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Improve the Yield and Quality of Red Roomy and Thompson Seedless Grape Cultivars

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Abstract

Experiments were carried out at the Experimental Orchard of Assiut University, Faculty of Agriculture. The experiments aimed to overcome the looseness of berries as well as improving the yield and berry quality of Red Roomy grape cultivar by using Boron, Zinc and NAA. The study also aimed to reduce the cluster compactness by using GA_3 and cluster thinning in order to improve the quality of Thompson Seedless grape cultivar.

The treatments significantly increased the initial fruit set (IFS) and decreased the berry drop percentage. The cluster numbers not significantly affected by various treatments. However, the treatments increased the yield over the control. The control vines gave the lowest yield among all the treatments. The present study showed that there were no significant differences between treatments on the cluster width. On the other hand, treatments exhibited significant differences comparing with the control in respect of the cluster height. The treatments except of spraying with NAA had significant differences comparing with the control in respect of the cluster weight. However, the control vines gave the lowest cluster weight during the two studied seasons. On the contrary, the control gave the highest weight of 100 berries. On the other hand, although the control produced the highest juice weight of 100 berries but the differences were not significant during the two seasons of study. There were no significant differences between the treatments in respect of TSS% during the two studied seasons. The sugar contents took the same trend of TSS%.

On the other hand, there were no significant differences between the treatments on the cluster number per vine of Thompson seedless grape cultivar. Yield weight significantly affected by GA_3 application. The lowest yield obtained from the control. Data revealed that spraying the cluster with GA_3 at 5 + 20 + 30 ppm gave the highest values of cluster width (cm) and height (cm). The clusters treated with GA_3 at 5 + 20 + 30 ppm were the heaviest clusters among all the treatments and the differences between their values and the values of other treatments were significant during the two seasons of study. The weight of 100 berries and 100 berreis juice weight took the same trend of cluster weight. On the contrary of the previous results, the control and cluster thinning followed by GA_3 at 5 ppm + thinning had the highest TSS% in the berry juice. Concerning the acidity percentage, the differences between the treatments mostly insignificant. GA_3 application recorded also the least ratio of TSS/acid ratio, however, the other treatments significantly surpassed it in this respect. Cluster thinning gave the highest percentage of total sugars followed by GA_3 at 5 ppm + thinning and then the control.

This study concluded that the beneficial effects of spraying boron and zinc during flowering to increase the berry set and decrease berry drop of Red Roomy grape cultivar. On the other hand; Gibberellic acid (GA_3) spraying increased berry size, cluster weight and expand the cluster length of Thompson Seedless grape cultivar that suffering from cluster compactness. Cluster thinning can be used for increasing berry and cluster weight and improving the quality.

Keywords: *Vitisvinefera, berry quality, GA_3, Thinning, Boron, Zinc.*

Introduction

Grape is one of the most important fruit crops in the world not only for fresh consumption but also for raisins and juice making. Most of grape cultivars planted in Egypt belong to the table grape and all of them are European grape cultivars (*Vitisvinifera* L.).

In Egypt, grape occupy the second rank after citrus. According to the Ministry of Agriculture Statistics (2014), the total area devoted for grapes reached 192934 feddans including 171882 feddans as fruitful vines producing about 159169 tons with an average of 9.286 tons/feddan. In Upper Egypt, Assiut is the leading governorate for grape areas and producing.

During the last two decades, many grape cultivars have been introduced to Egypt. Most of these cultivars have been planted in the new reclaimed lands, however, old lands in middle and Upper Egypt are still planting in a large scale with Red Roomy and Thompson Seedless cultivars.

There are some problems encounter both cultivars. For Red Roomy, the looseness of berries is the serious problem while the common problem in Thompson Seedless is the cluster compactness.

Boron and zinc are considered as an essential elements for plant growth and development. Sexual reproduction in plant is more sensitive to low boron than the vegetative growth. It plays an important role in flowering and fruiting process, nitrogen metabolism biosynthesis and translocation of carbohydrates. While, zinc plays an important role in many biochemical reactions within the plants. Zinc is also regulates the activity of several enzymes. It also has a role in auxin production, formation of chlorophyll and carbohydrates and plays an important role in flowering and fruiting of the economic plants. (Subramoniam *et al* 2006; Song *et al* 2015)

On grape cultivars, both boron and zinc were extensively studied. Investigators agreed upon the effectiveness of these elements on berry set and yield [Onioue (1938), Ali (2000), Prabau and Singaram (2002), Subramoniam *et al*. (2006), Er *et al* (2011), and Song *et al*. (2015)]. On the other hand, it is known that NAA plays an important role for decreasing the fruit drop. It also found that, NAA improved physical and chemical properties of grapes (Abu-Zahra, 2013).

Gibberellic acid (GA_3) sprays are commonly used at bloom to increase berry size, cluster weight and expand the cluster length of the grape cultivars that suffering from cluster compactness such as Thompson Seedless grape cultivar [Hassan *et al.* (1988), Shaaban *et al*. (1989), Mansour (1994), Hussein *et al*. (1998), Abd-El-Ghanny (2000), Casanova *et al*. (2009), Rizk-Alla*et al*. (2011) and Mohsen (2015)].

Cluster thinning has been widely used for increasing berry and cluster weight and improving the quality. It applied alone or in combined with GA_3 treatments (Mohsen, 2015; Zhao *et al*., 2006; Mohamed and Shaaban, 2008; Damota*et al*., 2010 and Bogicevic *et al*. 2015).

The aims of this study were:

1- An attempt to overcome the looseness of berries as well as improving the yield and berry quality of Red Roomy grape cultivar by using Boron, Zinc and NAA,

2- Reduce the cluster compactness by using GA_3 and cluster thinning to improve the quality of Thompson Seedless grape cultivar.

Materials and Methods

Experiments were carried out throughout two successive seasons of 2014 and 2015 on Red Roomy and Thompson Seedless grapevines grown at the Experimental Orchard of Assiut University, Faculty of Agriculture. The grapevines age were 12 years old at the beginning of the experiment and they were planted at 2x2.5 m apart. Forty-five uniform grapevines from Red Roomy and twenty-eight grapevines from Thompson Seedless were chosen. All grapevines were pruned as the traditional training system with 20 fruit spurs and 4 buds were left on each spur for Red Roomy and 5 buds for Thompson Seedless. Thus, the total buds left on each vine in this study were 80 and 100 buds for Red Roomy and Thompson Seedless grapevines, respectively.

The following procedures were executed on the vines:

1) The First Experiment:

This experiment was conducted on fourty five (45) Red Roomy grapevines. The treatment categories were:

1- Spraying with NAA at 2.5 ppm.

2- Spraying with NAA at 5 ppm.

3- Spraying with Boron at 20 ppm.

4- Spraying with Boron at 40 ppm.

5- Spraying with Zinc at 100 ppm.

6- Spraying with Zinc at 200 ppm.

7- Spraying with Boron at 20 ppm + Zinc at 100 ppm.

8- Spraying with Boron at 40 ppm + Zinc at 200 ppm.

9- Control (spraying with water).

The vines were sprayed using a Knapsack sprayer (16 L). A total volume of 16 lit was sufficient for spraying 5 vines. A surfactant super film at 0.1% was added to the spraying solutions. Both boron and zinc was used in chelated form. The spraying solution was added one time. The chelated elements were added during flowering period before the fall of caps while NAA was added after fruit set. Nine treatment combinations were tested comprised of NAA, Boron, and Zinc spraying along with a non-treated control. The experimental design was a completely randomized design with 5 replications and a vine was the experimental unit. Horticultural practices such as irrigation, soil management and fertilization were applied as recommended. The following measurements were taken on each vine:

1- Total number of clusters and yield weight (kg).

2- Percentage of initial fruit set (IFS) was calculated according to Mohamed and El-Sese (2004). Two clusters from each vine which sprayed with Boron and Zinc were sacked with white cheesecloth sacks prior to fruit set by about 10 days. One month after fruit set, the clusters were detached from the vines with their sacks. In the laboratory, the clusters were drawn out from the sacks on white paper sheet and then they sacked off on it. The flowers and berries were divided into 1) normal berries. 2) dropped berries. 3) flowers that did not set. The percentage of initial fruit set was calculated according to the following equation:

$$IFS\ \% = \frac{Total\ No.berries/cluster\ \bullet}{Total\ No.flowers/cluster\ *} x100$$

Berry drop percentage was then calculated.

3- Five clusters from each vine yield were randomly taken to estimate the following parameters:

- Cluster width (cm) and height (cm).
- Cluster weight (g).
- 100 berries weight.
- 100 berries juice weight (g).
- Total soluble solids % (TSS %) by using a hand refractometer.
- Total acidity using titration by NaoH at 0.1 N and phenolphthalein as an indicator then expressed as tartaric acid.
- TSS/acid ratio was then calculated.
- Total and reducing sugars according to Lane and Eynon procedure outlined in A.O.A.C. (1985).

2) The second experiment:

This experiment executed throughout two successive seasons of 2014 and 2015 on twenty eight (28) vines of Thompson Seedless grape cultivar.

The treatments were as follow:

1- Spraying with Gibberellic acid (GA_3) at 5 ppm when the cluster reaches 8-10 cm long. This spraying aimed to expand the cluster. One month later (after fruit set), same vine were sprayed with GA_3 at 20 ppm and then another spraying with 30 ppm after three weeks from the second spraying. The later 2 sprayings were to increase the berry size.

2- Hand cluster thinning by leaving the five shoulders located on the base of the cluster and removing the 6th, 7th and 8th shoulders and then cutting the quarter of the cluster from the bottom.

3- Spraying with GA_3 at 5 ppm + cluster thinning.

4- Control.

The following parameters were estimated for each vine:

1- Total number of clusters and yield weight (kg).

2- Cluster width cm), cluster height (cm), cluster weight (g), 100 berries weight (g) and 100 berries juice weight (g).

3- Total soluble solids %, total acidity %, TSS/acid ratio was then calculated, total sugars and reducing sugars.

The experiments were designed as a complete randomized design. The analysis of variance (ANOVA) was conducted according to Snedecor and Cochran (1972). Means were compared using the least significant differences (LSD) values at 5% level of the probability.

Results and Discussion

I- The first experiment:

The effect of boron and zinc spraying on initial fruit set percentage and berry drop of Red Roomy grape cultivar is presented in Table (1).

Data revealed that the treatments significantly increased the IFS with an exception of Boron at 20 ppm and Boron 40 ppm + Zinc 200 ppm. The most effective treatment in this respect was spraying with Zinc at 100 ppm followed by Boron at 40 ppm and then Boron at 20 ppm + Zinc at 100 ppm. The percentages related to the previous treatments were 23.43, 19.40 and 18.44% as an average of the two studied seasons, respectively. However, the percentage of IFS in the control was 12.90% (two season's average).

On the other hand, berry drop percentage (Table 1) was very high in the control as compared with the treatments. All the treatments showed high significant differences comparing with the control. Boron at 20 ppm exhibited the lowest berry drop percentage during the two studied seasons (9.44 and 9.79% for both seasons, respectively). While, Boron at 20 ppm + Zinc at 100 ppm was the 2^{nd} effective treatment in this respect followed by Zinc at 100 ppm. The percentage of berry drop for the last two treatments were 16.60 and 20.05% as an average of the two studied seasons, respectively. However, the control recorded the highest berry drop where it gave 46.28 and 48.27% for both seasons, respectively with an average of 47.27%.

Table 1. Effect of Boron and Zinc spraying on initial fruit set (IFS) and berry drop % of Red Roomy grape cultivar during 2014 and 2015 seasons.

Treatment	IFS %			Berry drop %		
	2014	2015	Mean	2014	2015	Mean
Boron 20 ppm	15.50	13.64	14.57	09.44	09.79	09.62
Boron 40 ppm	19.62	19.19	19.40	22.12	27.37	24.75
Zinc 100 ppm	25.22	21.64	23.43	16.32	23.78	20.05
Zinc 200 ppm	17.74	15.11	16.43	26.28	24.02	25.15
Boron 20 ppm + zinc 100 ppm	19.45	17.43	18.44	14.28	18.92	16.60
Boron 40 ppm + zinc 200 ppm	14.64	13.75	14.20	18.25	19.99	19.12
Control	13.68	12.12	12.90	46.48	48.27	47.27
L.S.D. 5%	03.76	01.48	01.91	09.46	08.90	06.20

Yield components as affected by NAA, Boron and Zinc are found in Table 2. The cluster numbers were not significantly affected by various treatments. The yield weight (kg/vine) of Red Roomy grapevines subjected to the various treatments is presented in Table 2. The results revealed that spraying the vines with zinc at 100 ppm produced the highest yield followed by boron at 20 ppm + zinc at 100 ppm along with Boron at 40 ppm. The yield weight (kg/vine) associated with the previous treatments was 9.59, 9.50 and 9.17 kg/vine as an average of two seasons, respectively. The rest of treatments, although they increased the yield over the control but the differences with the control were not significant. The control vines gave the lowest yield among all the treatments, (7.88 kg/vine as an average of two seasons). The above-mentioned results were in accordance with these reported by Ali (2000), Farooq and Halmani (2000), Subramoniam *et al.* (2006), Krizsics and Diofasi (2007), Bybardi and Shabanov (2010), Ebrahim and ahmed (2012), Song *et al.* (2015). They found that spraying grapevine with Boron and/or Zinc greatly enhanced the fruit set and yield.

Boron influences favorably the germinability of pollen grains of grapevine and it probably acts as a special nutrition for generative growth upon the setting of berries of the cultivar because of the augmentation of the number and percentage of normal berries. On the other hand, zinc is required for the synthesis of auxins, chlorophyll and starch. The production of clusters with undeveloped berries and poor fruit set is due to zinc deficiency.

Table 2. Effect of NAA, Boron and Zinc on yield components of Red Roomy grape cultivar during 2014 and 2015 seasons.

Treatment	Cluster number			Yield weight (kg)		
	2014	2015	Mean	2014	2015	Mean
NAA 2.5 ppm	22.80	24.40	23.60	8.00	8.74	8.37
NAA 5 ppm	23.20	24.20	23.70	8.39	8.68	8.53
Boron 20 ppm	22.40	23.80	23.10	8.33	8.77	8.55
Boron 40 ppm	24.60	25.80	25.20	9.20	9.14	9.17
Zinc 100 ppm	23.20	23.60	23.40	9.76	9.42	9.59
Zinc 200 ppm	23.00	24.00	23.50	8.42	8.91	8.67
Boron 20 ppm + Zinc 100 ppm	23.00	24.40	23.70	9.35	9.68	9.50
Boron 40 ppm + Zinc 200 ppm	22.20	23.60	22.90	8.19	8.70	8.45
Control	22.80	23.80	23.30	7.93	7.83	7.88
L.S.D. 5%	NS	NS	NS	1.01	1.10	0.90

The effect of NAA, Boron and Zinc on cluster dimensions is presented in Table 3. Data showed that there were no significant differences between treatments on the cluster width. On the other hand, treatments exhibited significant differences comparing with the control in respect of the cluster height. The highest value of cluster height was obtained from the vines treated with Boron at 20 ppm and Boron at 40 ppm with no significant differences between them. The average values of cluster height associated with these two treatments were 27.50 and 25.90 (cm) as an average of the two studied seasons, respectively. Spraying zinc at 100 ppm in the 1st season and Boron at 20 ppm + zinc at 100 ppm in the 2nd season gave also significant differences comparing with the control (25.00 and 26.00 cm). The control vines gave the lowest value in this respect where the cluster height reached 20.60 (cm) (two season's average).

Data presented in Table (4) showed the effect of NAA, Boron and Zinc on cluster weight, 100 berries weight and 100 berries juice weight of Red Roomy grapevines.

The results revealed that the treatments except of spraying with NAA had significant differences comparing with the control in respect of the cluster weight. The treatments of zinc at 100 ppm, Boron at 20 ppm + zinc at 100 ppm and Boron at 40 ppm gave the bet results and significantly surpassed the control. The average cluster weight over seasons reached 410.5, 399.5 and 396.8 (g) for the previous treatments, respectively. However, the control vines gave the lowest cluster weight during the two studied seasons (348.2 and 329.2 g), respectively. On the contrary, the control gave the highest weight of 100 berries (Table 5). The 100 berries weight of the control was 508.0 and 497.8 (g) for the two seasons with an average of 502.9 (g). The lowest values in this respect were associated with the treatments of zinc at 100 ppm, Boron at 40 ppm and Boron at 20 ppm. These treatments gave an average weight of 435.4, 441.3 and 451.1 (g), respectively.

Table 3. Effect of NAA, Boron and Zinc on cluster width and height of Red Roomy grape cultivar during 2014 and 2015 seasons.

Treatment	Cluster width (cm)			Cluster height (cm)		
	2014	2015	Mean	2014	2015	Mean
NAA 2.5 ppm	13.00	15.20	14.10	23.60	21.00	22.30
NAA 5 ppm	12.00	15.60	13.80	20.60	24.40	22.50
Boron 20 ppm	14.20	16.00	15.10	25.40	26.40	25.90
Boron 40 ppm	13.60	15.40	14.50	26.20	28.80	27.50
Zinc 100 ppm	14.00	14.40	14.20	25.00	22.20	23.60
Zinc 200 ppm	13.40	12.60	13.00	20.00	23.60	21.80
Boron 20 ppm + Zinc 100 ppm	13.80	14.60	14.20	23.20	26.00	24.60
Boron 40 ppm + Zinc 200 ppm	12.00	12.80	12.40	20.20	22.00	21.10
Control	12.60	12.80	12.70	19.20	22.00	20.60
L.S.D. 5%	NS	NS	NS	04.52	03.51	02.80

Table 4. Effect of NAA, Boron and Zinc on weight (g) of cluster; 100 berries and 100 berries juice of Red Roomy grape cultivar during 2014 and 2015 seasons.

Treatment	Cluster weight (g)			100 berries weight (g)			100 berries juice weight (g)		
	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
NAA 2.5 ppm	351.0	355.0	353.0	473.9	469.4	471.7	280.2	277.8	279.0
NAA 5 ppm	360.2	359.2	359.7	465.1	449.7	457.4	265.6	260.6	263.1
Boron 20 ppm	372.6	365.6	369.1	449.9	452.4	451.1	263.0	272.4	267.7
Boron 40 ppm	410.8	382.8	396.8	435.6	447.0	441.3	269.6	268.0	268.8
Zinc 100 ppm	421.8	399.2	410.5	416.9	453.8	435.4	248.0	267.0	257.5
Zinc 200 ppm	368.6	367.4	368.0	449.4	464.7	457.0	276.0	276.4	276.2
Boron 20 ppm + Zinc 100 ppm	405.2	393.8	399.5	458.6	461.4	460.0	274.8	274.0	274.4
Boron 40 ppm + Zinc 200 ppm	369.0	367.6	368.3	449.3	459.8	454.5	270.8	274.2	272.5
Control	348.2	329.2	338.7	508.0	497.8	502.9	299.6	298.6	299.1
L.S.D. 5%	048.1	035.2	027.2	039.4	NS	028.1	NS	NS	NS

On the other hand, although the control produced the highest juice weight of 100 berries (Table 4) but the differences were not significant during the two seasons of study.

These results came on line with the other papers reported by Ali (2000), Farooq and Hulmani (2000), Subramoniam *et al*. (2006), Ebrahim and Ahmed (2012), Abou Zahra (2013), Nikkah *et al*. (2013) and Mohsen (2015). They found that spraying the grapevines with Boron and/or Zinc increased cluster weight, berry weight and size. Boron plays an important role of both cell division and enlargement. On the other hand, zinc is required to obtain an optimum crop growth.

On the other hand, Kamal (2006) found that spraying Thompson Seedless grape cultivar with NAA at 10 ppm decreased berry weight and volume and decreased berry drop.

The effect of various treatments on some chemical characteristics of Red Roomy grape cultivar is presented in Tables 5 and 6.

There were no significant differences between the treatments in respect of TSS% (Table 5) during the two studied seasons, however, the combined analysis over seasons exhibited significant differences where the control surpassed most of the treatments (17.10%). The lowest percentages of TSS were obtained from zinc at 100 ppm and Boron at 40 ppm (15.70 and 15.90%, respectively).

The titratable acidity of various treatments revealed that the highest percentage of acidity was obtained from NAA at 2.5% and then the control along with Boron at 40 ppm + Zinc at 200 ppm. The later treatments gave 0.390, 0.382 and 0.374%, respectively, as an average of the two seasons of study. While, the lowest acidity percentage was obtained from Boron at 40 ppm and Boron at 20 ppm (0.305 and 0.345%, respectively). The differences were significant during the two seasons and over seasons.

Concerning the values of TSS/acidity, the presented results (Table 5) revealed that spraying with Boron at 40 ppm significantly surpassed most of the other treatments. The ratio of this treatment reached 53.27, while Boron at 40 ppm + Zinc at 200 ppm and NAA at 2.5 ppm gave the lowest ratios (43.27 and 42.79, respectively). Boron at 20 ppm gave also a higher ratio (47.07) but the difference between it and the control (44.99) was not significant.

Table 5. Effect of NAA, Boron and Zinc on TSS; acidity and TSS/acid ratio of Red Roomy grape cultivar during 2014 and 2015 seasons.

Treatment	TSS %			Acidity %			TSS/Acid Ratio		
	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
NAA 2.5 ppm	16.4	16.8	16.60	0.405	0.375	0.390	40.59	44.99	42.79
NAA 5 ppm	16.2	16.2	16.20	0.386	0.353	0.369	42.08	45.98	44.03
Boron 20 ppm	16.0	16.4	16.20	0.360	0.330	0.345	44.48	49.66	47.07
Boron 40 ppm	15.6	16.2	15.90	0.265	0.345	0.305	59.64	46.90	53.27
Zinc 100 ppm	15.4	16.0	15.70	0.381	0.336	0.359	40.41	47.65	44.03
Zinc 200 ppm	16.0	16.8	16.40	0.376	0.359	0.368	42.53	46.83	44.68
Boron 20 ppm + Zinc 100 ppm	16.0	16.8	16.40	0.380	0.338	0.359	42.14	49.82	45.98
Boron 40 ppm + Zinc 200 ppm	15.8	16.4	16.10	0.395	0.353	0.374	40.00	46.54	43.27
Control	17.0	17.2	17.10	0.383	0.381	0.382	44.49	45.49	44.99
L.S.D. 5%	NS	NS	0.75	0.023	0.023	0.020	04.49	NS	02.99

The sugar contents took the same trend of TSS% where the control gave the highest values of total sugars. Data presented in Table 6 showed that there were significant differences between the control and all the other treatments (except of NAA at 2.5 ppm in 2014). The percentage of total sugar in the control was 16.10% (2 seasons average) while the least percentages were taken from Boron at 40 ppm, followed by Zinc at 100 ppm and then Boron at 20 ppm.

The average of total sugars percentage for the later treatments was

14.65, 14.69 and 14.97%, respectively. The reducing sugars percentages took the same trend of total sugars where the control surpassed all other treatments, but the differences were significant only in the 1st season of study. Most of treatments produced berries containing more non-reducing sugars as comparing with the control, however, the differences were not significant.

Table 6. Effect of NAA, Boron and Zinc on sugar contents of Red Roomy grape cultivar during 2014 and 2015 seasons.

Treatment	Total sugars %			Reducing sugars %			Non-reducing sugars %		
	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
NAA 2.5 ppm	15.27	15.12	15.20	14.58	14.55	14.57	0.69	0.57	0.63
NAA 5 ppm	15.17	14.93	15.05	14.60	14.41	14.51	0.57	0.51	0.54
Boron 20 ppm	14.84	15.11	14.97	14.25	14.58	14.42	0.59	0.53	0.56
Boron 40 ppm	14.54	14.77	14.65	13.94	14.30	14.02	0.60	0.47	0.54
Zinc 100 ppm	14.78	14.59	14.69	14.33	13.98	14.16	0.44	0.61	0.53
Zinc 200 ppm	14.98	15.25	15.12	14.37	14.66	14.41	0.61	0.58	0.60
Boron 20 ppm + Zinc 100 ppm	14.84	15.27	15.06	14.26	14.76	14.51	0.58	0.51	0.54
Boron 40 ppm + Zinc 200 ppm	14.90	15.26	15.08	14.25	14.78	14.52	0.45	0.48	0.46
Control	16.03	16.16	16.10	15.58	15.71	15.64	0.45	0.48	0.46
L.S.D. 5%	0.79	0.81	0.57	0.84	NS	NS	NS	NS	NS

Some investigators reported that treating the grapevines with Boron and Zinc either had no effect on berry quality or decreased it but the berry reached its maturity standards. Christensen and Jensen (1978) mentioned that dilute application of zinc caused larger berries and lower Brix. They explained that the lower Brix readings are the result of increased berry set from zinc treatment response. Also, Krizsics and Diofasi (2007) found a positive correlation between boron concentrations of the leaves and the titratable acidity.

On the other hand, investigators found that applying Boron and Zinc to the grapevines improved berry quality in terms of TSS, acidity and sugars, e.g. Abdel-Hady (1995), Radwan (1999), Ali (2000), Prabu and Singaram (2002), Subramonicam *et al*. (2006), Bybordi and Shabanov (2010), Risk-Alla *et al.* (2011), Ebrahim and Ahmed (2012) and Song *et al*. (2015).

II- The second experiment:

The effect of GA_3 spraying and cluster thinning on yield and quality of Thompson Seedless grape cultivar is presented in Tables 7-11.

Table 7 shows the results of yield components during the two studied seasons as affected by various treatments. The second season of study gave much higher yield in terms of cluster numbers or weight comparing with the first season. There were no significant differences between the treatments on the cluster number per vine. The vines gave around 19.00 and 44.00 clusters/vine during the 1st and 2nd seasons, respectively. Yield weight (Table 7) significantly affected by GA_3 application. Spraying with GA_3 at 5 + 20 + 30 ppm significantly improved the yield weight comparing with the other treatments. Such treatment produced 7.27 and 19.43 kg/vine in the two seasons, respectively with an average of 13.35 kg/vine. The lowest yield was obtained from the control which gave 5.63 and 15.14 kg/vine for the two studied seasons, respectively with an average of 10.39 kg/vine. The differences between thinning, GA_3 + thinning and the control were not significant during the two seasons or over seasons.

The effect of GA_3 and cluster thinning on cluster dimensions is presented in Table 8.

Data revealed that, spraying the cluster with GA_3 at 5 + 20 + 30 ppm gave the highest values of cluster width (cm) and height (cm). The clusters subjected to such treatment exhibited significant differences (except of the 1st season) comparing with the other treatments. The mean cluster width (cm) reached 17.57 cm (two seasons average) for this treatment, however, the differences between other treatments were not significant during both seasons of study. Concerning the cluster height (cm), the results showed that spraying with GA_3 at 5 + 20 + 30 ppm significantly surpassed the rest of treatments. The values associated with such treatment reached 26.29 and 30.57 cm for the two studied seasons with an average of 28.43 cm. Cluster thinning and GA_3 at 5 ppm + thinning gave values lesser than the control. The mean cluster height (cm) for the control was 25.21 cm (two season's average).

Table 7. Effect of GA_3 and cluster thinning on yield components of Thompson Seedless grape cultivar during 2014 and 2015 seasons.

Treatment	Cluster number			Yield weight (kg)		
	2014	2015	Mean	2014	2015	Mean
GA_3 5 + 20 + 30 ppm	19.00	44.29	31.64	7.27	19.43	13.35
Thinning	19.57	44.71	32.14	6.64	15.81	11.23
GA_3 5 ppm + Thinning	18.57	45.29	31.93	6.26	16.16	11.21
Control	19.71	44.43	32.07	5.63	15.14	10.39
L.S.D. 5%	NS	NS	NS	1.08	02.09	01.68

Table 8. Effect of GA_3 and cluster thinning on cluster width and height of Thompson Seedless grape cultivar during 2014 and 2015 seasons.

Treatment	Cluster width (gm)			Cluster height (cm)		
	2014	2015	Mean	2014	2015	Mean
GA_3 5 + 20 + 30 ppm	16.14	19.00	17.57	26.29	30.57	28.43
Thinning	15.43	17.43	16.43	19.57	24.71	22.14
GA_3 5 ppm + Thinning	15.57	17.71	16.64	20.29	24.14	22.21
Control	14.57	16.71	15.64	23.71	26.71	25.21
L.S.D. 5%	NS	1.54	01.33	02.05	02.23	01.47

Data of the cluster weight (g), 100 berries weight (g) and 100 berries juice weight (g) which were subjected to various treatments are shown in Table 9.

The clusters treated with GA_3 at 5 + 20 + 30 ppm were the heaviest clusters among all the treatments and the differences between their values and the values of other treatments were significant during the two seasons of study.

The recorded values of cluster weight for such treatment were 385.1 and 441.4 (g) for the two seasons, respectively with an average of 413.3 (g). The second best treatment was GA_3 at 5 ppm + thinning. The later treatment had a significant differences with the control in the 1st season of study and over the two seasons. The mean cluster weight of it reached 347.9 (g) while it was 312.5 (g) in the control (two season's average). Thinning alone also surpassed the control respecting the cluster weight but the differences were not significant during the two studied seasons. The weight of 100 berries (Table 9) took the same trend of cluster weight. The superior treatment was GA_3 at 5 + 2 + 30 ppm followed by GA_3 at 5 ppm + thinning and then thinning alone. The differences between the three treatments and the control were significant. As an average of the two studied seasons, the 100 berries weight associated with these treatments was 189.7, 152.1 and 134.4 (g), respectively, while it was 115.3 (g) in the control. Data presented in the same Table showed also that 100 berries juice weight significantly affected by GA_3 at 5 + 20 + 30 ppm. The average 100 berries juice weight of this treatment was 78.57 (g). However, the differences between the other treatments were not significant during the two studied seasons.

Table 9. Effect of GA_3 and cluster thinning on weight (g) of cluster; 100 berries and 100 berries juice of Thompson Seedless grape cultivar during 2014 and 2015 seasons.

Treatment	Cluster weight (g)			100 berries weight (g)			100 berries juice weight (g)		
	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
GA_3 5 + 20 + 30 ppm	385.1	441.4	413.3	185.5	193.9	189.7	77.57	79.57	78.57
Thinning	318.9	354.6	336.7	128.4	140.4	134.4	64.71	64.43	64.57
GA_3 5 ppm + Thinning	337.7	358.0	347.9	136.0	168.2	152.1	68.29	64.86	66.57
Control	285.9	339.1	312.5	113.4	117.2	115.3	62.71	62.00	62.36
L.S.D. 5%	36.53	36.80	25.06	07.48	10.40	06.2	09.95	10.32	06.93

The results of berry quality as influenced by GA_3 application and cluster thinning are presented in Tables 10 and 11.

On the contrary of the previous results, the control and GA_3 at 5 ppm + thinning followed by cluster thinning had the highest TSS% in the berry juice (Table 10). The differences between these three treatments and the 1st treatment were significant, however, the differences between these three treatments were not significant. Concerning the acidity percentage, the differences between the treatments mostly insignificant except of the second season which GA_3 at 5 + 20 + 30 ppm and GA_3at 5 ppm + thinning significantly increased the acidity % compared with the other two treatments. GA_3 application recorded also the least ratio of TSS/acidity (Table 10), however, the other treatments significantly surpassed it in this respect. The TSS/acid ratios were 23.24, 23.22, 22.48 and 20.43 for the control, thinning, GA3 at 5 ppm + thinning, and GA_3 at 5 + 20 + 30 ppm as an average of two seasons, respectively.

Data concerning the sugar contents are presented in Table 11. The results of sugars took the same trend of TSS%. Cluster thinning gave the highest percentage of total sugars followed by GA_3 at 5 ppm + thinning and then the control, however, the differences between them were not significant. These three treatments significantly surpassed the treatment GA_3 at 5 + 20 + 30 ppm where it recorded the lowest percentage of total sugars (19.11%). Same trend could be observed respecting the reducing sugars percentage where GA_3 at 5 + 20 + 30 ppm gave the lowest values. On the other hand, the highest percentage of non-reducing sugars was found in the control (0.64%) while the differences between the other treatments were not significant during the two studied seasons.

Table 10. Effect of GA_3 and cluster thinning on TSS; acidity and TSS/Acid ratio of Thompson Seedless grape cultivar during 2014 and 2015 seasons.

Treatment	TSS %			Acidity %			TSS/Acid ratio		
	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
GA_3 5 + 20 + 30 ppm	21.43	19.86	20.64	1.012	1.029	1.020	21.52	19.33	20.43
Thinning	23.43	21.14	22.29	0.953	0.971	0.962	24.59	21.85	23.22
GA_3 5 ppm + Thinning	23.80	21.57	22.71	1.011	1.018	1.014	23.76	21.20	22.48
Control	23.57	21.86	22.71	0.992	0.966	0.979	23.83	22.65	23.24
L.S.D. 5%	01.25	01.25	0.86	NS	0.040	NS	NS	01.66	01.52

Table 11. Effect of GA_3 and cluster thinning on sugar contents of Thompson Seedless grape cultivar during 2014 and 2015 seasons.

Treatment	Total sugars %			Reducing sugar %			Non-reducing sugars %		
	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
GA_3 5 + 20 + 30 ppm	19.84	18.38	19.11	19.23	17.79	18.51	0.60	0.59	0.59
Thinning	22.04	19.64	20.84	21.53	19.05	20.29	0.51	0.59	0.55
GA_3 5 ppm + Thinning	22.19	19.33	20.76	21.61	18.86	20.24	0.57	0.48	0.52
Control	21.95	19.11	20.53	21.35	18.42	19.89	0.60	0.69	0.64
L.S.D. 5%	01.04	NS	0.78	01.01	NS	0.76	NS	0.18	0.12

The effect of GA_3 to increase the berry size, yield and decrease the cluster compactness by increasing the cluster length has been reported in many papers. Hopping (1975) found that GA_3 at 5-40 ppm decreased cluster compactness, however, yield/vine, sugar and acid contents were not affected. On Red Roomy grape cultivar, GA_3 increased cluster length (Abd-El-bar and El-Hagab, 1978) and increased yield weight, berry and cluster weight while it decreased berry quality (Hussein *et al*., 1986). Same results were found on Orland Seedless grape (Halbrooks and Mortensen, 1987), on Perlettegrape (Hassan *et al*., 1988), Dokoozlian and Peacock (2001) on Crimson Seedless grape cultivar and Rizk-Alla *et al*. (2011) on Black Monukka grape cultivar.

On the other hand, the results of the current study came on line with these reported by Ahmed (1988), Mahmoud (1989a and b), Shaaban *et al*. (1989), Mansour (1994), and Abd-El-Ghany (2000) found that treated Thompson Seedless grape with GA_3increased yield and cluster weight while it decreased TSS%, sugars and increased the total acidity.

Cluster and berry thinning are a common practice performed on many table grape cultivars to spare more carbohydrates for the remaining berries which surely reflected on advancing the berry ripening and improving its quality. Investigators

(Abd El-Galil and El-Wasfy, 2003; Mohsen, 2005; Zhao *et al*., 2006; Abd El-Wahab, 2006; Gerges, 2007; Mohamed and Shaaban, 2008; Damota *et al*., 2010; Santesteban *et al*. (2011); Őzer *et al*. 2012; and Bogicevic *et al*., 2015) found that cluster or berry thinning increased cluster weight, berry weight and size and improved berry quality.

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تحسين المحصول والجودة في صنفي العنب الرومي الأحمر والطومسون عديم البذور

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الملخص

أجريت التجارب على مدار موسمين متتاليين ٢٠١٤ و ٢٠١٥ على العنب الرومى الاحمر و الطومسون عديم البذور المزروع في مزرعة أبحاث الفاكهة – كلية الزراعة – جامعة أسيوط. كانت أعمار الكرمات ١٢ عاما في بداية التجربة، وكانت مزروعة على٢ x٢,٥ متر من بعضها البعض.. كل الكرمات قلمت بطريقة التربية الرأسية التقليدية مع ترك ٢٠ دابرة ثمرية و ٤ عيون على كل دابرة للعنب الرومى الاحمر و ٥ عيون للطومسون عديم بذور.

١ – التجربة الأولى:

أجريت على (٤٥) خمسة أربعون كرمة من صنف العنب الرومى الاحمر والتي تهدف إلى التغلب على ظاهرة انفراط الحبات وتحسين المحصول والجودة في هذا الصنف الهام وذلك باستخدام البورون (٢٠ ، ٤٠ جزء في المليون) والزنك (١٠٠ ،٢٠٠ جزء في المليون) ونافثالين حامض الخليك (٢,٥ ، ٥ جزء في المليون).

أدت المعاملات الى زيادة كبيرة فبنسبة العقد الأولي. بينما النسبة المئوية للحبات المتساقطة كانت عالية جدا في الكنترول بالمقارنة مع المعاملات. اما عدد العناقيد / كرمة لم تتأثر بشكل كبير بالمعاملات المختلفة. بينما أدت المعاملات الى زيادة في وزن المحصول (كجم/كرمة).

لم تكن هناك اختلافات معنوية بين المعاملات من ناحية عرض العنقود. اما ارتفاع العنقود فأظهرت المعاملات اختلافات كبيرة مقارنة مع الكنترول. فيما يتعلق بوزن العنقود فجميع المعاملات – إلا الرش بنافثالين حامض الخليك – أعطت اختلافات معنوية مقارنة بالكنترول وعلى العكس من ذلك أعطى الكنترول أعلى وزن ١٠٠ حبة.

لا توجد فروق ذات دلالة إحصائية بين المعاملات في النسبة المئوية للمواد الصلبة الذائبة الكلية خلال الموسمين. إن أعلى نسبة حموضة كانت مع المعاملة بنفثالين حامض الخليك بتركيز ٢,٥٪ ثم الكنترول ثم البورون بتركيز ٤٠ جزء في المليون + الزنك عند ٢٠٠ جزء في المليون. في حين تم الحصول على أدنى نسبة حموضة من معاملتي البورون بتركيز ٢٠ و ٤٠ جزء في المليون. وكانت الاختلافات معنوية خلال موسمي الدراسة. اما المواد الصلبة الذائبة الكلية / الحموضة، كشفت النتائج أن رش البورون بتركيز ٤٠ جزء في المليون تفوق إلى حد كبير على معظم المعاملات الأخرى. أخذت محتويات السكر نفس اتجاه الـ TSS حيث أعطى الكنترول أعلى القيم من السكريات الكلية. اتخذت السكريات المختزلة نفس اتجاه السكريات الكلية حيث تفوقت معاملة الكنترول على جميع المعاملات الأخرى.

ثانيا: التجربة الثانية:

وكان الهدف من هذه التجربة هو الحد من اكتناز العنقود وذلك بالرش بحامض الجبريليك بتركيز ٥ + ٢٠ + ٣٠ جزء في المليون،استخدام حامض الجبريليك بتركيز ٥ جزء في المليون + خف العناقيد يدويا وبدأ الرش عند وصول طول العنقود من ٨ – ١٠ سم ، خف العنقود يدويا و ذلك بهدف تحسين نوعية حبات العنب الطومسون عديم البذور. هذه التجربة نفذت على

مدار موسمين متتاليين ٢٠١٤ و ٢٠١٥ على ثمانية وعشرين (٢٨) كرمة من الطومسون عديم البذور.

لا توجد فروق ذات دلالة إحصائية بين المعاملات على عدد العناقيد/ الكرمة. بينما وزن المحصول (كجم/كرمة) تأثر بشكل كبير من خلال معاملة الرش بحامض الجبريليك حيث رش GA3 بتركيزات ٥ + ٢٠+ ٣٠ جزء في المليون أدى الى تحسن كبير في وزن المحصول مقارنة بالمعاملات الأخرى. بينما كان أدنى محصول من معاملة الكنترول. أظهرت البيانات أن رش العنقود بـــGA3 بتركيزات ٥ + ٢٠ + ٣٠ جزء في المليون أعطت أعلى القيم من حيث عرض وطول العنقود (سم). المعاملة بالــGA3 بتركيز ٥ + ٢٠ + ٣٠ جزء في المليون تفوق على جميع المعاملات من حيث متوسط وزن. وسلك وزن الـ ١٠٠ حبة ووزن عصير ١٠٠ حبة نفس اتجاه وزن العنقود. وعلى العكس من النتائج السابقة، أعطى الكنترول ثم الخف و الرش بالــــGA3 بتركيز ٥ جزء في المليون ثم الخف أعلى قيم TSS% في العصير. وكانت الخلافات بين هذه المعاملات الثلاثة والكنترول معنوية، ومع ذلك كانت الاختلافات بين هذه المعاملات وبعضها غير معنوية. وفيما يتعلق بنسبة الحموضة، كانت الاختلافات بين المعاملات معظمها ضعيفة واعطى خف العنقود أعلى نسبة من السكريات الكلية تليهاGA3 بتركيز ٥ جزء في المليون + الخف ثم الكنترول.

وخلصت هذه الدراسة إلى الآثار المفيدة لرش البورون والزنك خلال فترة التزهير وذلك لزيادة نسبة العقد وانخفاض نسبة تساقط الحبات في العنب الرومي الأحمر. من ناحية أخرى أدى الرش بحمض الجبريليك (GA3) الى زيادة حجم الحبات، ووزن العنقود وزيادة طول العنقود الطومسون عديم البذور حيث يعاني هذا الصنف من اكتناز العنقود. كذلك يمكن استخدام الخف لزيادة وزن العنقود والحبات وتحسين الجودة.