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Effect of gibberellic acid on berry quality parameters of different grape varieties under northern dry zone of Karnataka

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Abstract
The field experiment was conducted to study the effect of gibberellic acid on different grape varieties under Northern dry zone of Karnataka during October 2017 to March 2018. Two different schedules of gibberellic acid treatment *viz.,* schedule-1 [10 ppm GA_3 at parrot green stage as spray+ 20 ppm GA_3 during 1 week of 1st spray as spray + 30 ppm GA_3 at 3-4 mm berry size stage as bunch dipping + 40 ppm GA_3 at 8-10 mm berry size stage as bunch dipping + 50 ppm GA_3 as bunch dipping during 1 week after 4th treatment] and schedule-2 [20 ppm GA_3 at anthesis stage as dipping + 50 ppm GA_3 at berry set stage as dipping] were applied to four different varities of grape *viz.,* Thompson seedless, Manik Chaman, KR White and 2-A Clone to determine the effect of gibberellic acid on berry physico-chemical properties in different varieties of grape. The results revealed that, maximum berry juice content (66.85 %), TSS (20.77 ^{0}Brix), Total sugars (19.36 %), Reducing sugars (18.22 %), Non reducing sugars (1.13 %) Ascorbic acid (3.71 mg/ 100g), and minimum Acidity (% 0.560) was recorded in the grapes treated with schedule-1 set of gibberellic acid treatment compared to that of schedule-2 set of gibberellic acid treatment.

Keywords: grape, gibberellic acid, dipping, schedule-1, schedule-2

Introduction
Grape (*Vitis vinifera*) is basically a sub- tropical crop. However, in India, grapes are cultivated for their excellence also under tropical conditions. In India, Grapes are cultivated in an area of 1.19 lakh ha with a production of 25.85 lakh tons and productivity of 21.1 tons/ha. Because of special arbour training systems provided for grape cultivation in India, productivity is highest among the grape growing countries of the world. In Karnataka, it is being cultivated in an area 19,000 ha and with the production 3, 20,000 MT (Anon., 2017) [1] and mainly growing in Northern dry zone of Karnataka especially in Vijayapuar and Bagalkot area.
Various production strategies are being practiced in grape cultivation to improve production and quality, which includes nipping, to avoid staggered growth of grape berries. NAA is used to reduce post harvest berry drop, uniform ripening can be achieved through ethrel treatment at berry set stage. Amongst all the growth regulators being used in grape production, gibberellins are much popular and attaining great importance because of its remarked effect. The response of grapes to gibberellin are influenced by many factors like variety, dosage, time, method of application, age of the plant, physiological condition of the plant and prevailing weather conditions during its application. Therefore, it enables to standardize the hormonal schedule for grape varieties in general and the varieties gaining much commercial significance such as Thompson Seedless, Manik Chaman, K R White, 2-A Clone in particular. This study will also standardize hormonal schedule under Northern dry zone of Karnataka as the effect of hormones depends on varieties, environmental parameters and physiological state of the plants.

Materials and Methods
The field experiment was carried out at Main Horticultural Research and Extension Centre, College of Horticulture, University of Horticultural sciences, Bagalkot., during October 2017 to March 2018 by employing four different varities *viz.,* Thompson seedless, Manik Chaman, KR White and 2-A Clone.

All the vines are five years old, fairly uniform in their growth and vigour. They were planted at a distance of 3 x 1.5 meters. The experiment was set up in a 4 x 2 Factorial randomized block design, (Facor-1 with 4 different varieties and factor-2 is 2 schedules of gibberellic acid treatment), with 4 replications so which comprises 8 Treatment combinations. Hence, the number of plots were 32 (factors interaction that is treatment combination x replication) and 3 vines were selected from each plot (factors interaction), so number of vines selected for this experiment was 96. The two schedules of gibberellic acid treatment was applied for the selected vines in all four varities. At the ideal stage of ripening (120 days after pruning), three bunches were harvested from each treatment separately and berries were selected randomly from each bunches for taking observations. The juice content of the berries was measured by squeezing of berries for juice and then ratio of juice and pulp was calculated and expressed as percentage of juice content in pulp, TSS was measured using digital refractometer; acidity measured by titrating against standard NaOH using Phenopthaline as an indicator. The ascorbic acid content of juice was determined by Dye (dichlorophenol indophenol) binding method; Total sugar content of grapes samples were estimated as described by Ranganna (1986) [2] using Fehling's solution. The reducing sugars in the juice were determined by Dinitro-Salicylic acid (DNSA) method (Miller, 1972) [3]. The percentage of non-reducing sugar was determined by subtracting the per cent reducing sugar from the per cent total sugar and multiplying the same with 0.95. (Somogyi, 1952) [4]. The data obtained from the experiment were statistically analyzed by using excel sheet and compared the means with critical difference (C.D. at 5 %).

Results and Discussions

Data on juice content (%) of berries as influenced by two different schedules of gibberellic acid viz., schedule-1 and schedule-2 are recorded in Table 1. As juice content (%) of the grapes was recorded maximum in the grapes treated with schedule-1 set of gibberellic acid treatment compared to that of in the grapes treated with schedule-2 set of gibberellic acid treatment. this increases in juice content of grapes treated with schedule-1 set of gibberellic acid might have attributed to higher pulp weight, this resulted in recovery of maximum juice content. Similar findings were observed by earlier investigation of those reported by Sharma and Singh (2009) [5] in strawberry cv. Chandler and also by Marzouk and Kaseem (2011) [6] in grape.

The observations of total soluble solids were recorded in Table-1. Significant differences were observed in the TSS (^{0}Brix) of the grapes treated with schedule-1 and schedule-2 treatments of gibberellic acid, as TSS was found maximum in the grapes treated with schedule-1 set of gibberellic acid treatment compared to that of in the grapes treated with schedule-2 set of gibberellic acid treatment**.** This increase of TSS due to application of gibberellic acid is attributed to accumulation of more carbohydrates. The possible reason for improvement in the amount of TSS content could be due to increased capacity of the grape berries to draw more carbohydrates through increased amount of auxin content directly or indirectly by quicker metabolic transformation of soluble compounds induced by gibberellic acid (Singh *et al.*, 1993) [7]. The similar results are also reported in earlier findings of those reported by Zahedi *et al.* (2013) [8] and Chaitakhob *et al*. (2014) [9] in Perlette variety of grape and by Sunita (2017) [10] in Crimson Seedless grape.

Data on acidity of berry juice as influenced by two different schedules of gibberellic acid *viz*, schedule-1 and schedule-2 are recorded in Table-1. As juice acidity (%) of berries was found minimum in the grapes treated with schedule-1 set of gibberellic acid treatment compared to that of in the grapes treated with schedule-2 set of gibberellic acid treatment. This decrease in berry juice acidity in schedule-1 set of gibberellic acidy than that of in schedule-2 gibberellic acid treatment is attributed to rapid transformation of acids into sugars, the reduction in amount acid content is attributed mainly to transformation of organic acids to sugars (Habibi, 2009) [11]. These findings are found in the same line as that of those reported by Taleb and Salameh (2012) [12] in Black Magic variety of grape and also by Dimovska *et al*. (2014) [13] in Flame Seedless variety of grape.

The observations on ascorbic acid content of berry juice as influenced by two different schedules of gibberellic acid *viz.*, schedule-1 and schedule-2 are recorded in Table-1. Ascorbic acid content of berry juice was found maximum in the grapes treated with schedule-1 set of gibberellic acid treatment compared to that of in the grapes treated with schedule-2 treatment of gibberellic acid. This increase in amount of Ascorbic acid content in the grapes treated with schedule-1 set of gibberellic acid than that of in the grapes treated with schedule-2 gibberellic acid treatment is might be attributed to stimulated actions of enzymes responsible for synthesis of ascorbic acid and its precursor (Glucose- 6-phosphate) and additive effect of slow rate of oxidation in respiration process (Orzorek and Angell, 1974) [14]. These findings are in close proximity with those reported by Singh *et al.* (1993) [7] in Perlette and Beauty Seedless cultivars grape and Begum *et al.* (2007) [15] found increased ascorbic acid content in berries of gibberellic acid treated grapes than that of untreated grapes.

The observations recorded on total sugars are tabulated in Table-1. Significant differences were observed between the grapes treated with schedule-1 and schedule-2 treatments of gibberellic acid, as total sugars (%) was found maximum in the grapes treated with schedule-1 set of gibberellic acid treatment than that of in grapes treated with schedule-2 set of gibberellic acid treatment. Similar results of increased total sugars due to application of gibberellic acid are also reported in earlier works of those reported by Rusjan (2010)[16] in Cardinal and Michele Palieri varieties of grape and by Dimovska *et al*. (2011) [13] with treatment during before flowering, after flowering and before veraison stage in Thompson Seedless and Belgrade varieties of grapes.

Significant differences were observed between the grapes treated with schedule-1 and schedule-2 treatments of gibberellic acid (Table-1). Reducing sugar (%) was found maximum in the grape treated with schedule-1 set of gibberellic acid treatment compared to that of in the grapes treated with schedule-2 set of gibberellic acid treatment. Similar results are reported by Ahmad *et al.* (2005) with girdling + dipping of bunches in Perlette grape variety; Gowda *et al*. (2006) [17] in berries of Thompson Seedless grape variety and by Begum *et al.* (2007) [15] with 50 ppm GA_3 in grape (*Vitis vinifera* L.) when compared to control.

The observations of non reducing sugars are recorded in Table-1. Significant differences were observed in the grapes treated with schedule-1 and schedule-2 treatments of gibberellic acid, as non reducing sugar (%) was recorded maximum in the grapes treated with schedule-1 set of gibberellic acid treatment compared to that of in the grapes treated with schedule-2 set of gibberellic acid treatment, these results are found in close proximity with those reported by

Gowda *et al*. (2006) [17] in berries of Thompson Seedless grape variety.

The increase in reducing, non-reducing and total sugars might be attributed to sequence of application of maximum number of gibberellic acid treatment at different concentration helps to the conversion of carbohydrates or starch and acids into sugars in addition to continuous movement of sugars from leaves to berries (Singh *et al*., 1993) [7].

Table 1: Berry quality parameters of different grape varieties as influenced by different Schedules of gibberellic acid treatment

Varieties (V)	Juice content (%)			TSS (^{0}Brix)			Acidity (%)			Ascorbic acid (mg/ 100g)		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
V_1	68.02	65.75	66.88	21.01	19.03	20.02	0.550	0.580	0.570	3.78	3.65	3.71
V_2	67.52	65.18	66.35	22.12	20.55	21.33	0.540	0.570	0.550	3.87	3.73	3.8
V_3	66.37	64.16	65.26	20.53	19.02	19.77	0.570	0.590	0.580	3.65	3.54	3.59
V_4	65.51	63.44	64.47	19.43	18.27	18.85	0.580	0.600	0.590	3.57	3.47	3.52
Mean	66.85	64.32		20.77	19.21		0.560	0.580		3.71	3.59	
For comparing means of	S.Em ±		C.D. at 5 %	S.Em ±		C.D. at 5 %	S.Em ±		C.D. at 5 %	S.Em ±		C.D. at 5 %
Varieties (V)	0.35		1.02	0.26		0.76	0.003		0.008	0.02		0.04
Schedules (S)	0.25		0.72	0.18		0.54	0.002		0.006	0.01		0.03
Vx S	0.49		NS	0.37		NS	0.004		NS	0.02		NS

NS- Non Significant, V_1- Thompson Seedless, V_3- K R White
S_1- Schedule-1, V_2- Manik Chaman, V_4- 2-A Clone, S_2- Schedule-2

Table 2: Contd…..

Varieties (V)	Total sugars (%)			Reducing sugars (%)			Non reducing sugars (%)		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
V_1	19.72	18.52	19.12	18.56	17.39	17.97	1.27	1.14	1.02
V_2	20.41	19.28	19.84	19.27	18.24	18.75	1.14	1.02	1.08
V_3	19.18	18.10	18.64	17.98	17.06	17.52	1.06	1.03	1.04
V_4	18.15	17.20	17.67	17.08	16.19	16.63	1.06	1.03	1.04
Mean	19.36	18.27		18.22	17.22		1.13	1.05	
For comparing means of	S.Em ±		C.D. at 5 %	S.Em ±		C.D. at 5 %	S.Em ±		C.D. at 5 %
Varieties (V)	0.15		0.45	0.15		0.45	0.04		0.10
Schedules (S)	0.11		0.32	0.11		0.32	0.03		0.07
Vx S	0.21		NS	0.22		NS	0.05		NS

NS- Non Significant, V_1- Thompson Seedless, V_3- K R White
S_1- Schedule-1, V_2- Manik Chaman, V_4- 2-A Clone, S_2- Schedule-2

Conclusion

The maximum berry Juice, TSS, Total sugar, Reducing sugar, Non- reducing sugar, Ascorbic acid and minimum acidity of berries was recorded in the grapes treated with schedule-1 set of gibberellic acid treatment compared to that of the grapes treated with schedule-2 treatment of gibberellic acid and among the varities Manik Chaman was found superior followed by Thompson Seedless compared to other two varities.

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