International Journal of Farm Sciences **6(3):** 88-94, 2016

Effect of GA_3 and its combination with urea phosphate and BA on storage changes in grape cv Thompson Seedless

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ABSTRACT

Effect of GA_3 and its combination with urea phosphate and BA on storage changes in grape cv Thompson Seedless were evaluated. Ten treatments of GA_3 and its combination with urea phosphate and BA and control (water spray) were applied at two stages that were pre-bloom and berry set. All the bio-regulator and chemical treatments proved more effective in improving berry storage parameters after 7 days of ambient storage over control. The combined application of both GA_3 and BA in different concentrations (30 ppm GA_3 at pre-bloom stage with 30 ppm GA_3 + 10 ppm BA at berry set stage and 40 ppm GA_3 at pre-bloom stage with 30 ppm GA_3 + 10 ppm BA at berry set stage) proved more effective in reducing physiological loss in weight along with higher juice content after 7 days of ambient storage. The application of 40 ppm GA_3 at pre-bloom and again at berry set stage proved effective in maintaining higher TSS, TSS:acid ratio and reducing titratable acidity after 7 days of ambient storage. The study showed that the application of plant growth regulators viz GA_3 and BA and a chemical urea phosphate at pre-bloom and berry set stages influenced the storage changes after 7 days under ambient conditions.

Keywords: Thompson Seedless; GA_3; urea phosphate; BA; storage changes

INTRODUCTION

Thompson Seedless grape vines (*Vitis vinifera* L) are planted throughout the world and are used to produce dried fruits (raisins), grapes for the fresh market (table grapes) and juice for concentrate (Mullins et al 1992). It is a mid-season and uniform ripening cultivar and produces white, small to medium and oval seedless berries. The berries have soft skin and a firm juicy pulp with pleasant flavor. These are yellowish green to golden yellow when fully ripe. Among the various practices, application of plant growth regulators are the most important factor for quality grape production. Gibberellic acid (GA_3) is most widely used growth regulator in the table grape industry. However the effect depends upon climate, cultivar, stage and rate of application (Cirami et al 1992). When GA_3 was used with urea phosphate, the action of GA_3 was enhanced (Shulman et al 1987). GA_3 has been found to

increase the shelf-life of Thompson Seedless grapes (Marzouk and Kassem 2011). Benzylaminopurine (BA) delays the tissue senescence (Bangerth 2004). So there was a need to test these chemicals under temperate climate of Kashmir valley to study the influence of bioregulators on storage changes in grapes cv Thompson Seedless under ambient conditions.

MATERIAL and METHODS

The present investigation was carried out in the Model Grape Vine Orchard, Department of Horticulture, Karal Bagh, Ganderbal, Jammu and Kashmir during the year 2012. For this study 15-17 year old vines of grape cultivar Thompson Seedless trained on telephone system were selected. In total 33 vines were selected for experiment and were subjected to randomization and there were eleven treatments replicated thrice. GA_3, urea phosphate and BA sprays were given at two stages of panicle development viz pre-bloom and berry set.

Treatment details

Bioregulators viz GA_3, BA and a chemical urea phosphate were sprayed as per Table 1.

Measured storage parameters

Physiological loss in weight after 7 days of ambient storage was calculated by subtracting the final weight from initial weight of the fruit with the help of the formula:

$$WL\ (\%) = \frac{Wi - Wf}{Wi} \times 100$$

where WL= Physiological loss in weight, Wi= Iinitial fruit weight (g), Wf= Final fruit weight (g) at the indicated period

For measuring storage parameters the representative fruit samples after 7 days of ambient storage from each replication were crushed and juice was obtained by straining through muslin cloth. The readings for total soluble sugars (TSS) were taken with the help of hand refractometer (Anon 1970). Total titratable acidity was determined by titrating 10 ml of aliquot with NaOH (0.1N) using phenolphthalein as indicator. The end point was marked by the appearance of light pink colour. The acidity was expressed in terms of tartaric acid and the results were expressed as percentage total titratable acidity.

For measuring juice content fifty berries per bunch were randomly selected and weighed on the top pan electronic balance; the juice was extracted and its volume was measured. The juice percentage was calculated using the formula:

$$\text{Juice content}\ (\%) = \frac{\text{Juice yield (ml)}}{\text{Weight of berries (g)}} \times 100$$

Sugar:acid ratio was calculated by dividing the values of total sugars by the acidity percentage of the corresponding treatment.

Table 1. Treatments comprising GA_3, BA and chemical urea phosphate sprayed on cv Thompson Seedless

Treatment	Concentration of chemicals sprayed at	
	Pre-bloom	Berry set
T_0	Water spray (control)	Water spray (control)
T_1	30 ppm GA_3	30 ppm GA_3
T_2	30 ppm GA_3	40 ppm GA_3
T_3	30 ppm GA_3	30 ppm GA_3 + 1000 ppm urea phosphate
T_4	30 ppm GA_3	40 ppm GA_3 + 1000 ppm urea phosphate
T_5	30 ppm GA_3	30 ppm GA_3 + 10 ppm BA
T_6	40 ppm GA_3	30 ppm GA_3
T_7	40 ppm GA_3	40 ppm GA_3
T_8	40 ppm GA_3	30 ppm GA_3 + 1000 ppm urea phosphate
T_9	40 ppm GA_3	40 ppm GA_3 + 1000 ppm urea phosphate
T_{10}	40 ppm GA_3	30 ppm GA_3 + 10 ppm BA

Experimental design and statistical analysis

The experiment was laid out in a randomized complete block design (RCBD) with single grapevine as an experimental unit with 11 treatments replicated thrice. The data recorded were statistically analysed as per Panse and Sukhatme (1989). The significance of treatment effects was tested through variance ratio and the significance of difference between any two means was judged with the critical difference (CD) at 5 per cent level of significance.

RESULTS and DISCUSSION

Physiological loss in weight

The results shown in Table 2 reveal that there was significant decrease in weight after 7 days of ambient storage in all the treatments in comparison to control. Minimum physiological loss in weight (8.56%) after 7 days of ambient storage was recorded in the treatment T_{10} (40 ppm GA_3 at pre-bloom and 30 ppm GA_3 + 10 ppm BA at berry set) as compared to highest physiological loss in weight in control (10.23%). Mangasuli et al (1997) reported that GA_3 treatment reduced the transpiration rate and lowered the physiological loss in weight in Thompson Seedless grapes. Marzouk and Kassem (2011) reported that GA_3 increased the shelf-life of Thompson Seedless grapes. Bangerth (2004) reported that BA delayed the tissue senescence. The results are also in agreement with the findings of Al-Juboory et al (1990), Mangasuli et al (1997), Mangasuli et al (1998) and Marzouk and Kassem (2011).

TSS

Maximum TSS (20.13°Brix) was recorded with 40 ppm GA_3 when applied

Table 2. Effect of GA_3, urea phosphate and BA on fruits of grape cv Thompson Seedless 7 days after ambient storage

Treatment	WL (%)	TSS:acid ratio	TSS at harvest (°B)	TSS at 7 DAS (°B)	Titratable acidity at harvest (%)	Titratable acidity at 7 DAS (%)	Juice content at harvest (%)	Juice content at 7 DAS (%)
T0	10.23 (3.19)	21.29	16.15	17.25	0.87 (0.93)	0.81 (0.90)	59.45	53.75
T1	9.88 (3.14)	25.21	18.12	18.91	0.81 (0.89)	0.75 (0.87)	65.02	59.14
T2	9.18 (3.03)	27.66	18.83	19.92	0.78 (0.88)	0.72 (0.85)	66.93	60.23
T3	9.86 (3.14)	24.63	17.84	18.71	0.82 (0.90)	0.76 (0.87)	65.84	60.12
T4	8.79 (2.96)	25.74	18.44	19.05	0.80 (0.89)	0.74 (0.86)	67.24	60.94
T5	8.61 (2.93)	23.35	17.30	18.21	0.84 (0.91)	0.78 (0.88)	68.07	62.47
T6	9.43 (3.07)	25.60	18.33	18.94	0.81 (0.90)	0.74 (0.86)	65.36	59.79
T7	8.97 (2.99)	28.35	19.02	20.13	0.77 (0.87)	0.71 (0.84)	69.58	62.84
T8	8.84 (2.97)	23.84	17.45	18.35	0.83 (0.91)	0.77 (0.88)	66.41	61.09
T9	8.73 (2.95)	26.65	18.53	19.46	0.79 (0.88)	0.73 (0.85)	67.68	62.31
T10	8.56 (2.92)	22.82	17.05	18.03	0.85 (0.92)	0.79 (0.89)	68.74	63.43
$CD_{0.05}$	0.31	1.04	0.08	0.10	0.03	0.03	1.35	0.32

WL= Physiological loss in weight, TSS= Total soluble sugars, DAS= Days after sowing

at pre-bloom stage and again at berry set stage (T_7) and Minimum (17.25°Brix) was recorded under control. Increase in TSS after 7 days of ambient storage was observed in all the treatments including control over harvested stage readings. This increase in TSS may be attributed partly to the conversion of acids to sugars. GA_3 application at pre-bloom and berry set stages causes chemical mediated degradation of starch and metabolism of organic acids into soluble sugars which may be the reasons for significant increase in TSS over control. These results coincide with the findings of Beniwal et al (1993) who reported that TSS increased up to six days of storage in grapes and Desai et al (1980) who reported that TSS increased in Thompson Seedless grapes by the application of BA.

Titratable acidity

Titratable acidity was significantly influenced by the application of GA_3 and its combination with urea phosphate and BA. The lowest acidity (0.71%) after 7 days of ambient storage was recorded in T_7 and highest (0.81%) under control. Generally oxidative and hydrolytic enzymes are responsible for enhanced respiration. The reduction in acidity percentage of juice accompanied by increased accumulation of total soluble solids (TSS) content in grape berries clearly suggests increased catabolization of organic acids into sugars as has been suggested by Singh and Sharma (1996). The increase in TSS and decrease in acidity due to GA_3 application may be due to chemical mediated degradation of starch and metabolism of organic acids into soluble sugars. The results obtained under the present investigation are in conformity with the findings of Desai et al (1980) and Beniwal et al (1993).

TSS:acid ratio

All the growth regulator treatments significantly increased the TSS:acid ratio after 7 days of ambient storage in comparison to control. Maximum TSS:acid ratio (28.35) was recorded in T_7 and minimum (21.29) under control. The treatments that consisted of GA_3 and its combination with urea phosphate and BA increased the TSS and reduced the acidity after 7 days of ambient storage. The results obtained under the present investigation coincide with the findings of Desai et al (1980) and Beniwal et al (1993).

Juice content

Percentage of juice content after 7 days of ambient storage was significantly influenced by the bioregulator treatments. Vines under T_{10} had highest juice content (63.43%). In the present investigation GA_3 and BA treatments resulted in minimum physiological loss in weight and increased the size and weight of the berries. These may be the reasons for reduced juice content. Lowest juice percentage (53.75%) was recorded under control. These results are in conformity with the findings of Garcia-Luis et al (1985), Pozo et al (2001), Davies et al (1999), Fidelibus et al (2002) and Khalid et al (2012).

CONCLUSION

The application of plant growth regulators viz GA_3, BA and chemical urea phosphate at pre-bloom and berry set stage resulted in improved storage parameters after 7 days of ambient storage. The application of 40 ppm GA_3 at pre-bloom and again at berry set stage proved more effective in maintaining higher TSS, TSS:acid ratio and reducing titratable acidity after 7 days of ambient storage. The combined application of GA_3 and BA at different concentrations proved more effective reducing physiological loss in weight along with higher juice content after 7 days of ambient storage.

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Received: 9.9.12015 ***Accepted: 3.3.2016***