Available online at www.elixirpublishers.com (Elixir International Journal)

Agriculture

Elixir Agriculture 41 (2011) 5731-5735

ISSN: 2229-712X

# Influence of girdling, thinning and $GA_3$ on fruit quality and shelf life of grape (*vitis vinifera*) cv. perlette

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**ARTICLE INFO**

**Article history:**

Received: 15 September 2011;

Received in revised form:

16 November 2011;

Accepted: 28 November 2011;

**Keywords**

*Vitis vinifera L.*

Soluble solids,

Titratable acidity.

**ABSTRACT**

Grape is one of the most delicious, refreshing and nourishing fruits. One of the most important cultivars of grape, cv. Perlette is being grown extensively in northern India owing to its attractive colour, heavy bearing and good fruit quality. However, more thrust is to be laid on further improvement of the fruit quality. In this report we demonstrate the effect of girdling, thinning and application of $GA_3$ on fruit quality and shelf life of grape. Girdling + 40 ppm of $GA_3$ proved most effective in increasing the quality in terms of total soluble solids (TSS) (17.47 %), total sugar (8.94 %) reducing sugar (10.35 %), TSS/acid ratio (27.24 %) and resulted in decrease in acidity (24.59 %). During storage at room temperature minimum physiological loss in weight (9.42 %) was observed after three days of storage. The present study therefore suggests that girdling and growth regulator application is a desirable practice to enhance berry ripening and fruit quality in grape cv. Perlette.



## Introduction

Grape (*Vitis vinifera* L.) is believed to be one of the most essential commercial fruit crops of temperate to tropical regions (Gowda et al., 2008). Due to its high nutritive value, excellent in taste, multipurpose use and better returns grape is becomming more popular (Ghosh et al., 2008). On a worldwide basis table grape consumption has increased (Celik et al., 2005). Grape is cultivated over an area of 7.60 million hectares in the world with an annual production of 67.55 million tonnes. In India, it is cultivated over an area of 80 thousand hectares with an annual production of 1.87 million tonnes (FAO, 2009). "Perlette" variety is quite successful in north Indian region, occupying more than 90 per cent of total area under grapes. Perlette is a hybrid between Siolokertik Hiracynoje 26 + Sultania marble and was developed by Dr. H.P.Olmo at university of California, USA. This cultivar has the striking feature of translucence of the mature fruit. Sunlight exposed fruits contain more sugar and less acid than poorly-exposed. Removing basal leaves slightly changed temperature, atmospheric humidity, wind speed, and leaf wetness around grape clusters (English et al., 1990). Sunlight-exposed fruits are generally greater in total soluble solids and anthocyanins, and lower in titratable acidity compared to non-exposed or canopy shaded (Ferree et al., 2004; Kliewer et al., 2005; Santesteban and Royo, 2006; Prajitna et al., 2007). Fruit thinning improves fruit quality when removing about one-half of each cluster (the lower part of the main stem), leaving four or five branches near the cluster's base. The lower part of the cluster is usually compact, and the berries ripen later than those on the upper part (Herrera 2002). Application of Gibberellic acid ($GA_3$) at fruit set is used widely to increase berry size of *Vitis vinifera* seedless table grapes (Rizk-Alla et al., 2011). Gibberellins primarily affect growth by controlling cell elongation and division, which is reflected on yield and its components and fruit quality of various grape cultivars (Rizk-Alla, 2000 and Omar and Girgis 2005). Preharvest application of growth regulators like $GA_3$ along with mechanical treatments like girdling and thinning reduced weight loss (%), decay (%), shattering (%), total spoilage (%) and acidity (%) while it increased berry colour, TSS and TSS/acid ratio compared to control after 45 days of storage at 0°C, RH 90-95% (Fatma and Aisha, 2005; Rizk-Alla and Meshreki; 2006; Abd El-Rahman 2007; Mohamed et al., 2007; Yamane and Shibayama 2006; Saini et al., 2011).

In view of the above observation we also investigated the effect of girdling, thinning and $GA_3$ on fruit quality and shelf life of grape (*vitis vinifera*) cv. Perlette.

This study has been conducted in Perlette grape orchards were different cultural practices have been developed to optimize the quality of the table grapes. This work was aimed to evaluate girdling, thinning along with 40 ppm Gibberellic acid ($GA_3$) applied to improve the fruit quality and shelf life of Perlette grape.

## Materials and Methods

The present investigation was carried oput in the research farm of Sh F.H PG College N.Kalan Agra. The harvested fruit was kept in cardboard boxes line in news papers and kept at room temperature on the shelves.

The observations were taken three days interval fruit remained in good condition. Physiological loss in weight (PLW) the initial weight and the final weight of bunches were recorded at an interval of three days till more than fifty percent of the bunches were unmarketable and the loss was calculated by the formula as,

$$\text{Percent loss in weight} = \frac{\text{Percent loss in weight}}{\text{Initial weight}} \times 100$$

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Fruit chemical properties (TSS %, using hand refractrometer and titrable acidity and reducing sugar using tartaric acid equivalents) (Anonymous 1990)

**Statistical Analysis**

Data were tested for the effects of treatments on analyzed parameters by the one-way analysis of variance (ANOVA) technique. All statistical analyses were performed at the level 5% using statistical software CPCS-1 package developed by Cheema and Singh (1990).

**Results and Discussion**

Physiological loss in weight (PLW): Physiological loss in weight (PLW) during room temperature storage of grapes (*Vitis vinifera* L.) cv. Perlette. As per usual of the dataon the third of storage reveals that PLW was significantly less in all the treatments as compared to control. However trunk girdling + 40 ppm GA3 treatment recorded a minimumloss of (9.42 %) followed by 13.12 % in girdling and also in 40 ppm GA3.Maximum value of PLW (19.18%) was recorded in the treatment girdling + thinning + 40 ppm GA3 compared to control (22.31%). On the sixth day of storage, PLW ranged from (30.20 %) in treatment girdling + 40 ppm GA3 to (33.91%) in girdling + thinning +20 ppm $GA_3$ (Table 1) The PLW losses in all the treatments including control were stastically at par on sixth day of storage. As berries on sixth day of storage has shattered and sunken, the biochemical aspects were analysed only upto third day of storage. Post harvest studies in grapes (*Vitis vinifera* L.) cv. Perlette being a non climacteric fruit gets subjected to physiological deterioration and physiological loss in weight during present study maximum physiological loss in weight was recorded in control in on third of storage (22.31%), were as the minimum PLW (9.42%) was recorded obtained from vines treated with girdling + 40 ppm $GA_3$. on sixth day of storage the PLW losses in treatments including control ranged from 30.20% to 33.91 %. Similar results of reduced physiological loss in weight was also recorded with the application of flower bud thinning (60) + girdling (4mm) and $GA_3$ (40ppm) in grapes cv. Perlette (Singh et al., 2003) Eswara et al., (1989), also reported loss in weight of pachadraksha grape berries at 23.35°C which was 36.78% on tenth day of storage. As for as the present investigation is concerned in addition to PLW, browning of the berries also causes great loss under room temperature. After three days of storage, the berries developed dull appearance and were not marketable, similar findings have been reported by (Ladania 1986, Fatma and Aisha, 2005; Rizk-Alla and Meshreki; 2006; Abd El-Rahman 2007; Mohamed et al., 2007) which are in confirmation with the present investigation. More recently Rizk-Alla et al., (2011) also reported reduction in physiological loss in weight with the application of $GA_3$.

Total soluble solids (TSS): Total soluble solids (TSS) content in fruits (Table 2), there was a slight increase in TSS content berries during storage. Most of the treatments recorded significantly higher average values of TSS when compared with control which recorded lowest value of 14.69% on third of storage, highest TSS content of 17.47 % was found in berries of those vines that had received girdling + 40 ppm $GA_3$ treatment closely followed by thinning + 40 ppm $GA_3$ (17.36) and both were significantly superior to control (14.69%) TSS increased maximum to a tune of 18.19% in girdling + 40 ppm $GA_3$ on third day of room storage. Total solible solids of the fruit increased slightly during storage and the berries tested sweeter on the third day of storage. Highest TSS content of 17.47% was recorded due to girdling + 40 ppm $GA_3$ and lowest TSS content of 15.00% due to thinning alone as compared to control (14.69) the increase in TSS during storage was also reported by Shankariah and Roy (1991) under room conditions. The increase in TSS during storage might be due to the fact that concentration of sugar increased due to loss of moisture, so that the grapes become sweeter. Many researchres have observed that sunlight-exposed fruits are usually rich in total soluble solids and show reduced titratable acidity, compared to nonexposed or canopy shaded. (Ferree et al., 2004; Kliewer and Dokoozlian, 2005; Santesteban and Royo, 2006; Reynolds, 2005; Fox, 2006; Reynolds et al. 2006).Similar effect of growth regulators was also shown by Fatma and Aisha, (2005) on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed et al., (2007) on Crimson Seedless grapes who found that $GA_3$ spraying after fruit set significantly increased in the juice TSS (%) compared to control during storage. Furthermore, recently Abu Zahra (2010) and Abd El-Razek et al., (2010) reported increase in TSS content in grapevine with application of $GA_3$.

Titratable acidity: The data pertaining to the percent titratable acidity is given in table 3. Berries in all the treatments recorded a reduction in the acid content on third day of storage. A minimum acid content (0.610%) on third day was recorded in grapes from those vines which received trunk girdling + 40 ppm $GA_3$ treatment followed by 0.69% in thinning + 40 ppm GA3 treated vines and both the treatments proved.significantly superior over control (0.769%).The maximum percentage of titrable acidity of 0.773 was recorded in the berries which has been treated with 20 ppmGA3 and stood at par withcontrol (0.769%). The acidity decreases to a tune of 24.59% in girdling + 40 ppm $GA_3$ on third day of room storage. A slightly decrease in acidity was noticed during storage, however minimum acidity of (0.610 %) was recorded on third day of storage in trunk girdling + 40 ppm $GA_3$ as compared to control (0.769%). Suresh et.al, (1976) and Sarkar et al, (1996) reported decline in acidity in grapes during storage. Our results are similar to those achieved by Fatma and Aisha, (2005) on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed et al., (2007) on Crimson Seedless grapes who found that $GA_3$ spraying after fruit set significantly decreased in the juice acidity (%) compared to control during storage. Similar reduction in acidity due to thinning practice in grape was also reported by Abd El-Razek et al., (2010) Furthermore, and thinning treatments increased light penetration into the canopy that improves berry maturity being associated with decreased acidity in the berries. (Abd El-Razek et al., (2010).

Total Soluble Solids/ Acid ratio: All the treatments TSS/acid ratio increased during storage at room temperature and on third of shelf-life the highest TSS/acid ratio of 24.38 was recorded in berries of these vines treated with girdling + 40 ppm $GA_3$ closely followed by thinning + 40 ppm GA3 and girdling alone with their corresponding values of 24.05 and 23.95 respectively as compared to control (19.16).(Table 4) All other treatments were found to be significantly as compared to control TSS/acid ratio increased by 27.24% in girdling + 40 ppm $GA_3$ on third of room temperature. These results are in agreement with those obtained by Fatma and Aisha, (2005) on Roumy Ahmer grapes; Rizk –Alla and Meshreki, (2006) and Mohamed et al., (2007) on Crimson Seedless grapes who found that $GA_3$ spraying after berry set significantly increased in the juice TSS/acid ratio compared to control during storage. Similar,

increase in TSS/acid ratio by thinning in grapes was also observed by Abd El-Razek et al., (2010)

Reducing sugars: As perusal of data on reducing sugar content of grapes reveals that the reducing sugar content decreases during storage period. The observations further revealed that on the day of harvesting the maximum and minimum percentage of reducing sugar was in girdling + 40 pm GA3 and thinning treatment having values of 13.00% and 11.80% which decreased to 12.90% and 11.69% on third day of storage respectively. On third day at room temperature storage , significantly highest content of reducing sugar 12.90% was recorded in berries of those vines which received pre-harvest treatment of girdling + 40 ppm GA3 followed by girdling + thinning + 20 ppm GA3 with corresponding values of 12.67% and 12.60% respectively, and those treatments proved significantl at 5 % level of significance when compared to control (11.69) (Table 4)However the maximum increase in reducing sugars was observed to be 10.35% in girdling + 40 ppm GA3. There was a slight reduction in the contents of reducing sugars of berries during storage. The increase in the reducing sugar content with the application of GA3 and cultural practices like thinning was also reported by Josan et al 2001 and Mota et al. 2010.

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**Table 1. Effect of girdling, thinning and $GA_3$ on physiological loss in weight (PLW) of harvested grapes (*Vitis vinifera* L.) cv. perlette at room temperature**

| Treatment | Average weight (g) of bunches at harvest | PLW (%) | |
|---|---|---|---|
| | | 3-day | 6 day |
| G | 473.20 | 13.12 | 30.40 |
| T | 404.04 | 19.10 | 32.00 |
| $GA_3^*$ | 384.04 | 15.83 | 31.24 |
| $GA_3^{**}$ | 392.65 | 13.12 | 31.00 |
| G+T | 292.09 | 16.04 | 31.88 |
| $G+GA_3^*$ | 393.91 | 15.28 | 32.10 |
| $G+GA_3^{**}$ | 495.73 | 9.42 | 30.20 |
| $T+GA_3^*$ | 380.61 | 18.35 | 30.33 |
| $T+GA_3^{**}$ | 370.06 | 18.57 | 33.79 |
| $G+T+GA_3^*$ | 455.70 | 16.64 | 33.91 |
| $G+T+GA_3^{**}$ | 405.72 | 19.18 | 30.41 |
| Control | | 22.31 | 32.18 |
| S.E.m(±) | | 0.51 | |
| C.D. at 5% | | 1.51 | NS |

**Table 2. Effect of girdling, thinning and $GA_3$ on total soluble solids (TSS) of harvested grapes (*Vitis vinifera* L.) cv. perlette at room temperature**

| Treatment | Total Soluble Solids TSS (%) | | | |
|---|---|---|---|---|
| | 0-days | Per cent increase over control | 3- days | Per cent increase over control |
| G | 16.83 | 16.30 | 17.33 | 17.97 |
| T | 14.66 | 1.31 | 15.00 | 2.11 |
| $GA_3^*$ | 16.00 | 10.57 | 16.34 | 11.23 |
| $GA_3^{**}$ | 16.33 | 12.85 | 16.89 | 15.65 |
| G+T | 14.66 | 1.31 | 15.06 | 2.51 |
| $G+GA_3^*$ | 16.50 | 14.02 | 16.70 | 13.68 |
| $G+GA_3^{**}$ | 17.00 | 17.48 | 17.47 | 18.92 |
| $T+GA_3^*$ | 14.50 | 0.20 | 14.77 | 0.54 |
| $T+GA_3^{**}$ | 17.00 | 17.48 | 17.36 | 18.17 |
| $G+T+GA_3^*$ | 15.33 | 5.94 | 15.46 | 5.24 |
| $G+T+GA_3^{**}$ | 16.66 | 15.13 | 17.03 | 15.94 |
| Control | 14.47 | | 14.69 | |
| S.E.m(±) | 0.17 | | 0.25 | |
| C.D. at 5% | 0.51 | | 0.74 | |

**Table 3. Effect of girdling, thinning and GA3 on percent titrable acidity of harvestedgrapes (Vitis vinifera L.) cv. perlette at room temperature**

| Treatment | Acidity % | | | |
|---|---|---|---|---|
| | 0-days | Per cent increase over control | 3- days | Per cent increase over control |
| G | 0.733 | 8.75 | 0.73 | 5.55 |
| T | 0.713 | 11.25 | 0.707 | 8.57 |
| $GA_3^*$ | 0.808 | 0.0 | 0.773 | -1.29 |
| $GA_3^{**}$ | 0.743 | 7.50 | 0.701 | 8.57 |
| G+T | 0.806 | 0.00 | 0.731 | 4.10 |
| $G+GA_3^*$ | 0.790 | 1.25 | 0.711 | 7.04 |
| $G+GA_3^{**}$ | 0.689 | 15.0 | 0.610 | 24.59 |
| $T+GA_3^*$ | 0.772 | 3.75 | 0.709 | 8.57 |
| $T+GA_3^{**}$ | 7.51 | 6.25 | 0.692 | 10.14 |
| $G+T+GA_3^*$ | 0.743 | 7.50 | 7.34 | 4.10 |
| $G+T+GA_3^{**}$ | 0.800 | 0.0 | 0.751 | 1.33 |
| Control | 0.808 | 0.0 | 0.769 | 0.0 |
| S.E.m(±) | 0.020 | | 0.004 | |
| C.D. at 5% | 0.058 | | 0.014 | |

G= Trunk girdling; T=thinningby clipping; $GA_3$ = Gibberellic acid
*= 20 ppm, ** = 40 ppm
x

**Table 4. Effect of girdling, thinning and $GA_3$ on Total soluble solids /acid ratio ofharvested grapes (*Vitis vinifera* L.) cv. perlette at room temperature**

| Treatment | T.S.S /acid ratio | | | |
|---|---|---|---|---|
| | 0-days | Per cent increase over control | 3- days | Per cent increase over control |
| G | 23.12 | 35.28 | 23.95 | 25.00 |
| T | 19.52 | 14.21 | 21.57 | 12.57 |
| $GA_3^*$ | 19.97 | 16.85 | 21.02 | 9.70 |
| $GA_3^{**}$ | 22.12 | 29.43 | 23.67 | 23.53 |
| G+T | 18.70 | 9.42 | 19.78 | 3.23 |
| $G+GA_3^*$ | 20.91 | 22.35 | 22.90 | 19.51 |
| $G+GA_3^{**}$ | 24.15 | 41.48 | 24.38 | 27.24 |
| $T+GA_3^*$ | 18.85 | 10.29 | 21.22 | 10.75 |
| $T+GA_3^{**}$ | 23.84 | 39.49 | 24.05 | 25.52 |
| $G+T+GA_3^*$ | 20.78 | 21.59 | 20.98 | 9.94 |
| $G+T+GA_3^{**}$ | 20.69 | 21.06 | 21.64 | 12.94 |
| Control | 17.09 | 0.00 | 19.16 | 0.00 |
| S.E.m(±) | 0.081 | | 0.41 | |
| C.D. at 5% | 0.39 | | 1.20 | |

G= Trunk girdling; T=thinningby clipping; GA3 = Gibberellic acid
*= 20 ppm, ** = 40 ppm

**Table 5. Effect of girdling, thinning and GA3 on reducing sugar of harvested grapes(Vitis vinifera L.) cv. perlette at room temperature**

| Treatment | Reducing sugar | | | |
|---|---|---|---|---|
| | 0-days | Per cent increase over control | 3- days | Per cent increase over control |
| G | 12.20 | 2.86 | 12.11 | 3.59 |
| T | 11.80 | -0.06 | 11.69 | 0.0 |
| $GA_3^*$ | 12.08 | 1.85 | 11.75 | 0.51 |
| $GA_3^{**}$ | 11.90 | 0.33 | 11.76 | 0.59 |
| G+T | 12.18 | 2.69 | 12.03 | 2.90 |
| $G+GA_3^*$ | 11.90 | 0.33 | 11.16 | -4.53 |
| $G+GA_3^{**}$ | 13.00 | 9.61 | 12.90 | 10.35 |
| $T+GA_3^*$ | 11.86 | 0.0 | 11.36 | -2.82 |
| $T+GA_3^{**}$ | 12.33 | 3.96 | 12.21 | 4.44 |
| $G+T+GA_3^*$ | 12.80 | 7.92 | 12.60 | 7.78 |
| $G+T+GA_3^{**}$ | 12.78 | 7.75 | 12.67 | 8.38 |
| Control | 11.86 | 0.0 | 11.69 | 0.0 |
| S.E.m(±) | 0.10 | | 0.04 | |
| C.D. at 5% | 0.30 | | 0.11 | |

G= Trunk girdling, T= Thinning by clipping, $GA_3$ = Gibberellic acid
* = 20 ppm, ** = 40 ppm