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Effect of GA_3, Girdling or Pruning on Yield and Quality of 'Parletta' Seedless Grape

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Abstract: Grape vines of cultivar 'Parletta' were sprayed with GA_3 at 10 (G1), 15 (G2), 20 (G3), 30 (G4) or 40ppm (G5) when cluster was 7-12cm length (S1), at full bloom (S2) or when berry was 2-4mm (S3). Treatments were as the following combinations: Water spray (T0) as a control, G1S1 (T1), G1S1 + G2S2 (T2), G1S1 + G3S3 (T3), G1S1 + G5S3 (T4), G2S1 (T5), G2S1 + G2S2 (T6), G2S1 + G4S3 (T7), G2S1 + G5S3 (T8), G3S2 (T9), G3S2 + G4S3 (T10), G3S2 + G5S3 (T11), manual thinning by comb (T12), pruning to 50 eyes (T13) or girdling vine arms (T14). Treatments T6 and T1 produced the highest yield kg $vine^{-1}$ where T7 and T6 had the highest number of clusters $vine^{-1}$. The heaviest clusters were produced in T13, T1 and T14. The treatments increased berry weight than control. Cluster length did not change significantly where the heaviest berries were produced in T13, T9, T5 and T3. The lowest cluster compactness was in T11, T9, T8, T14, T7 and T4. Shot berries % showed the lowest percentages in T8, T14, T4, T3 and T5. Fruit total soluble solids (TSS) increased in T5, T3, T12 and T13. Titratable acidity had the lowest values in T3, T14 while T12. TSS /acid ratio induced the highest ratio in T3, T12, T14 and T13.

Keywords: Acidity, Berry, Cluster, Grape, TSS

1. Introduction

Table grape (*Vitis vinifera*L.) is an important fruit and is traditionally produced in the Mediterranean region. The crop is also produced in all over the World during the last decades where the crop total production has increased, especially in Asia in China and India (O. I. V., 2007). Grape is used as dried berries (raisins), table grape fruit and juice (Mullins et al., 1992).

The local consumers have accustomed to consume traditional cultivars like Dapoki, Karishi, etc. where these grapes are of large berries and rain-fed. Nowadays, several seedless cultivars were imported where these varieties are grown in the open field or in greenhouses under drip-irrigation system (MoA, 2014).

Seedless grape is characterized by small berries, compacted cluster which are un favorite to the consumers**.** 'Perlette' is a seedless cultivar characterized by delicious early maturing fruits and edible soft leaves. The cultivar was produced in 1936 in California as a hybrid between Scolokertekhiralynoje 26 x Sultanina marble (English et al., 1990).

Gibberlic acidas GA_3 is a growth regulator that is widely used during fruit set stage to increase size of seedless berries. GA_3 had potential impact on grape quality where the impact depended on grape varieties (Rusjan, 2010). A positive correlation was observed between GA_3 application and amount of nutrients like N, P or K absorbed which enhanced the enlargement of grape berries and sink capacity of grape cluster to absorb water or nutrients such as potassium. (Zhenning et al, 2008).

Girdling is the removing of a small section of park (4 mm width) where it has been practiced for years to enlarge berries of table grape. Girdling resulted in an increase in carbohydrate concentrations above girdle and an increase weight per unit leaf area of grape vine (During, 1978). The application of GA_3 on grapevine mitigated the depressing effect of girdling on leaf gas exchange (Harrel and Williams, 1987 and Roper and Williams, 1989).

Spray of 25 or 50 ppm GA_3 on white 'Banaty' seedless grapevine significantly reduced each of TSS and the ratio between TSS/ acid (Wassel et al., 2007). Application of 50ppm GA_3 + CPPU [1-(2-chloro-4-pyridyl)-3-phenylure] at 2.5 ppm

on 'Parletta' after 14 days of full bloom increased berry size, cluster weight and acidity without effect on TSS (Nilnond et al, 2010). Application of GA_3 or GA_3 + girdle produced heavier berries, increased berry diameter, heavier bunches, and increased number of berries punch^{-1}, TSS increased and decreased titratable acidity (Abu-Zahra and Salameh, 2012). Spray of 40 mg GA_3L^{-1} on cluster significantly increased cluster weight, insignificantly increased berry weight, significantly increased number of berries cluster^{-1}, insignificantly increased cluster length and significantly decreased TSS (Abu-Zahra, 2013). Spray of GA_3 at 20 mg L^{-1} on flame seedless grape increased weight of the cluster and berry where GA3 had no significant influence on sugar content, TSS and acidity (Dimovska et al, 2014).

The current study aimed at improving the cluster and berries property of 'Parlette' cultivar by GA_3 spray on vine's canopy, manual thinning of cluster's berries or girdling of main vine arms.

2. Materials and Methods

2.1. Site and Season of the Experiment

The experiment was carried out in the North Governorate, Gaza Strip, Palestinian territories on grape (*Vitis vinifera* L.) in season 2012. 'Perlette' seedless cultivar of 9 years old vines were grown in a clay soil, drip-irrigated and spaced at 2 x 3 m.

2.2. Design and Treatments of the Experiment

The experiment was laid out in the completely randomized block design (CRBD) with 4 replications where each replicate-plot contained one tree. Treatments were as following in Table (1).

Table 1. *Treatments applied.*

Treatments code	Treatment stage		
	Spray when cluster 7 – 12 cm length	Spray at full boom	Spray after fruit set (2–4 mm diameter)
	GA_3 ppm		
T0	0	0	0
T1	10	0	0
T2	10	20	0
T3	10	0	30
T4	10	0	40
T5	15	0	0
T6	15	20	0
T7	15	0	30
T8	15	0	40
T9	0	20	0
T10	0	20	30
T11	0	20	40
T12	Manual thinning at fruitlets 2-4 mm stage		
T13	Retaining to 50 nodes at pruning time		
T14	Tree arms girdling at pruning time		

Vines were trained to the bilateral cordon system and pruned to short spurs (Alfonso et al., 2008) retaining an average of 70 buds per vine. The other horticultural practices were carried out according to the recommendations of Ministry of Agriculture (MoA, 2014).

2.3. Data Collection

2.3.1. Yield Components

It was determined in each replicate as yield kg vine^{-1} and clusters number vine^{-1}.

2.3.2. Cluster Properties

Eight clusters were randomly devoted to determine average of cluster weight (g), cluster length (cm), cluster compactness (Fig 1, consisted of 1-5 grads where 1 represented the least compacted cluster, grade 5 represented the most compacted where 3 represented the normal compactness) of cluster (El-Mahdi, 1960) and shot berries percentage.

2.3.3. Fruit Properties

Five clusters per each replicate were randomly devoted to determine average weight of 100 berry, titratable acidity as tartaric acid per 100 milliters of juice against 0.1 N NaOH (A.O.A.C., 1970), total soluble solids TSS using hand refractometer and TSS / titratable acidity ratio was calculated.

2.4. Statistical Analysis

Data were statistically analyzed using Duncan's multiple range test where means of similar letter/s are not significantly different at $p = 0.05$.

3. Results and Discussion

3.1. Yield Components

Yield as kg plant^{-1} (Table, 2) did not change significantly by the different treatments than control. Treatment T6 (12.412) and T1 (12.373) respectively produced higher yield than the other treatments or control. Number of cluster plant^{-1} was not affected significantly by the different treatments than control where T7 (50.3) and T6 (48.8) had higher number than the other treatments and the untreated control. Khan, 2009; Dimovska et al., (2006) reported that the effect of GA_3 is depending on variety of grapevine, the concentration and time of hormone application. Giberlic acid affects grape berry through different pathways: formation of flower cluster, berry set, berry enlargement, cluster length increase, thinning cluster berries and to prevent berry cracking (Korkutal et al., 2008).

3.2. Cluster and Berries Physical Properties

Cluster weight (Table, 3) showed insignificant changes due to the treatments compared to untreated control. Treatment T13 (332) and T1 (314) and T14 (308) respectively produced the heaviest clusters than the other treatments or control while T11 (172) and T9 (210) had the lightest cluster weight. Cluster length showed insignificant changes where no trend could be noticed. The average weight of 100 berries generally increased in the different treatments than control

where treatments T13 (179), T9 (169), T5 (167) and T3 (161) produced the heaviest grape berries than the other treatments or control (145). GA_3 has a beneficial effect on cell division and cell enlargement, thus on a higher accumulation of sugar and water without changing pressure potential, which in consequence translate into larger berry and cluster size during harvest (Perez and Gomez, 200; Casonova et al., 2009). Cluster compactness (Figure. 1) showed indefinite trend at the scale 1-5. In this concern T11 (2.26), T9 (2.56), T8 (2.61), T4 (2.66), T7 (2.87) and T4 (2.66) respectively produced the lowest cluster compactness, however changes were insignificantly among all treatments and/ or control. Percentage of shot berries showed insignificant changes among the different treatments and control where no rend could be detected in this respect. Treatments T8 (6.80), T14 (7.28), T4 (8.21), T3 (8.24) and T5 (8.63) resulted in the lowest shot berries %. On the other hand T13 (14.92), T7 (13.04), T11 (12.73) and T10 (12.6) resulted in the highest percentage of small berries.

Figure 1. *Cluster compactness (grade 1-5).*

These findings in harmony with those of Abu-Zahra and Salameh.

3.3. Chemical Properties

Total soluble solids % (Table, 4) in general insignificantly increased whereas T5 (12.0), T3 (11.8), T12 (11.7) as well as T13 (11.7) had the highest TSS content. Titratable acidity of the grape juice also insignificantly affected however, T3, T14 and T12 respectively contained lower acidity content than the other treatments or control. Total soluble solids/ acid ratio also showed insignificant changes. The treatments T3 (26.3), T12 (25.6), T14 (24.3) and T13 (23.5) had the highest ratio than control and other treatments

The current study relatively came to the same results reported by Dimovsk et al., (2014).

Table 2. *Yield components.*

Treatments	Yield kg plant^{-1}	Number of clusters plant^{-1}
T0	11.968 a	47.0 abc
T1	12.373 a	38.0 abc
T2	9.881 a	40.5 abc
T3	11.319 a	44.3 abc
T4	10.545 a	41.0 abc
T5	9.383 a	34.8 bc
T6	12.412 a	48.8 ab
T7	10.292 a	50.3 a
T8	9.772 a	43.8 abc
T9	9.061 a	44.8 abc
T10	10.071 a	36.8 abc
T11	5.423 a	33.8 c
T12	8.445 a	33.5 c
T13	10.867 a	33.3 c
T14	11.505 a	41.0 abc

Means followed by same letter/s do not differ significantly at $p = 0.05$ according to Duncan's multiple range test.

Table 3. *Physical properties of cluster and berries.*

Treatment	Cluster weight (g)	Cluster Length (cm)	average weight of 100 Berry (g)	Shot Berries %	Cluster Compactness (grade 1-5)
T0	283 abc	23.3 a	145 ab	10.98 a	3.25 ab
T1	314 ab	21.9 a	157 ab	10.72 a	3.51 a
T2	280 abc	23.9 a	153 ab	9.82 a	3.35 ab
T3	265 abc	21.6 a	161 ab	8.24 a	3.25 ab
T4	258 abcd	22.1 a	152 ab	8.21 a	2.66 ab
T5	276 abc	22.2 a	167 ab	8.63 a	3.09 ab
T6	266 abc	21.9 a	141 ab	9.64 a	3.55 a
T7	240 abcd	23.8 a	136 b	13.04 a	2.87 ab
T8	231 bcd	21.9 a	154 ab	6.80 a	2.61 ab
T9	210 cd	21.8 a	169 ab	9.90 a	2.56 ab
T10	249 abcd	21.5 a	163 ab	12.06 a	2.80 ab
T11	172 d	22.0 a	141 ab	12.73 a	2.26 b
T12	255 abcd	23.1 a	153 ab	9.12 a	3.22 ab
T13	332 a	23.1 a	179 a	14.92 a	3.69 a
T14	308 ab	22.0 a	158 ab	7.28 a	3.77 a

Means followed by same letter/s do not differ significantly at $p = 0.05$ according to Duncan's multiple range test.

Table 4. *Chemical properties of berries.*

Treatment	TSS%	Titratable acidity mg 100^{-1} ml	TSS /acid ratio
T0	10.8 a	0.53 ab	20.7 ab
T1	10.6 a	0.50 ab	21.3 ab
T2	11.2 a	0.51 ab	22.1 ab
T3	11.8 a	0.48 ab	26.3 a
T4	10.8 a	0.55 ab	19.9 ab
T5	12.0 a	0.55 ab	21.8 ab
T6	10.1 a	0.59 a	17.4 b
T7	11.1 a	0.54 ab	20.7 ab
T8	10.5 a	0.57 ab	18.8 ab
T9	11.2 a	0.54 ab	21.0 ab
T10	10.5 a	0.58 ab	18.3 ab
T11	9.9 a	0.51 ab	19.6 ab
T12	11.7 a	0.46 b	25.6 ab
T13	11.7 a	0.50 ab	23.5 ab
T14	11.4 a	0.47 ab	24.3 ab

Means followed by same letter/s do not differ significantly at $p = 0.05$ according to Duncan's multiple range test.

4. Conclusion

Seedless grapes in general are characterized by small berries where this creates a problem for consumers. The current study aimed at improving berry quality of cultivar 'Parletta' where 15 treatments were devoted to achieve the goal. Vines were treated by spraying with GA_3 at 3 stages and 5 levels, fruitlets manual thinning, pruned to 50 eyes or main arms girdling. Spraying with GA_3 at 15 ppm when cluster 7-12mm could be recommended for the potential economic benefits.

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