (3): Effect of spraying normal or nano boron on chemical characteristics of the berries of Flame seedless grapevines during 2015 and 2016 seasons.

Treatments	T.S.S.%		Reducing sugars %		Total acidity %		T.S.S/ acid	
	2015	2016	2015	2016	2015	2016	2015	2016
Control	17.0	17.2	14.9	15.1	0.680	0.677	25.0	25.4
Normal – Boron at 0.025%	17.8	17.9	15.7	15.8	0.644	0.640	27.6	28.0
Normal – Boron at 0.05%	18.4	18.5	16.3	16.4	0.630	0.625	29.2	29.6
Normal – Boron at 0.1%	18.8	18.9	16.8	16.0	0.615	0.605	30.6	31.2
Nano – Boron at 0.0125%	18.6	18.7	16.5	16.7	0.620	0.610	30.0	30.7
Nano – Boron at 0.025%	19.0	19.2	16.9	17.1	0.600	0.595	31.7	32.3
Nano – Boron at 0.05%	19.2	19.4	17.1	17.3	0.590	0.580	32.5	33.4
New L.S.D. at 5%	0.4	0.5	0.3	0.4	0.020	0.022	1.1	1.2

The promotion on fruit quality was associated with increasing concentrations of nano or normal boron. No significant (p>0.05) promotion on berries characteristics was observed among 0.025 to 0.05% nano boron or 0.05 to 0.1% normal boron.

The best results in regard to berries characteristics were observed for the vines that were received boron via nano technology at 0.025% from economical point of view. These results were true during both seasons.

DISCUSSION

The benefit effects of using nano boron on stimulating vegetative growth characteristics, nutrients vine, berry setting, yield and quality of the berries in grapevines cv. Flame seedless might be attributed to its positive action on synchronizing the release of boron and preventing undesirable nutrient losses to soil, water and air via direct internalization by crops and avoiding the interaction of nutrients with soil, microorganisms of water and air as well as increasing their efficiency and reducing soil toxic. They mainly delay the release of the nutrients and extent fertilizer effect period (Rai, *et al.,* 2012 and Prasad *et al.,* 2014). The important regulatory effect of boron in activating metabolism enzymes, biosynthesis and translocation of sugars, building of IAA, cell division and enlargement, water absorption and nutrient transport may give another explanation (Nijjar, 1985 and Mengel *et al.,* 2001).

These results regarding the effect of using nanotechnology on promoting grow, yield and berries quality of Flame seedless grapevines are in agreement with those obtained by Wassel *et al.,* (2017) ; Ahmed *et al.,* (2018) and Dabdoup- Basma,(2019).

The present results concerning the promoting effect of using normal boron on yield and quality of berries are in agreement with those obtained by Ali, (2000); Abd El- Gaber-Nermeen, (2009); El- Kady- Hanaa, (2011) and Abdelaal, (2012).

Conclusion

Under the experimental and resembling conditions, it was suggested to spray Flame seedless grapevines three times at growth start just after berry setting and three week later with nano boron at 0.025 % as a replacement for normal boron for improving yield and berries quality.

REFERENCES

Abdelaal, E.H.A. (2012): The synergistic effect of using some nutrients as well as antioxidant substances on growth, nutritional status and productivity of Thompson seedless grapevines grown under Sohag region. Ph. D., Thesis Fac. of Agric. Sohag, Univ. Egypt.

Abd El-Gaber- Nermean, M.E.H. (2009): Response of Red Roomy grapevines to foliar application of boron, magnesium and zinc. M. sc. Thesis Fac. of Agric. Minia Univ. Egypt.

Ahmed, F.F.; Abdelaal, A.M.K. and Dabsdoub- Basma, A.E.A. (2018): physiological studies on fertilization of superior grapevines by nano technology system. World Rural Observations10(4)10-20.

Ali, A.H. (2000): Response of Flame seedless grapevines to spraying with ascorbic acid and boron. Minia J. of Agric. Res. & Develop. 20(1): 15-174.

Association of Official Agricultural Chemists (2000): Official Method of Analysis (A.P.A.C.) 15th Ed., Published by A.O.A.C. Washington D.C. (U.S.A.) pp. 490-510.

Chapman, H.D. and Pratt , P.P. (1965): Method of Analysis for soils, Plants and water . Univ. of California Division of Agric., Sci., 172-173.

Dabdoub- Basma, A.E.A. (2019): Reducing the adverse effects of salinity on growth and fruiting of Superior grapevines by using nano- technology soil conditions M. Sc. Thesis Fac. of Agric. Minia. Univ. Egypt.

El- Kady- Hanaa, F.M. (2011): Productive performance of Thompson seedless grapevines in relation to application of some antioxidants, magnesium and boron. M. sc. Thesis Fac. of Agric. Minia Univ. Egypt.

Farahat, I.A.M. (2008): Effect of some antioxidant and boron treatments on growth and fruiting of Red Globe grapevines M. Sc. Thesis Fac. of Agric. Minia Univ., Egypt.

Marschner, H. (1995): Mineral nutrition of Higher plants. 2nd ed. Academic press Pub., New York (USA), pp. 559.

Mead, R.N. and Harted, A.M. (1993): Statistical methods in Agricultural and experimental Biology. 2nd Ed. Chapman & Hall. London, pp. 10-44.

Mengel, K.E.; Kirkbt, A.; Koesgarten, H. and Appel, T. (2001): principals of plant nutrition 5th El- Kluwer Academic publishers , Dordrecht p. 1-311.

Nijjar, G.S. (1985): Nutrition of fruit trees. Mrs Usah Raj Kumar, for Kalyani publishers, New Delhi India, pp. 283-302.

Prasad, R.; Kumar, V. and Prasad, K. S. (2014): Nanotechnology in sustainable agriculture, present concerns and future aspects. African J. f Biotechnology 13 (6):705-713.

Rai, V.; Acharya, S.; Dey, N. (2012): Implications of nanobiosensors in agriculture. J. Biomater. Nanobiotechnol. 3 , 213-324.

Wassel, A.M.M.; El- Wasfy, M.M.M. and Mohamed, M.M.A. (2017): Response of Flame seedless grapevines to foliar application of nano fertilizers J. Product, Dev., 22 (3): 469-485.

Wilde, S.A.; Corey, R.B.; Lyre, I.G. and Voigt, G.K. (1985): Soil and Plant Analysis for Tree Culture. 3"d Oxford 8113M publishing Co., New Delhi, pp. 1-142.

استجابة العنب الفليم سيسدلس لرش البورون بنظام النانوتكنولوجى

عبد الحميد محمد مرسى واصل[1] ، حسين حمدان محمد سعيد[2]، سلامة مغنى ابراهيم عبد الوهاب[3]

[1] قسم البساتين– كلية الزراعة– جانمعة المنيا– مصر.
[2] قسم البساتين– كلية الزراعة والموارد الطبيعية– جامعة أسوان– مصر
[3] طالب دراسات عليا

تم تنفيذ هذه الدراسة خلال موسمى 2015، 2016 لاختبار تاثير البورون بنظام النانوتكنولوجي و البورون بالنظام العادي على صفات المحصول وجودة حبات العنب الفليم سيدلس النامية تحت الظروف المناخية لمنطقة المنيا.

تم معاملة كرمات العنب الفليم سيدلس ثلاث مرات بالبورون بنظام النانوتكنولوجى بتركيز من 0.0125 الى 0.05% و البورون العادى بتركيز من 0.025 الى 0.1%.

تأثرت ايجابيا كل من نسبة عقد الحبات وكمية المحصول على الكرمة ووزن العنقود وكذلك الصفات الفيزيائية والكيميائية للحبات وذلك مقارنة بالكونترول.

استخدم البورون بنظام النانو تكنولوجى تفوق عن استخدام البورون بالطرق العادية على تلك الصفات.

وأحسن النتائج المتحصل عليها بالنسبة للعقد وكمية المحصول وجودة حبات العنب الفليم سيدلس كانت الناتجة من المعاملة بالبورون بنظام النانو تكنولوجي بتركيز 0.025%.