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Effect of Preharvest Application of Growth Regulators on Postharvest Quality of Grape cv Sahebi under Ambient Conditions

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ABSTRACT

Growth regulators were evaluated on storability of grape cv sahebi under ambient conditions having twenty three years old vines trained on bower system for two consecutive years. There were nine treatments viz., G_0 (control), G_1= Gibberellic acid @ 20 ppm, G_2 = Gibberellic acid @ 40 ppm, G_3 = 6-Benzyladenine @ 10 ppm, G_4= 6-Benzyladenine @ 20 ppm, G_5= GA_3 @ 20 ppm+ 6-BA @ 10 ppm, G_6= GA_3 @ 20 ppm + 6-BA @ 20 ppm, G_7 = GA3 @ 40 ppm+ 6-BA@ 10 ppm, G_8 = GA_3 @ 40 ppm + 6-BA @ 20 ppm which were sprayed at three stages i.e. S_1 = pre-bloom (single spray), S_2 = 3-4 mm berry size (single spray), S_3 = pre-bloom + 3-4 mm berry size (double superimposed spray) replicated thrice with double plot size in a completely Randomized Block Design. Observations were recorded on physiological loss in weight (%), berry shatter (%), TSS (°B), acidity (%), TSS/acid ratio and juice content (%).The results obtained indicated that the minimum physiological loss in weight as well as berry shatter, highest total soluble solids, TSS/acid ratio and juice content after 5 and 10 days of ambient storage was recorded in treatment G_7 (GA_3 @ 40 ppm + 6-BA @ 10 ppm) during both the years. The stage of growth regulator application and interaction of growth regulators and stage of growth regulator application had no significant influence on the storability of grape under ambient conditions. Combined application of growth regulators GA_3 @ 40 ppm + 6-BA @ 10 ppm enhanced the storability of grape and can be recommended for getting better returns.

Keywords Growth regulators, Storability, Sahebi, Juice content, Berry shatter.

INTRODUCTION

Grape (*Vitisvinifera* L.) is one of the most important fruit crops of temperate zone, which has acclimatized to sub-tropical and tropical agro climatic conditions prevailing in the Indian sub-continent. It is a non-climacteric fruit, rich in sugars, acids, minerals, vitamins and tannins. These can be eaten raw or used for making jam, juice, jelly, vinegar, wine, grape seed extracts, raisins, molasses and in some

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kinds of confectionery. Plant growth regulators such as gibberellins and cytokinins are most commonly employed in grape production for varied uses such as thinning of berries, improving fruit-set, hastening or delaying maturity of berries, improving the quality and shelf life of berries and for inducing seedlessness in berries. After harvest, grape clusters are susceptible to dehydration and enzymatic browning of rachis particularly when they are exposed to ambient uncontrolled environment. Post-harvest grape deterioration can be due to physical, physiological or pathological factors that may occur in the vineyard (pre-harvest) or after harvest. Extensive water loss can lead to berry shatter, wilting of clusters and shriveling of the berries thereby affecting the quality and marketability of fruits. In such conditions, plant growth regulators play an important role in affecting physico-chemical changes in grapes during storage by influencing the protein synthesis and retarding senescence. This may prove useful in increasing the shelf life of grapes and relieving market congestion. Thus there is a need to improve the post-harvest quality of grape through pre-harvest growth regulator management. The present investigations were therefore carried out to standardise the growth regulator application for improving shelf life of grape cv Sahebi under temperate conditions of Kashmir valley.

MATERIALS AND METHODS

Present investigations were carried out at Model Grapevine orchard of Department of Horticulture at Kralbagh, Tehsil Lar, District Ganderbal (J and K) for two consecutive years. The experiment comprised of nine treatments viz., G_0 (control), G_1= Gibberellic acid @ 20 ppm, G_2 = Gibberellic acid @ 40 ppm, G_3 = 6-Benzyladenine @ 10ppm, G_4= 6-Benzyladenine @ 20 ppm, G_5= GA_3 @ 20 ppm + 6-BA @ 10 ppm, G_6= GA_3 @ 20 ppm + 6-BA @ 20 ppm, G_7 = GA_3 @ 40 ppm + 6-BA @ 10 ppm, G_8 = GA_3 @ 40 ppm + 6-BA @ 20 ppm which were sprayed at three stages i.e., S_1 = pre-bloom (single spray), S_2 = 3-4 mm berry size (single spray), S_3 = pre-bloom + 3-4 mm berry size (double superimposed spray) replicated thrice with double plot size in a completely Randomized Block Design. Fresh spray solutions of GA_3 and 6-BA were prepared just before use. A stock solution of 100 ppm GA_3 was prepared by dissolving 100 mg of the chemical in few ml of 95 % methyl alcohol and volume was raised to 1000 ml with water. Similarly for 6-BA, a stock solution of 100 ppm was prepared by dissolving 100 mg of the chemical in few ml of HCl (0.01 %) and volume raised to 1000 ml with distilled water. From these respective stock solutions, the desired strength of spray solution was prepared by diluting with water to which Tween-20 (surfactant) was added to facilitate effective absorption.

The observations on physiological loss in weight (%), berry shatter (%), TSS (°B), acidity (%), TSS/acid ratio and juice (%) were recorded after 5-10 days of ambient storage period.The per cent loss in weight after each interval of ambient storage was calculated by subtracting final weight from the initial weight of the fruits. Berry shatter (%) was calculated on the number basis by counting the number of shattered berries in comparison to the total number of berries. Freshly extracted juice of fifty randomly selected berries was strained through muslin cloth, stirred and a drop of it was placed on the hand refractometer and the TSS was calculated.Titrable acidity was estimated by titrating a known quantity of homogenized juice against 0.1N NaOH solution using phenolphthalein as indicator (AOAC 1990) and was expressed in terms of tartaric acid. Fruit juice percentage was measured as per the method described by Mazumdar and Majumder (2003). The data generated were subjected to statistical analysis as per the procedures described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Application of growth regulators significantly influenced all the studied characters after 5 -10 days of ambient storage period. However the stage of application and its interaction with the application of growth regulators did not significantly affected the storability studies after 5 - 10 days of ambient storage.

Minimum physiological loss in weight after 5 -10 days of ambient storage was recorded with the application of GA_3 @ 40 ppm + 6-BA @ 10 ppm (3.79 and 9.06%) and (4.30 and 9.29 %) during the both the years of study, respectively which was statistically at par with G_8 treatment i.e. GA_3 @ 40 ppm + 6-BA @ 20 ppm (Table 1). Maximum physiological loss in weight

Table 1. Effect of foliar application of growth regulators at different stages on physiological loss in weight (PLW) and berry shatter (%) after 5 -10 days in ambient storage of grape cv Sahebi.

Treatments	Physiological loss in weight (%)				Berry shatter (%)			
	1st year		2nd year		1st year		2nd year	
	5	10	5	10	5	10	5	10
Control	5.97	13.80	6.42	13.87	2.75	6.57	2.88	6.72
GA_3 @ 20 ppm	4.21	10.66	4.63	12.21	2.04	4.28	2.24	4.56
GA_3 @ 40 ppm	3.95	10.51	4.42	10.52	2.06	4.41	2.21	4.70
6-BA @ 10 ppm	5.38	11.45	5.82	11.85	2.13	4.64	2.43	4.87
6-BA @ 20 ppm	4.28	11.52	5.73	11.93	2.18	4.52	2.48	4.76
GA_3 @ 20 ppm + 6-BA @ 10 ppm	4.01	9.64	4.45	10.47	1.71	4.18	2.13	4.40
GA_3 @ 20 ppm + 6-BA @ 20 ppm	4.08	10.60	4.52	10.43	1.78	4.19	2.10	4.49
GA_3 @ 40 ppm + 6-BA @ 10 ppm	3.79	9.06	4.30	9.29	1.68	3.78	2.05	4.13
GA_3 @ 40 ppm + 6-BA @ 20 ppm	3.84	9.17	4.37	9.38	2.00	3.91	2.24	4.29
$CD_{0.05}$	0.06	0.11	0.10	0.13	0.06	0.21	0.04	0.18

was recorded under control after 5 -10 days of storage during both the year of study. This reduction in physiological loss in weight might be attributed to the role of GA_3 in reducing the transpiration rate and 6-BA in delaying the tissue senescence. The present results are in the accordance with the findings of Patil *et al.* (2006), Marzouk and Kassem (2011). Berry shatter after 5 -10 days of ambient storage was recorded to be minimum in the treatment G_7 i.e. GA_3@ 40 ppm + 6-BA @ 10 ppm) (1.68 and 2.05 %) and (3.88 and 4.13 %) during the two years, respectively (Table 1). During both the year of study, treatment G_7 was statistically at par with treatment G_8 (GA_3 @ 40 ppm + 6-BA @ 20 ppm) after 10 days of storage of fruit under ambient conditions. During both the year of study, maximum berry shatter was recorded under control after 5 -10 days of ambient storage. The increased pedicel thickness and better berry adherence due to the application of GA_3 and 6-BA might have resulted in reduced berry shatter. GA_3 inhibits ethylene and ABA biosynthesis, inactivates the activity of cellulase and polygalacturonase and delay the development of abscission layer. Cytokinins also play an important role in controlling the formation of ABA and increase the activity of auxins. These results are in agreement with the findings of Ladniya (1982).

Maximum total soluble solids (18.05 °B) after 5 days of ambient storage was recorded when $GA_3$was applied @ 40 ppm + 6-BA @ 10 ppm during the first year of study which was statistically higher among all the treatments however after 10 days of storage treatment G_7 i.e. GA_3 @ 40 ppm + 6-BA @ 10 ppm

Table 2. Effect of foliar application of growth regulators at different stages on TSS (°B) and acidity (%) after 5 - 10 days in ambient storage of grape cv Sahebi.

Treatments	TSS (°B)				Acidity (%)			
	1st year		2nd year		1st year		2nd year	
	5	10	5	10	5	10	5	10
Control	16.53	17.48	16.87	17.82	0.57	0.55	0.59	0.56
GA_3 @ 20 ppm	17.54	18.28	17.82	18.60	0.51	0.48	0.53	0.50
GA_3 @ 40 ppm	17.53	18.25	17.93	18.69	0.52	0.49	0.53	0.51
6-BA @ 10 ppm	17.24	18.02	17.65	18.41	0.53	0.50	0.55	0.51
6-BA @ 20 ppm	17.39	18.15	17.71	18.50	0.52	0.49	0.54	0.51
GA_3 @ 20 ppm + 6-BA @ 10 ppm	17.79	18.50	18.16	18.84	0.51	0.48	0.52	0.49
GA_3 @ 20 ppm + 6-BA @ 20 ppm	17.67	18.40	18.02	18.79	0.51	0.48	0.52	0.50
GA_3 @ 40 ppm + 6-BA @ 10 ppm	18.05	18.72	18.38	19.05	0.50	0.47	0.51	0.48
GA_3 @ 40 ppm + 6-BA @ 20 ppm	17.92	18.61	18.40	19.09	0.50	0.47	0.52	0.49
$CD_{0.05}$	0.10	0.20	0.14	0.19	NS	NS	NS	NS

Table 3. Effect of foliar application of growth regulators at different stages on TSS/acid ratio and juice content (%) after 5 and 10 days in ambient storage of grape cv Sahebi.

Treatments	TSS/acid ratio				Juce content (%)			
	1st year		2nd year		1st year		2nd year	
	5	10	5	10	5	10	5	10
Control	29.00	31.78	28.59	31.82	58.15	51.27	52.15	58.38
GA_3 @ 20 ppm	34.28	38.06	33.65	37.25	61.59	55.69	56.63	62.41
GA_3 @ 40 ppm	34.13	37.70	33.76	37.12	62.30	56.55	57.30	62.88
6-BA @ 10 ppm	32.82	36.36	32.40	35.86	59.93	53.69	56.43	62.26
6-BA @ 20 ppm	33.35	37.14	32.99	36.30	61.81	55.97	54.57	60.24
GA_3 @ 20 ppm + 6-BA @ 10 ppm	35.33	38.98	34.88	38.36	61.94	56.31	56.41	62.24
GA_3 @ 20 ppm + 6-BA @ 20 ppm	34.80	38.52	34.46	38.02	61.30	55.39	56.34	62.11
GA_3 @ 40 ppm + 6-BA @ 10 ppm	36.11	40.19	35.91	39.54	62.64	56.77	57.54	63.45
GA_3 @ 40 ppm + 6-BA @ 20 ppm	35.72	39.71	35.60	39.02	61.65	55.67	56.33	61.88
$CD_{0.05}$	0.78	1.24	0.12	1.12	0.15	0.12	0.21	0.17

(18.72°B) was statistically at par with treatment G_8 i.e., GA_3@ 40 ppm + 6-BA @ 20 ppm (18.61°B) (Table 2). During the second year of study, treatment G_8 (GA_3@ 40 ppm + 6-BA @ 20 ppm) recorded maximum total soluble solids (18.40 and 19.09 °B) after 5 -10 days of storage, respectively which were statistically at par with treatment G_7 i.e., GA_3@ 40 ppm + 6-BA @ 10 ppm (18.38 and 19.05 ^{0}Brix), respectively. Minimum total soluble solids was recorded under control after 5 -10 days of storage during both the year of study. This improvement in TSS might be due to the enhanced photosynthetic efficiency of the leaves as a result of increased leaf area and a possible increase in the translocation of assimilates with the application of GA_3 and 6-BA (Mostafa1989). The increase in TSS may be associated with increased translocation of organic assimilates from leaves in response to hormonal stimulation. These findings are in conformity with Duane (2001), Liu (2002), Marzouk and Kassem (2011), El-Gendy *et al.* (2012).

The data pertaining to berry acidity after 5-10 days of ambient storage was not appreciably influenced by the application of growth regulators (Table 2). G_7 (GA_3 @ 40 ppm + 6-BA @ 10 ppm) and G_8 (GA_3 @ 40 ppm + 6-BA @ 20 ppm) treatment recorded minimum acidity (0.50 and 0.47 %) after 5-10 days of ambient storage during the first year of study whereas in the second year, after 5-10 days of storage minimum acidity (0.51 and 0.48 %, respectively) was recorded in treatment G_7 (GA_3 @ 40 ppm + 6-BA @ 10 ppm). The non-significant decrease in acidity due to growth regulator application has also been reported by Siddiqui and Chakrawar (1980), Daulta (1982) and Sandhu *et al.* (1985). The decrease in acidity percentage of juice accompanied by increased accumulation of total soluble solids content indicates chemically mediated degradation of starch and metabolism of organic acids into soluble sugars. Abdul *et al.* (1998), Reynolds and Savigny (2004), El-Gendy *et al*. (2012) also reported similar results while working on Fujiminon, Sovereign Coronation and Thompson Seedless grapes, respectively.

Maximum TSS/acidity ratio after five (36.11 and 40.19) and ten (35.91 and 39.54) days of ambient storage was registered in G_7 treatment (GA_3 @ 40 ppm + 6-BA @ 10 ppm) during both the years of study, respectively which was statistically at par with the treatment G_8 treatment (GA_3@ 40 ppm + 6-BA @ 20 ppm). The increased TSS/acid ratio may be due to maximum total soluble solids and minimum acidity recorded in the treatments. The present results are in conformity with the findings of Tambe (2001), El-Gendy *et al*. (2012).

After 5 -10 days of ambient storage, the maximum juice content (62.64 and 56.77%) and (63.45 and 57.54%) was obtained when the fruits were procured for storage from the plants sprayed with GA_3@ 40 ppm + 6-BA @ 10 ppm during both the years, respectively which were statistically higher among all the treatments (Table 3). Minimum juice content was recorded under control after 5 -10 days

of storage during both the year of study. This may be due to minimum physiological loss in weight recorded in this treatment. The result of the present study with respect to juice content is in conformity with the findings of Fidelibus *et al.* (2002), Khalid *et al.* (2012).

Combined application of the growth regulators GA_3 @ 40 ppm + 6-BA@ 10 ppm both at pre-bloom stage and when berries were of 3-4 mm in size proved to be the best in improving the shelf life of grapes.

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