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Research Paper

Impact of pre-harvest growth regulators application on postharvest quality of grape cv. Sahebi

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ABSTRACT

The study was conducted on 23 years old Sahebi grape vines trained on bower system at model grapevine orchard of department of Horticulture, Kralbagh, Ganderbal for two consecutive years with the objective to standardise the application of growth regulators for improved shelf life. The experiment consisted of nine treatments viz. G_0 (control), G_1= Gibberellic acid (GA_3-20ppm), G_2 = Gibberellic acid (GA_3-40ppm), G_3 = 6-Benzyl adenine (BA) -10ppm, G_4= 6-Benzyl adenine (BA) -20ppm, G_5= GA_3 (20ppm)+ BA (10ppm), G_6= GA_3 (20ppm)+ BA (20ppm), G_7 = GA_3 (40ppm)+ BA (10ppm), G_8 = GA_3 (40ppm) + BA (20ppm) sprayed at 3 stages, S_1 = Pre-bloom (Single spray), S_2 = 3-4mm berry size (Single spray), S_3 = Pre-bloom + 3-4mm berry size (Double superimposed spray). Treatment combinations were replicated thrice with double plot size in a completely randomized block design. The results indicated that the minimum physiological loss in weight as well as berry shatter, highest total soluble solids (TSS), TSS/acid ratio and juice content after 5 and 10 days of ambient storage were recorded in treatment G_7 (GA_3-40ppm + BA-10ppm), during the two years thus enhanced the storability. The stage of growth regulator application and the interaction of growth regulators with of application had no significant influence on the storability of grape under ambient conditions during the two years.

Key words: Berry, grape, growth regulator, juice content, storability, TSS

Grape (*Vitis vinifera* L.) belonging to family Vitaceae 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. Grape cultivation is believed to have originated in Armenia near the Caspian Sea in Russia from where it seems to have spread westward to Europe and eastward to Iran and Afghanistan (Winkler *et. al.*, 1974). Grape is a non-climacteric fruit, in particular a berry, that grows on the perennial and deciduous woody vines of the genus *Vitis*. It is a refreshing fruit, rich in sugars, acids, minerals, vitamins and tannins. Major constituents of fruits are carbohydrates (12-18%), proteins (0.5-0.6%), fat (0.3-0.4%), minerals (0.2-0.6%), organic acids (0.3-1.5%), nitrogenous compounds (0.03-0.7%), iron (0.003-0.017%), calcium (0.004-0.025%), potassium (0.1-0.2%), phosphorous (0.08-0.01%), vitamin A (0.001-0.0015%), vitamin B complex (391-636 mg/100g) and vitamin C (1.0-12.5 mg/100 g) (Yadav *et.al.*, 2009). Tannins are present in skin and seeds of berries, which influence palatability of fruits and products. In 1997, Jang *et. al.*, discovered the chemical constituent, resveratrol in grapes that shows anti-carcinogenic activity and it has been proved to inhibit tumors by stopping DNA damage and slowing cell transformation from normal to cancerous state which in turn slows tumor growth. Resveratrol has anti-inflammatory properties and is very useful for colon cancer prevention and a wide variety of other tumors. Grapes can be eaten raw or they can be used for making jam, juice, jelly, vinegar, wine, grape seed extracts, raisins, molasses and grape seed oil. Grapes are also used in some kinds of confectionery.

Plant growth regulators e.g. gibberellins, cytokinins etc. 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 rachis enzymatic browning 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 vine yard (preharvest) 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. Plant growth regulators also 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. So, there is a need to improve the post-harvest quality of grape through pre-harvest growth regulator management. Hence the present investigation was carried out to standardise the growth regulator application for improved shelf life in grape cv. Sahebi

MATERIALS AND METHODS

This investigation was carried out to assess the influence of pre-harvest application of growth regulators on postharvest quality of grape cv. Sahebi under ambient conditions in model grapevine orchard of department of Horticulture at Kralbagh, Tehsil Lar District Ganderbal (34.23ºN 74.78ºE) (J&K) for two consecutive years (2018 and 2019). Nine treatments viz. G_0 (control), G_1= Gibberellic acid (GA_3- 20ppm), G_2 = Gibberellic acid (GA_3-40ppm), G_3 = 6-Benzyl adenine (BA) -10ppm, G_4= 6-Benzyl adenine (BA) -20ppm, G_5= GA_3 (20ppm)+ BA (10ppm), G_6= GA_3 (20ppm)+ BA (20ppm), G_7 = GA_3 (40ppm)+ BA (10ppm), G_8 = GA_3 (40ppm) + BA (20ppm) were applied at 3 stages, S_1 = Pre bloom (Single spray), S_2 = 3-4mm berry size (Single spray), S_3 = Pre bloom + 3-4mm berry size (Double superimposed spray) replicated thrice with double plot size in a completely randomized block design.

Spray solutions of GA_3 and BA were prepared just before use. In case of GA_3, a stock solution of 100 ppm was prepared by dissolving 100 mg of the chemical in small quantity of 95 per cent methyl alcohol and volume raised to 1000 ml with water. Similarly for BA, a stock solution of 100 ppm was prepared by dissolving 100mg of the chemical in few milliliters of 0.01% HCl and volume raised to 1000ml with distilled water. From the respective stock solutions, the desired strength of spray solution was prepared by diluting with water to which Tween-20 (0.05 %) (surfactant) was added to facilitate effective absorption.

The observations on physiological loss in weight (%), berry shatter (%), T.S.S (ºBrix), acidity (%), T.S.S/ acid ratio and juice (%) were recorded after 5 and 10 days of ambient storage period. The percent 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 with respect to the total number of berries. Freshly extracted juice of fifty randomly selected berries was strained through muslin cloth. It was thoroughly stirred and a drop of it was placed on the hand refractometer and the TSS reading was recorded in ºBrix. The readings were corrected at 20ºC with the help of temperature correction chart (A.O.A.C., 1990). Titratable acidity was estimated by titrating a known quantity of homogenized juice against 0.1N NaOH solution using phenolphthalein as indicator (A.O.A.C., 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 was subjected to statistical analysis as per the procedures described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Application of growth regulators significantly influenced physiological loss in weight (%), berry shatter (%), T.S.S (ºBrix), acidity (%), T.S.S/ acid ratio and juice (%) after 5 and 10 days of ambient storage period. However, the stage of application and its interaction with the application of growth regulators did not significantly affect the storability studies after 5 and 10 days of ambient storage.

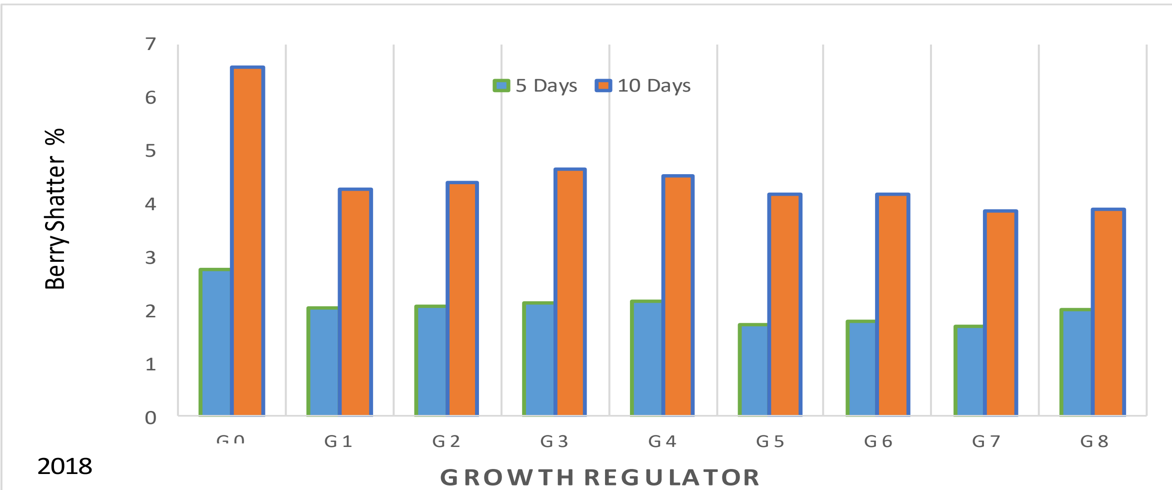
Minimum physiological loss in weight at 5 and 10 days of ambient storage was recorded as3.79 and 9.06 % during 1st year and 4.30 and 9.29% during 2nd year in the treatment G_7: GA_3-40 ppm + BA-10 ppm respectively (Table 1, Fig 1). This reduction in physiological loss in weight might be attributed to the role of GA_3 in reducing the transpiration rate and BA in delaying the tissue senescence. These results are in line with the findings of Patil *et al.* (2006) and Marzouk and Kassem (2011). Berry shatter after 5 and 10 days of ambient storage was recorded to be minimum in the treatment G_7: GA_3-40 ppm + BA-10 ppm (1.68 and 2.05%) and (3.88 and 4.13%) during consecutive years respectively (Table 1, Fig 2). The increased pedicel thickness and better berry adherence due to the application of GA_3 and BA might have resulted in reduced berry shatter. The growth regulator 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).

Table 1: Effect of foliar application of growth regulators at different stages on physical characteristics after 5 and 10 days in ambient storage of grape cv. Sahebi during the two years

Treatments	PLW (%) After 5 days		PLW (%) After 10 days		Berry shatter (%) After 5 days		Berry shatter (%) After 10 days	
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
G_0	5.97	6.42	13.80	13.87	2.75	2.88	6.57	6.72
G_1	4.21	4.63	10.66	12.21	2.04	2.24	4.28	4.56
G_2	3.95	4.42	10.51	10.52	2.06	2.21	4.41	4.70
G_3	5.38	5.82	11.45	11.85	2.13	2.43	4.64	4.87
G_4	4.28	5.73	11.52	11.93	2.18	2.48	4.52	4.76
G_5	4.01	4.45	9.64	10.47	1.71	2.13	4.18	4.40
G_6	4.08	4.52	10.60	10.43	1.78	2.10	4.19	4.49
G_7	3.79	4.30	9.06	9.29	1.68	2.05	3.88	4.13
G_8	3.84	4.37	9.17	9.38	2.00	2.24	3.91	4.29
$CD_{(0.05)}$	0.06	0.10	0.11	0.13	0.06	0.04	0.21	0.18
S_1	4.72	5.24	10.66	10.99	2.04	2.32	4.23	4.49
S_2	4.29	4.89	11.15	11.39	2.29	2.57	5.09	5.35
S_3	4.16	4.75	10.54	10.77	1.78	2.03	4.21	4.46
$CD_{(0.05)}$	NS	NS	NS	NS	NS	NS	NS	NS
G_0S_1	5.97	6.42	13.80	13.87	2.75	2.88	6.57	6.72
G_0S_2	5.97	6.42	13.80	13.87	2.75	2.88	6.57	6.72
G_0S_3	5.97	6.42	13.80	13.87	2.75	2.88	6.57	6.72
G_1S_1	4.80	5.25	11.51	11.77	2.15	2.46	3.52	4.60
G_1S_2	4.17	4.62	9.70	12.65	2.56	2.67	5.21	5.53
G_1S_3	3.65	4.02	10.77	11.57	1.42	1.58	4.12	3.55
G_2S_1	4.73	4.97	9.56	10.56	1.21	1.44	4.20	3.72
G_2S_2	3.26	3.77	11.40	9.60	2.50	2.62	5.35	5.59
G_2S_3	3.87	4.51	10.57	11.41	2.46	2.57	3.68	4.80
G_3S_1	5.50	5.84	12.62	11.90	2.21	2.48	4.62	4.00
G_3S_2	5.91	6.31	9.88	12.72	2.69	2.77	5.43	5.68
G_3S_3	4.72	5.30	11.85	10.93	1.48	2.05	3.87	4.92
G_4S_1	3.70	5.22	11.90	11.01	2.70	2.80	3.71	4.85
G_4S_2	4.32	5.70	11.75	11.97	1.53	2.16	5.40	5.62
G_4S_3	4.82	6.28	10.92	12.80	2.30	2.48	4.46	3.81
G_5S_1	3.89	4.51	10.23	9.57	1.62	2.46	3.33	4.43
G_5S_2	3.40	3.83	10.34	11.30	2.37	2.45	5.16	5.46
G_5S_3	4.75	5.02	8.34	10.55	1.14	1.49	4.06	3.30
G_6S_1	4.76	5.09	10.60	11.60	2.41	2.54	5.15	4.65
G_6S_2	3.97	4.57	9.72	10.00	1.78	2.39	3.30	3.31
G_6S_3	3.51	3.91	11.47	9.69	1.16	1.38	4.11	5.50
G_7S_1	4.55	4.91	9.97	9.26	1.95	2.29	3.06	4.21
G_7S_2	3.77	4.36	8.20	10.16	1.81	2.51	4.77	5.01
G_7S_3	3.06	3.62	9.02	8.45	1.27	1.36	3.81	3.17
G_8S_1	4.58	4.98	10.12	9.41	1.35	1.54	3.92	3.26
G_8S_2	3.83	4.43	8.2	10.24	2.63	2.71	4.61	5.22
G_8S_3	3.12	3.70	9.16	8.48	2.02	2.46	3.21	4.38
$CD_{(0.05)}$	NS	NS	NS	NS	NS	NS	NS	NS

Fig. 1: **Effect of foliar application of growth regulators at different stages on physiological loss in weight (PLW) after 5 and 10 days in ambient storage of grape cv. Sahebi during the to years**

G_0 (Control), G_1 (GA_3-20 ppm), G_2 (GA_3-40 ppm), G_3 (BA-10 ppm), G_4 (BA-20 ppm), G_5 (GA_3-20 ppm + BA-10 ppm), G_6 (GA_3-20 ppm + BA-20 ppm), G_7 (GA_3-40 ppm + BA-10 ppm), G_8 (GA_3-40 ppm + BA-20 ppm).



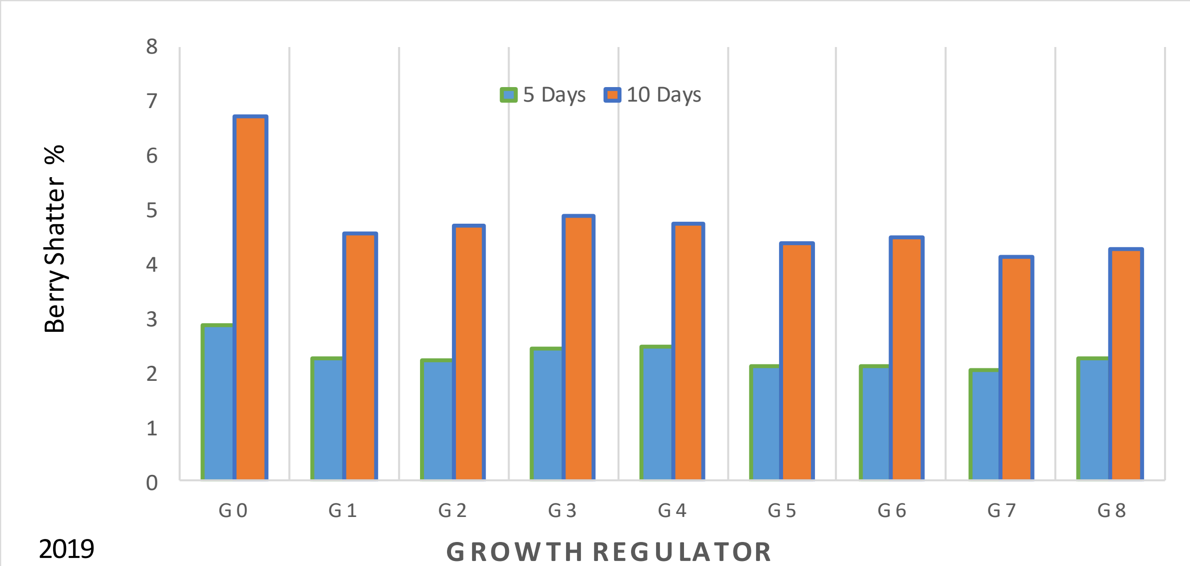
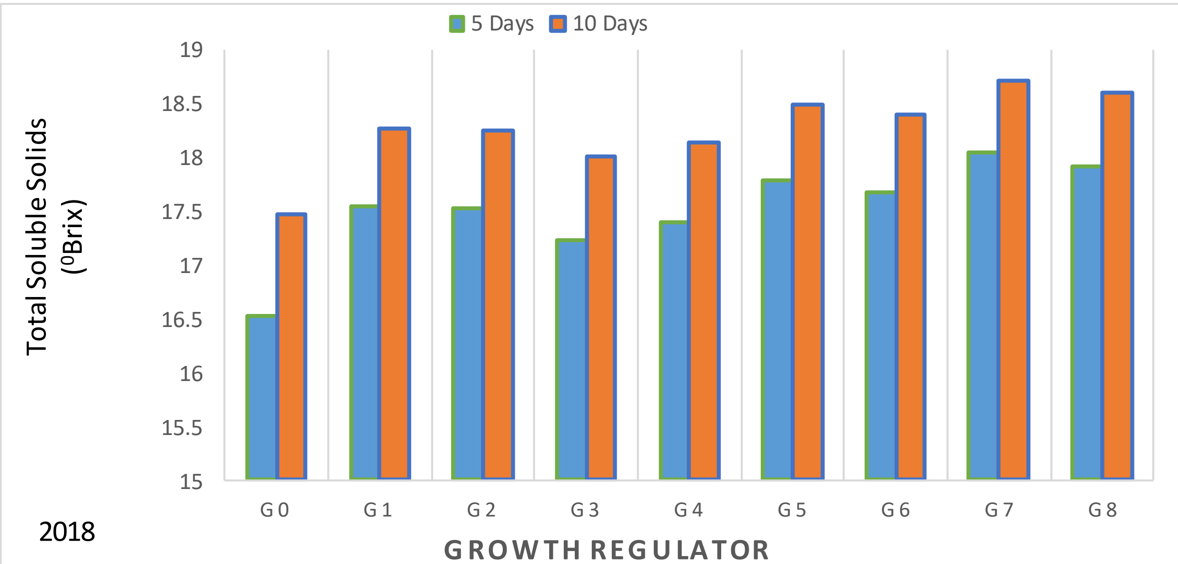


Fig. 2: Effect of foliar application of growth regulators at different stages on berry shatter after 5 and 10 days in ambient storage of grape cv. Sahebi during the two years

G_0 (Control), G_1 (GA_3-20 ppm), G_2 (GA_3-40 ppm), G_3 (BA-10 ppm), G_4 (BA-20 ppm), G_5 (GA_3-20 ppm + BA-10 ppm), G_6 (GA_3-20 ppm + BA-20 ppm), G_7 (GA_3-40 ppm + BA-10 ppm), G_8 (GA_3-40 ppm + BA-20 ppm)

The highest TSS (Table 2, Fig, 3) at 5 and 10 days of ambient storage was recorded in the treatment G_7: GA_3-40 ppm + BA-10 ppm (18.05 and 18.72 °Brix) during the 1st year and treatment G_8: GA_3-40 ppm + BA-20 ppm (18.40 and 19.09 ^{0}Brix) which was followed non significantly by treatment G_7: GA_3-40 ppm + BA-10 ppm (18.38 and 19.05 °Brix) during the 2nd year. 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 (Mostafa, 1989) and BA. The increase in TSS may be associated with increased translocation of organic assimilates from leaves in response to hormonal stimulation. These results are in line with Duane (2001), Liu (2002), Marzouk and Kassem (2011) and El-Gendy *et al*. (2012).



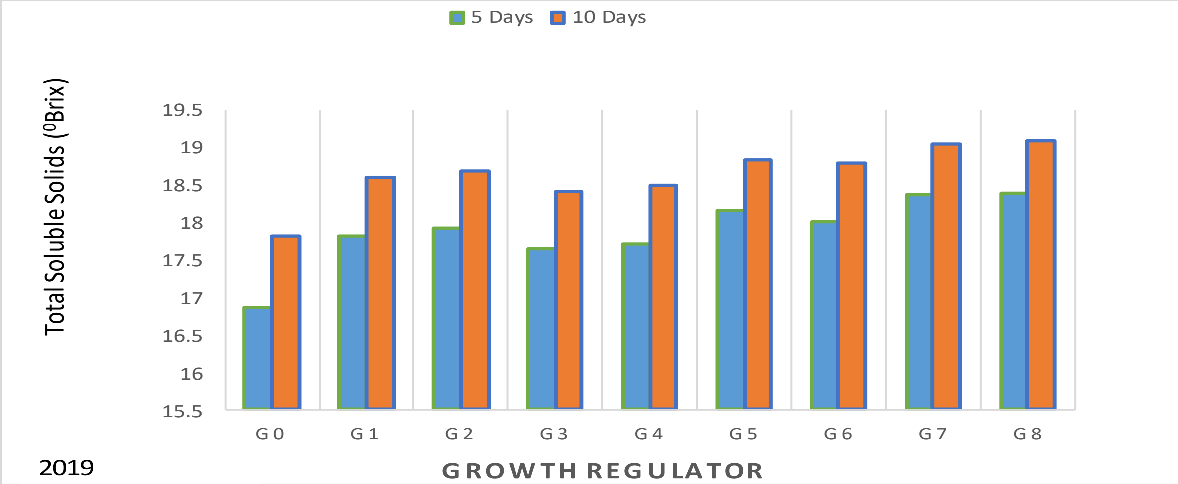


Fig. 3: **Effect of foliar application of growth regulators at different stages on TSS after 5 and 10 days in ambient storage of grape cv. Sahebi during the two years**

G_0 (Control), G_1 (GA_3-20 ppm), G_2 (GA_3-40 ppm), G_3 (BA-10 ppm), G_4 (BA-20 ppm), G_5 (GA_3-20 ppm + BA-10 ppm), G_6(GA_3-20 ppm+BA-20 ppm), G_7(GA_3-40 ppm+BA-10 ppm), G_8 (GA_3-40 ppm + BA-20 ppm

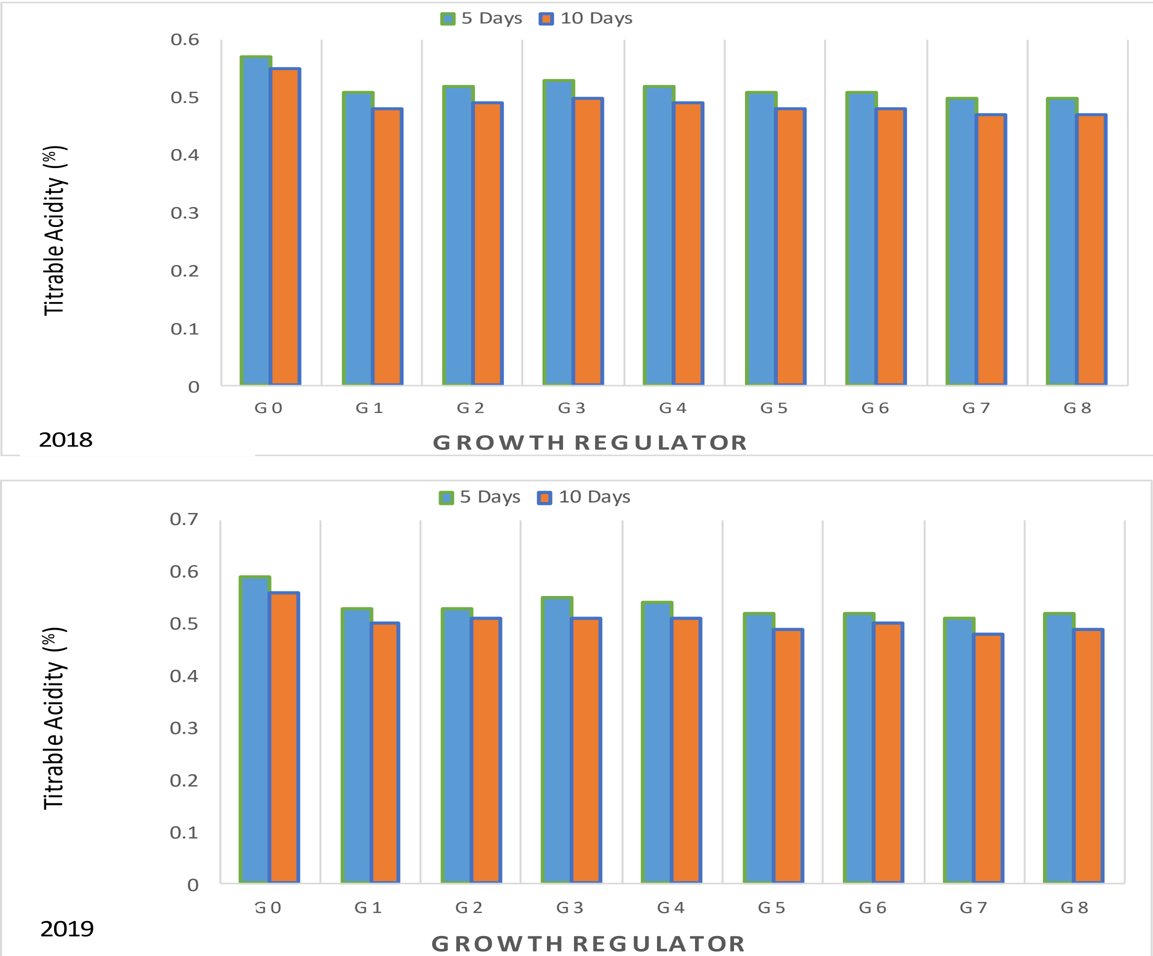


Fig. 4: **Effect of foliar application of growth regulators at different stages on titrable acidity after 5 and 10 days in ambient storage of grape cv. Sahebi during the two years**

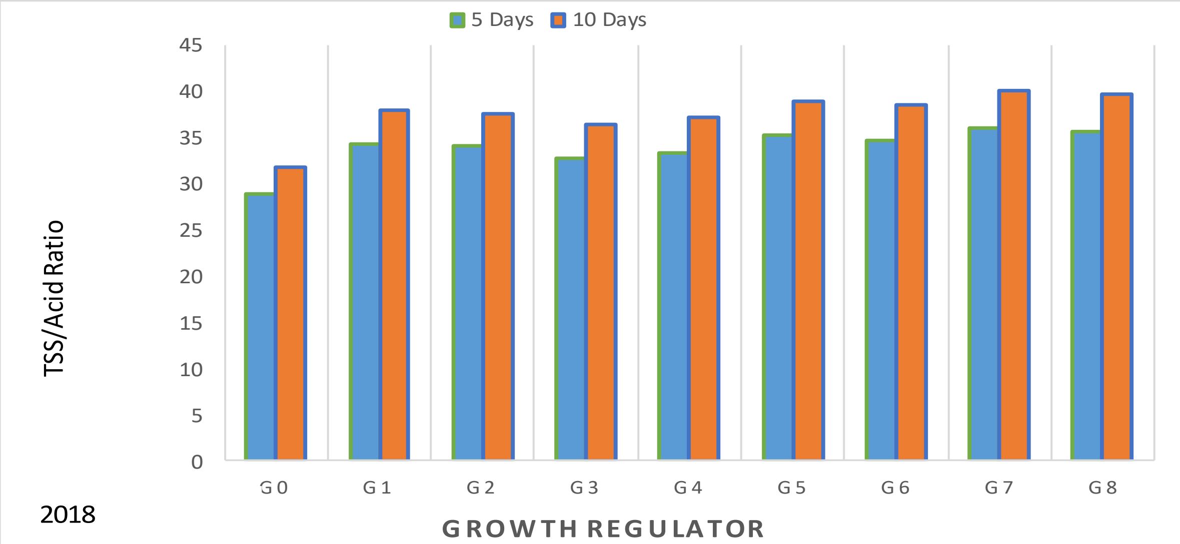
G_0 (Control), G_1 (GA_3-20 ppm), G_2 (GA_3-40 ppm), G_3(BA-10 ppm), G_4(BA-20 ppm), G_5 (GA_3-20 ppm+BA-10 ppm), G_6 (GA_3-20 ppm + BA-20 ppm), G_7 (GA_3-40 ppm + BA-10 ppm), G_8 (GA_3-40 ppm + BA-20 ppm)

Table 2: Effect of foliar application of growth regulators at different stages on total soluble solids and titratable acidity (%) after 5 and 10 days in ambient storage of grape cv. Sahebi during the two years

Treatments	Total soluble solids (ºBrix) 5 days interval		Total soluble solids (ºBrix) 10 days interval		Titratable acidity (%) 5 days interval		Titratable acidity (%) 10 days interval	
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
G_0	16.53	16.87	17.48	17.82	0.57	0.59	0.55	0.56
G_1	17.54	17.82	18.28	18.60	0.51	0.53	0.48	0.50
G_2	17.53	17.93	18.25	18.69	0.52	0.53	0.49	0.51
G_3	17.24	17.65	18.02	18.41	0.53	0.55	0.50	0.51
G_4	17.39	17.71	18.15	18.50	0.52	0.54	0.49	0.51
G_5	17.79	18.16	18.50	18.84	0.51	0.52	0.48	0.49
G_6	17.67	18.02	18.40	18.79	0.51	0.52	0.48	0.50
G_7	18.05	18.38	18.72	19.05	0.50	0.51	0.47	0.48
G_8	17.92	18.40	18.61	19.09	0.50	0.52	0.47	0.49
$CD_{(0.05)}$	0.10	0.14	0.20	0.19	NS	NS	NS	NS
S_1	17.12	17.61	17.91	18.41	0.53	0.55	0.50	0.52
S_2	17.33	17.80	18.12	18.58	0.53	0.54	0.49	0.51
S_3	18.11	18.23	18.78	18.93	0.50	0.52	0.47	0.49
$CD_{(0.05)}$	NS	NS	NS	NS	NS	NS	NS	NS
G_0S_1	16.53	16.87	17.48	17.82	0.57	0.59	0.55	0.56
G_0S_2	16.53	16.87	17.48	17.82	0.57	0.59	0.55	0.56
G_0S_3	16.53	16.87	17.48	17.82	0.57	0.59	0.55	0.56
G_1S_1	18.35	17.07	18.98	17.95	0.49	0.51	0.46	0.48
G_1S_2	16.74	18.51	17.56	19.19	0.54	0.55	0.50	0.52
G_1S_3	17.54	17.88	18.30	18.66	0.52	0.53	0.48	0.50
G_2S_1	16.65	17.18	17.48	18.03	0.54	0.56	0.52	0.54
G_2S_2	17.46	17.96	18.22	18.73	0.52	0.53	0.49	0.50
G_2S_3	18.47	18.65	19.05	19.32	0.49	0.51	0.45	0.48
G_3S_1	16.42	18.44	17.28	19.07	0.55	0.58	0.53	0.55
G_3S_2	17.22	17.71	18.00	18.52	0.53	0.54	0.50	0.51
G_3S_3	18.09	16.80	18.77	17.64	0.50	0.52	0.47	0.49
G_4S_1	16.57	16.88	17.42	17.77	0.55	0.57	0.52	0.54
G_4S_2	17.31	17.78	18.08	18.58	0.52	0.53	0.49	0.51
G_4S_3	18.30	18.46	18.96	19.14	0.50	0.52	0.46	0.49
G_5S_1	18.62	18.81	19.20	19.43	0.48	0.50	0.45	0.47
G_5S_2	16.92	17.39	17.75	18.22	0.53	0.54	0.50	0.52
G_5S_3	17.83	18.27	18.56	18.87	0.51	0.52	0.48	0.49
G_6S_1	16.77	18.08	17.58	18.84	0.54	0.55	0.50	0.52
G_6S_2	17.73	17.25	18.48	18.15	0.51	0.53	0.48	0.50
G_6S_3	18.52	18.72	19.14	19.37	0.48	0.50	0.45	0.47
G_7S_1	17.15	17.52	17.94	18.35	0.53	0.54	0.50	0.51
G_7S_2	18.08	18.32	18.78	18.94	0.51	0.52	0.47	0.49
G_7S_3	18.91	19.31	19.45	19.86	0.47	0.49	0.44	0.45
G_8S_1	17.03	17.65	17.83	18.46	0.53	0.54	0.50	0.51
G_8S_2	17.98	18.41	18.69	19.09	0.51	0.52	0.47	0.49
G_8S_3	18.76	19.13	19.32	19.71	0.47	0.49	0.44	0.47
$CD_{(0.05)}$	NS	NS	NS	NS	NS	NS	NS	NS

The data pertaining to acidity after 5 and 10 days of ambient storage was not significantly influenced by the application of growth regulators (Table-2, Fig-4). 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. These findings are in accordance with the results of Abdul *et al.* (1998), Reynolds and Savigny (2004) and El-Gendy *et al.* (2012).

Maximum TSS/acidity ratio at 5 and 10 days of ambient storage (Table 3, Fig 5) was registered in treatment G_7 : GA_3-40 ppm + BA-10 ppm (36.11 and 40.19) and (35.91 and 39.54) during the two years respectively. The increased TSS/acid ratio may be due to maximum TSS and minimum acidity recorded in this treatment. This is in conformity with the findings of Tambe (2001) and El-Gendy *et al*. (2012).



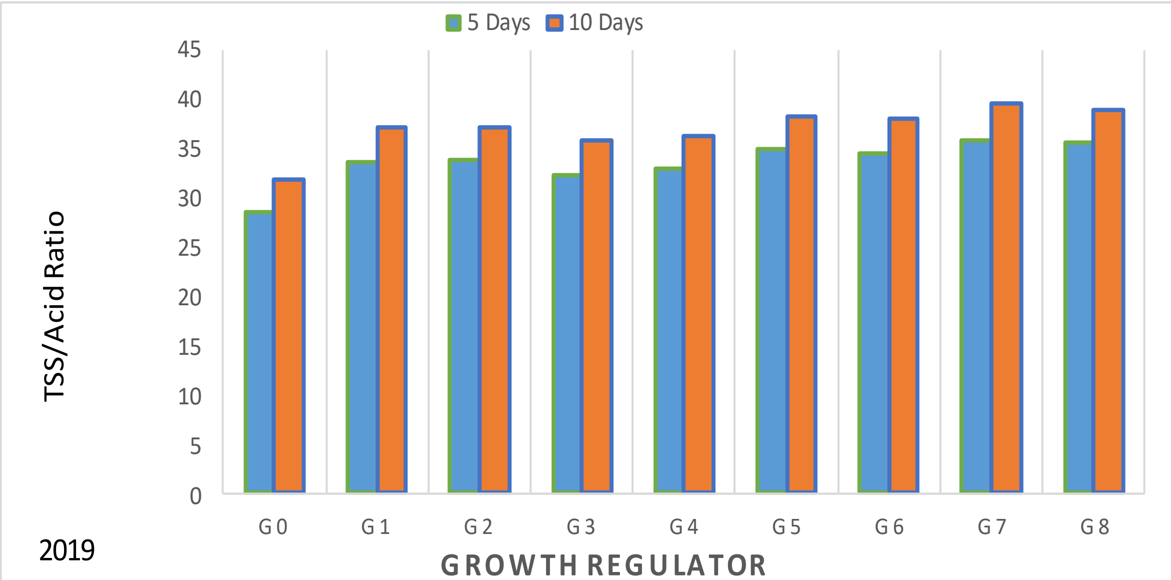


Fig. 5 : Effect of foliar application of growth regulators at different stages on TSS/acid ratio after 5 and 10 days in ambient storage of grape cv. Sahebi during the two year

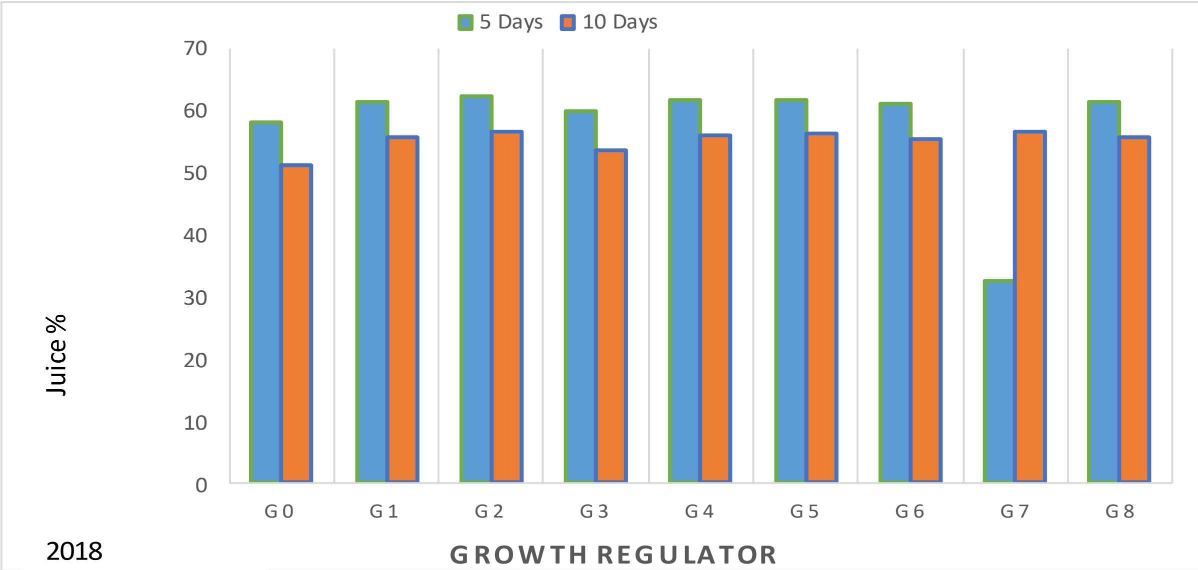
G_0 (Control), G_1 (GA_3-20 ppm), G_2 (GA_3-40 ppm), G_3 (BA-10 ppm), G_4 (BA-20 ppm), G_5 (GA_3-20 ppm + BA-10 ppm), G_6 (GA_3-20 ppm + BA-20 ppm), G_7 (GA_3-40 ppm + BA-10 ppm), G_8 (GA_3-40 ppm + BA-20 ppm)

After 5 and 10 days of ambient storage, the highest juice content (Table-3, Fig-6) was recorded with treatment G_7: GA_3-40 ppm + BA-10 ppm (62.64 and 56.77%) and (63.45 and 57.54%) during the two years respectively.

This may be due to minimum physiological loss in weight recorded in this treatment. These results were in conformity with the findings of Fidelibus *et al*. (2002) and Khalid *et al*. (2012).

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 during the two years**

Treatments	TSS/acid ratio 5 days interval		TSS/acid ratio 10 days interval		Juice (%) 5 days interval		Juice (%) 10 days interval	
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
G_0	29.00	28.59	31.78	31.82	58.15	58.38	51.27	52.15
G_1	34.28	33.65	38.06	37.25	61.59	62.41	55.69	56.63
G_2	34.13	33.76	37.70	37.12	62.30	62.88	56.55	57.30
G_3	32.82	32.40	36.36	35.86	59.93	62.26	53.69	56.43
G_4	33.35	32.99	37.14	36.30	61.81	60.24	55.97	54.57
G_5	35.33	34.88	38.98	38.36	61.94	62.24	56.31	56.41
G_6	34.80	34.46	38.52	38.02	61.30	62.11	55.39	56.34
G_7	36.11	35.91	40.19	39.54	32.64	63.45	56.77	57.54
G_8	35.72	35.60	39.71	39.02	61.65	61.88	55.67	56.33
$CD_{(0.05)}$	0.78	0.12	1.24	1.12	0.15	0.21	0.12	0.17
S_1	32.49	32.23	35.87	35.57	61.23	61.76	55.26	55.98
S_2	33.05	33.14	36.77	36.54	60.37	61.01	54.32	55.14
S_3	36.31	35.38	40.17	38.99	62.17	62.51	56.19	56.78
$CD_{(0.05)}$	NS	NS	NS	NS	NS	NS	NS	NS
G_0S_1	29.00	28.59	31.78	31.82	58.15	58.38	51.27	52.15
G_0S_2	29.00	28.59	31.78	31.82	58.15	58.38	51.27	52.15
G_0S_3	29.00	28.59	31.78	31.82	58.15	58.38	51.27	52.15
G_1S_1	37.67	33.33	41.53	37.16	63.32	62.42	57.54	56.53
G_1S_2	31.11	33.77	34.84	37.04	62.00	60.28	56.10	54.73
G_1S_3	34.05	33.86	37.80	37.54	59.45	64.52	53.42	58.63
G_2S_1	30.60	30.56	33.81	33.63	62.224	63.12	56.54	57.38
G_2S_2	33.70	33.88	37.33	37.23	60.31	60.63	54.58	55.12
G_2S_3	38.08	36.85	41.96	40.50	34.34	64.88	58.54	59.40
G_3S_1	29.69	31.62	32.35	34.92	58.72	61.72	52.50	55.81
G_3S_2	32.80	33.10	36.36	36.45	58.54	61.55	51.74	55.62
G_3S_3	35.96	32.49	40.36	36.22	62.53	63.50	56.83	57.87
G_4S_1	30.29	29.77	33.56	32.66	61.27	63.34	55.35	57.72
G_4S_2	33.16	33.35	36.82	36.79	62.77	58.65	57.16	52.74
G_4S_3	36.60	35.84	41.03	39.46	61.40	58.72	55.41	53.26
G_5S_1	39.11	37.77	42.85	41.51	63.83	64.70	58.27	58.72
G_5S_2	31.92	32.02	35.42	35.37	59.81	62.19	54.35	56.00
G_5S_3	34.96	34.86	38.66	38.19	62.18	59.82	56.32	54.52
G_6S_1	31.28	33.17	34.95	36.44	61.48	59.64	55.50	54.30
G_6S_2	34.62	32.85	38.26	36.59	59.24	62.31	53.28	56.27
G_6S_3	38.50	37.36	42.34	41.03	63.17	64.38	57.38	58.44
G_7S_1	32.54	32.56	36.16	36.05	62.35	63.25	56.75	57.55
G_7S_2	35.73	35.36	40.21	38.73	60.86	61.38	54.72	55.43
G_7S_3	40.06	39.81	44.20	43.84	64.72	65.72	58.83	59.63
G_8S_1	32.19	32.68	35.80	35.98	59.67	59.27	53.62	53.64
G_8S_2	35.39	35.33	39.93	38.80	61.66	63.73	55.67	58.23
G_8S_3	39.57	38.80	43.41	42.29	63.62	62.64	57.73	57.13
$CD_{(0.05)}$	NS	NS	NS	NS	NS	NS	NS	NS



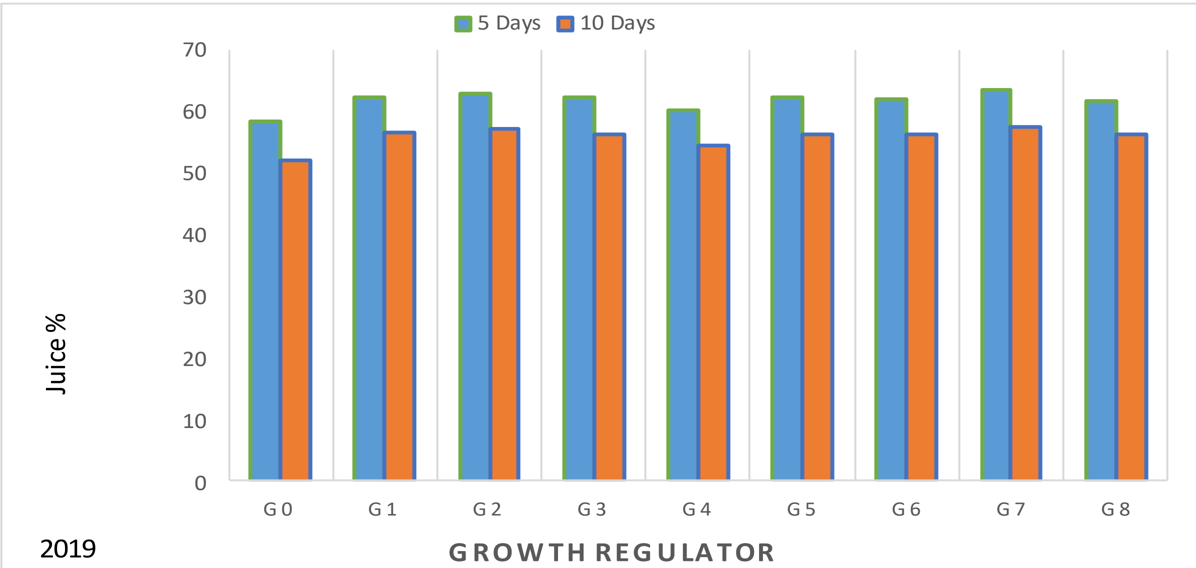


Fig. 6: Effect of foliar application of growth regulators at different stages on juice content after 5 and 10 days in ambient storage of grape cv. Sahebi during the two years

G_0 (Control), G_1 (GA_3-20 ppm), G_2 (GA_3-40 ppm), G_3 (BA-10 ppm), G_4 (BA-20 ppm), G_5 (GA_3-20 ppm + BA-10 ppm), G_6 (GA_3-20 ppm + BA-20 ppm), G_7 (GA_3-40 ppm + BA-10 ppm), G_8 (GA_3-40 ppm + BA-20 ppm)

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