

## Effect of gibberellic acid and jasmine oil on yield and fruit quality of Ruby Seedless grape cultivar

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### Abstract

This experiment was carried out during two seasons of 2018 and 2019 on 25 years old grapevines of Ruby Seedless cultivar. Head training system was applied by leaving 36 buds per vine (18 fruiting spurs x 2 buds). Eight treatments of GA<sub>3</sub> and jasmine oil as a single treatment or combined were evaluated. The experiment aimed to examine the effect of GA<sub>3</sub> and jasmine oil on improving yield and berry quality of Ruby Seedless grape cultivar. The studied treatments increased the yield, cluster and berry weight. The best treatment in this term was spraying with GA<sub>3</sub> at 20 ppm when berry size about 3 mm plus jasmine oil at 1.5 cm<sup>3</sup>/liter at the beginning of the veraison stage while the control vines gave the lowest values among all treatments. Jasmine oil as a single treatment was the best treatment in respect of TSS%, acidity, TSS/TA ratio and reducing sugars among all treatments. This study concluded that the beneficial effects of spraying jasmine oil at veraison stage as single or in combined with GA<sub>3</sub> at 20 ppm when berry size about 3 mm to increase yield, berry and cluster weight and improving berry quality of Ruby Seedless grape cultivar.

**Keywords:** Grape; Ruby Seedless; Jasmine oil; Gibberellic acid

### Introduction

The grape is one of the most important fruit crops in the world. The cultivated area has grown rapidly in last few years because of its high return. Ruby Seedless cultivar become one of the most important table grapes both in local and export markets. Small berry size and poor coloration are the most problem facing this cultivar which can cause a major loss in production and quality. Plant growth substances play a major role in plant growth and development. GA<sub>3</sub> spraying still used to

increase berry size and thinning bunch berries in seedless cultivars.

The effect of GA<sub>3</sub> differed according to the studied cultivar, application date and concentration used (Orth, 1990 and Colapietra *et al.*, 1995). Recently, natural plant extracts are considering the new alternative compounds for improving yield and fruit quality as safety agents for human and environment. Application of plant extracts improves growth and productivity of fruit crops. Jasmonic acid has three categories of biological effects that are stimulation, inhibition and entrainment. It can induce the expression of the ethylene synthesis and promote the generation of ethylene. Jasmonic acid promotes

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degradation of chlorophyll and it also inhibit the photosynthesis of plant (Avanci *et al.*, 2010; Wasternack and Hanse, 2013 and Ashish *et al.*, 2015). I

In climacteric fruits such as apple, Methyl Jasmonate (MJ) application on fruit increases the red color, anthocyanin and  $\beta$  carotene and lots of ester compound also accumulate (Rudell *et al.*, 2002).

While in the non-climacteric fruit such as the small fruits (berries) the soluble solid/titratable acidity (SSC/TA) ratio, sucrose and glucose concentrations, and anthocyanin content also increase after MJ application (Wang and Zheng, 2005; Wang *et al.*, 2008). Therefore, the objective of this study is to examine the effect of spraying gibberellic acid ( $GA_3$ ) and jasmine oil on yield and fruit quality of "Ruby Seedless" grape cultivar under Assiut climatic conditions.

### Materials and Methods

This investigation was carried out during two successive seasons of 2018 and 2019 on 25 years old grapevines of "Ruby Seedless" cultivar. The selected vines were almost uniform in their vigor and growth and grown at the experimental orchard of the Faculty of Agriculture, Assiut University, where the soil is clay. The vines were trained according to the head training system and pruned during the second week of January. Head training system was applied for leaving total bud load of 36 bud per vine (18 fruiting spurs x 2 buds). This experiment included eight treatments and 3 vines/treatment. Thus, the total vines used for this experiment were 24 grapevines.

The treatment categories were:

- 1- Control (spraying water only).
- 2- Spraying jasmine oil at 1.5 cm<sup>3</sup>/liter at the beginning of the veraison stage

(when 20% of berries of 50% bunch/vine were softened).

- 3- Spraying  $GA_3$  at 10 ppm when shoot length about 20 cm.
- 4- Spraying  $GA_3$  at 10 ppm + jasmine oil at 1.5 cm<sup>3</sup>/liter.
- 5- Spraying  $GA_3$  at 10 ppm when berry size about 3 mm.
- 6- Spraying  $GA_3$  at 10 ppm + jasmine oil at 1.5 cm<sup>3</sup>/liter.
- 7- Spraying  $GA_3$  at 20 ppm when berry size about 3 mm.
- 8- Spraying  $GA_3$  at 20 ppm + jasmine oil at 1.5 cm<sup>3</sup>/liter.

The following parameters were estimated for each treatment.

- 1- Yield weight (kg).
- 2- Cluster (bunch) weight (g).
- 3- Bunch length (cm).
- 4- Bunch width (cm).
- 5- Berry length and diameter.
- 6- 50 berries weight (g).
- 7- 50 berries juice weight (g)
- 8- Total soluble solids % (TSS %) by using a hand refractometer.
- 9- Total acidity (TA) using titration by NaOH at 0.1 N and phenolphthalein as an indicator and expressed as tartaric acid and then TSS/acid ratio was calculated.
- 10- Reducing sugars according to Lane and Eynon procedure outlined in A.O.A.C. (1985).

The experiment was 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

#### (1) Yield and cluster (bunch) characteristics:

Data presented in Table 1 shows the effect of spraying with GA<sub>3</sub> and jasmine oil on yield and cluster characteristics of King Ruby grape cultivar during 2018 and 2019 seasons. It is obvious from the obtained data that spraying jasmine oil single or combined spraying with GA<sub>3</sub> significantly increased yield (kg/vine). The most effective treatments in this respect were spraying GA<sub>3</sub> at 20 ppm (when the berry size reached 3mm) + jasmine oil followed by GA<sub>3</sub> at 20 ppm (when the berry size reached 3mm) compared to untreated (control) vine. The yield weight (kg/vine) associated with previous treatments were 9.233 & 9.11 and 9.033 & 9.080 kg/vine, respectively during the two seasons of study. While the control vine gave the lowest values (5.611 and 6.047 kg/vine) during the two studied seasons. It is evident that all treatments improved cluster weight. The clusters treated with GA<sub>3</sub> at 20 ppm + jasmine oil were the heaviest clusters among all the treatments and the differences between this treatment values and the values of other treatments were significant during the two studied seasons. The clusters weight of this treatment was 692.00 and 665.00 (g) during the two studied seasons, while the lowest values were obtained from the control vine. The recorded values were 342.00 and 330.00 (g) respectively during 2018 and 2019 seasons. Concerning the effect of tested treatments on cluster dimensions during the two studied seasons, it was found that spraying GA<sub>3</sub> at 10 ppm alone or combined with jasmine oil was more effective than other treatments. The obtained results showed that the previous treatments gave the highest values of cluster height (cm) and width (cm). The values of cluster height (cm) and width (cm) subjected to these treatments were 29 & 27.67 cm and

14 & 13.67 and 30.00 & 26.00 and 14 & 12.67 cm, respectively during the two studied seasons. While the lowest cluster length and width values were obtained from the untreated vine. The values associated with this treatment reached 21.33 & 19.67 and 9.50 & 9.33 during 2018 and 2019 seasons.

## (2) Berry physical characteristics:

Data of various berry physical characteristics as affected by studied treatments during 2018 and 2019 seasons are shown in Table 2. It is clear from the obtained results that all the treatments significantly increased berry length compared to untreated vines. Spraying GA<sub>3</sub> at 20 ppm plus jasmine oil gave the highest berry length and diameter. The berry length and diameter (cm) associated with the previous treatment were 1.85, 1.633 as an average of two seasons respectively. On the other side, untreated vines gave the lowest values of 1.400, 1.267 cm as an average of the two studied seasons respectively. Concerning the effect of studied treatments on 50 berries weight (g) and 50 berries juice weight (g). Data showed that 50 berries weight and juice weight were affected by all the studied treatments. The highest values in this respect were obtained from the vines treated with GA<sub>3</sub> at 20 ppm plus jasmine oil while the untreated vine gave the lowest values. The average values of 50 berry weight associated with these two treatments were 140.4 and 95.5 g as an average of the two studied seasons. Concerning juice weight, spraying with GA<sub>3</sub> at 20 ppm plus jasmine oil gave the highest values (85.00 and 74.00 g) comparing with the control vine (58.33 and 53.33 g) respectively during the two studied seasons.

**Table 1.** Effect of spraying GA<sub>3</sub> and jasmine oil on yield, cluster weight and dimensions of Ruby Seedless grape cultivar during 2018 & 2019 seasons.

Treatments	Yield weight (kg/vine)			Cluster weight (g)			Cluster length (cm)			Cluster width (cm)		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
Control	5.611	6.047	5.829	342.0	330.0	336.0	21.33	19.67	20.50	9.50	9.33	9.42
Jasmine oil (at veraison stage)	6.555	6.667	6.611	370.3	370.0	370.2	22.33	21.00	21.67	11.67	12.33	12.00
GA <sub>3</sub> 10 ppm (shoot length 20 cm)	6.120	6.167	6.143	375.7	398.3	387.0	30.00	26.00	28.00	14.00	12.67	13.33
GA <sub>3</sub> 10 ppm (shoot length 20 cm) + Jasmine oil (at veraison stage)	6.513	6.715	6.614	405.3	375.7	390.5	29.00	27.67	28.33	14.00	13.67	13.83
GA <sub>3</sub> 10 ppm (berry size 3 mm)	7.407	7.700	7.553	568.3	570.0	569.2	23.67	23.33	23.50	12.33	12.33	12.33
GA <sub>3</sub> 10 ppm (berry size 3 mm) + Jasmine oil (at veraison stage)	7.767	8.365	8.066	675.0	518.3	596.7	25.33	22.00	23.67	14.00	12.00	13.00
GA <sub>3</sub> 20 ppm (berry size 3 mm)	9.033	9.080	9.057	648.7	558.3	603.5	27.00	26.00	26.50	13.33	13.00	13.17
GA <sub>3</sub> 20 ppm (berry size 3 mm) + Jasmine oil (at veraison stage)	9.233	9.110	9.172	692.0	665.0	678.5	28.50	26.33	27.42	13.67	12.67	13.17
<b>New L.S.D 0.05</b>	<b>1.093</b>	<b>1.173</b>		<b>75.04</b>	<b>10.59</b>		<b>2.742</b>	<b>2.24</b>		<b>1.793</b>	<b>1.499</b>	

**Table 2.** Effect of spraying GA<sub>3</sub> and jasmine oil on berry length, berry diameter, 50 berry weight and 50 berry juice weight of Ruby Seedless grape cultivar during 2018 & 2019 seasons.

Treatments	berry length(cm)			berry diameter(cm)			50 berry weight (g)			50 berry juice weight (g)		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
Control	1.433	1.367	1.400	1.333	1.200	1.267	101.0	90.0	95.5	58.33	53.33	55.83
Jasmine oil (at veraison stage)	1.633	1.500	1.567	1.433	1.367	1.400	121.0	95.0	108.0	63.33	61.67	62.50
GA <sub>3</sub> 10 ppm (shoot length 20 cm)	1.667	1.633	1.650	1.467	1.267	1.367	97.30	123.3	110.3	71.67	58.33	65.00
GA <sub>3</sub> 10 ppm (shoot length 20 cm) + Jasmine oil (at veraison stage)	1.733	1.600	1.667	1.533	1.500	1.517	119.2	111.7	115.4	78.33	53.33	65.83
GA <sub>3</sub> 10 ppm (berry size 3 mm)	1.900	1.467	1.683	1.600	1.267	1.433	129.3	125.0	127.2	65.00	70.00	67.50
GA <sub>3</sub> 10 ppm (berry size 3 mm) + Jasmine oil (at veraison stage)	1.833	1.600	1.717	1.600	1.500	1.550	132.8	130.0	131.4	75.00	76.67	75.83
GA <sub>3</sub> 20 ppm (berry size 3 mm)	1.833	1.700	1.767	1.500	1.567	1.533	140.0	125.0	132.5	85.00	67.00	76.00
GA <sub>3</sub> 20 ppm (berry size 3 mm) + Jasmine oil (at veraison stage)	1.933	1.767	1.850	1.700	1.567	1.633	149.2	131.7	140.4	85.00	74.00	79.50
<b>New L.S.D 0.05</b>	<b>0.110</b>	<b>0.1448</b>		<b>0.145</b>	<b>0.134</b>		<b>9.19</b>	<b>6.84</b>		<b>17.85**</b>	<b>7.36</b>	

**Table 3.** Effect of spraying GA<sub>3</sub> and jasmine oil on TSS%, TA%, TSS/TA ratio and reducing sugars % of Ruby Seedless grape cultivar during 2018 & 2019 seasons.

Treatments	T.S.S %			TA %			TSS/TA ratio			Reducing sugars %		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
Control	18.27	19.00	18.63	0.507	0.490	0.498	36.06	38.78	37.42	14.67	15.48	15.07
Jasmine oil (at veraison stage)	18.80	19.80	19.30	0.473	0.463	0.468	39.73	42.74	41.24	15.09	16.60	15.84
GA <sub>3</sub> 10 ppm (shoot length 20 cm)	17.23	18.53	17.88	0.527	0.515	0.521	32.72	35.99	34.36	13.35	14.95	14.15
GA <sub>3</sub> 10 ppm (shoot length 20 cm) + Jasmine oil (at veraison stage)	18.33	17.60	17.97	0.507	0.527	0.517	36.20	33.42	34.81	14.63	14.15	14.39
GA <sub>3</sub> 10 ppm (berry size 3 mm)	17.07	17.73	17.40	0.627	0.618	0.623	27.24	28.68	27.96	13.22	13.72	13.47
GA <sub>3</sub> 10 ppm (berry size 3 mm) + Jasmine oil (at veraison stage)	17.17	19.00	18.08	0.607	0.570	0.588	28.30	33.34	30.82	13.55	15.41	14.48
GA <sub>3</sub> 20 ppm (berry size 3 mm)	17.40	16.70	17.05	0.623	0.653	0.638	27.91	25.56	26.74	13.62	13.53	13.57
GA <sub>3</sub> 20 ppm (berry size 3 mm) + Jasmine oil (at veraison stage)	18.00	17.53	17.77	0.493	0.523	0.508	36.50	33.52	35.01	14.28	13.89	14.08
<b>New L.S.D 0.05</b>	<b>0.399</b>	<b>0.391</b>		<b>0.017</b>	<b>0.0173</b>		<b>0.982</b>	<b>1.11</b>		<b>0.493</b>	<b>0.747</b>	

**(3) Berry chemical characteristics:**

Data presented in Table 3 shows the effect of tested treatments on TSS%, total acidity% (TA), TSS/TA ratio and reducing sugars%. It could be demonstrated that spraying jasmine oil as a single treatment significantly improved fruit quality in terms of total soluble solids, total acidity, TSS/TA ratio and reducing sugars comparing with untreated vine and other treatments. The results took similar trend during the two studied seasons. The most effective treatment in this respect was spraying jasmine oil followed by untreated vines (control).

The results revealed that spraying the vines with jasmine oil produced the highest total soluble solids values (18.80 & 19.80%), lowest total acidity (0.473 & 0.463) highest TSS/TA ratio (39.73 & 42.74) and highest reducing sugars (15.09 & 16.60%) during the two studied seasons respectively. While GA<sub>3</sub> at 20 ppm gave the lowest TSS% (17.40 & 16.70) highest TA (0.623 & 0.653) lowest TSS/TA ratio (27.91 & 25.56) and lowest reducing sugars (13.62 & 13.53) as average during 2018 and 2019 seasons, respectively.

**Discussion and Conclusion**

GA<sub>3</sub> still used for seedless grape production to increase cluster and berry weight. GA<sub>3</sub> is very effective for enhancing fruit development in seedless grapevine cultivars through its important role in cell elongate stimulation, enhancing the water absorption and stimulating protein biosynthesis which lead to increase the cluster length as well as berry weight and size. The effect of GA<sub>3</sub> depends on the concentration used and date of the treatments (Perez *et al.*, 2000 and Casanova *et al.*, 2009).

The results of the current study are on line with those obtained by Hussein *et al.* (1986), Ahmed (1988), Shaaban *et al.* (1989), Mansour (1994), Abd El-Ghany (2000), Dokoozlian and Peacock (2001), Selim (2007), El-Salhy *et al.* (2009) and Abu-Zahra (2010). They reported that treated grapevine with GA<sub>3</sub> increased yield, cluster and berry weight while it decreased TSS%, sugars and increased the total acidity.

Recently, using natural oils is the new alternative compounds for improving yield and fruit quality. Jas, such as methyl jasmonate, jasmonic acid and other derivatives are referred to as jasmine a kind of plant

endogenous hormones. Generally, jasmonic acid has three categories of biological effects that are stimulation, inhibition and entrainment. It can induce the expression of the ethylene synthesis and promote the generation of ethylene (Creelman and Mullet, 1995, 1997).

This results are on line with those obtained by Wang *et al.* (2017), El-Kenawy (2018), Gil-Munoz *et al.* (2018), Garcia-Pastor *et al.* (2019) and Mohamed *et al.* (2019) who reported that yield weight, berry attributes, cluster measurements, total soluble solids, anthocyanin content and reducing sugars increased while the acidity decreased by MJ treatment.

According to the previous results, it could be recommended that spraying Ruby Seedless grape vine with jasmine oil as single treatment at the beginning of the veraison stage or spraying GA<sub>3</sub> at 20 ppm when berry size about 3 mm plus jasmine oil 1.5 cm<sup>3</sup>/liter at the beginning of the veraison to improve yield, cluster weight, berry weight and berry quality.

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