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EFFECT OF GA_3 IN COMBINATION WITH UREA PHOSPHATE AND BA ON YIELD AND PHYSICAL QUALITY PARAMETERS OF GRAPE CV. THOMPSON SEEDLESS

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ABSTRACT
Effect of GA_3 in combination with Urea Phosphate and BA on yield and quality parameters of grape cv. Thompson Seedless was evaluated. GA_3 in combination with Urea Phosphate and BA at different concentrations were applied at two stages that were pre bloom and berry set. Among all the treatments, application of GA_3 @ 30 ppm at prebloom and 30 ppm GA_3 + 10 ppm BA at berry set stage and 40 ppm at pre bloom and 30 ppm GA_3 + 10 ppm BA at berry set stage, effectively improved fruit physical parameters such as bunch weight (570.87 g), number of berries per bunch (166), berry length (2.43 cm), berry breadth (1.90 cm), berry weight (3.41g) and yield (21 kg/vine). The data from this study indicated that GA_3 along with Urea phosphate and BA influence the yield and quality of grape cv. Thompson Seedless

INTRODUCTION

Thompson Seedless multipurpose variety is good for both table and raisin making and grown commercially in the country. It is a mid season and uniform ripening cultivar and produces white, small to medium and oval seedless berries. They have a soft skin and a firm juicy pulp with the pleasant flavor. The berries are yellowish green to golden yellow when fully ripe. Inspite of such qualitative attributes, it suffers from major problems such as small berry size, bunch size and poor yield as compared to other cultivars. This necessitates the use of modern production technologies as means of improving yield and berry quality. Among the various practices application of plant growth regulators are the most important factor for quality grape production. The plant growth regulators acts as messengers and needed in small quantities at low concentrations for altering the growth and metabolism. Gibberellic acid (GA_3) applied at fruit set is used extensively to increase the berry size of seedless grapes. It primarily affect growth by controlling cell elongation and division, which is reflected on yield and its components and fruit quality of various grape cultivars (Omer and El Morsey, 2000 & Omer and Girgis, 2005). Use of GA_3 sprays at anthesis which reduces the number of flowers that set and then an additional GA_3 spray shortly thereafter which will increase berry size (Rooper and Wiilliams, 1989). GA_3 when used with the addition of urea phosphate enhanced the effect on berry size (Shulman *et al*., 1987). Cytokinins (BA) and cytokinin like substances promote cell division and increase cell expansion along the lateral axis and increase the berry size (Krishna moorthy, 1981). BA increased berry size and weight in Thompson Seedless grapes (Vlachakis *et al*., 1996).

This work was aimed to find out the optimum concentration of GA_3 in combination with urea phosphate and BA for improving yield and quality of grapes cv. Thompson Seedless.

MATERIALS 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 years-old vines of grape cultivar 'Thompson Seedless' trained on telephone system were selected. There were 33 vines 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 i.e. pre-bloom and berry set.

Treatments details

Measured parameters

Bunch and berry physical parameters such as bunch length was measured from the apex to base with the help of vernier calliper, bunch breadth was measured at a point of maximum spread by using vernier calliper and berry length and berry breadth were derived by averaging the 60 berries randomly from each treatment and measured using vernier calliper and the mean length and breadth per berry was expressed in

Treatments	Concentration of chemical and crop stage 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

centimeters. Bunch weight was derived by averaging the weight of 3 bunches randomly from each treatment and was expressed in grams per bunch. Bunch weight was recorded using weighing balance. Number of berries counted from selected three bunches in each replication and average no .of berries per bunch were calculated. Number of bunches per vine was counted in each replication and average number of bunches per vine was calculated. The weight of sixty berries was taken on top pan electronic balance and mean weight was expressed in grams and Yield per vine was calculated by taking weight of all the grape bunches harvested per vine by using a weighing balance and expressed as kg/vine.

Experimental design and statistical analysis

The experiment design was a randomized complete block design (RCBD), with a single grapevine as an experimental unit with 11 treatments and replicated thrice. The data recorded was statistically analysed as per method described by 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 (C.D) at 5 per cent level of significance.

RESULTS AND DISCUSSION

Bunch length

Bunch length was significantly increased by all the treatments over control. Maximum bunch length (28.22cm) was observed with 40 ppm GA_3 applied at pre-bloom stage and again at berry set stage (T_7). The minimum bunch length (22.30cm) was recorded in control. This increase in bunch length might be due to pre-bloom applications of GA_3. Which promotes the elongation of rachis by cell elongation and cell expansion and increased concentration of GA_3 causes the increased bunch length (Prasad and Kumar, 1998). Similar findings have been reported by Shehata and El-Barbary (1996), Tambe (2001) and Warusavitharana *et al*. (2008).

Bunch breadth

All the bio regulator treatments significantly increased the bunch breadth over control. Highest bunch breadth (14.15cm) was recorded with 40 ppm GA_3 applied at pre-bloom and again 30 ppm GA_3 at berry set stage (T_6). Lowest bunch breadth (11.43cm) was recorded under control. This increase in bunch breadth might be due to pre-bloom application of GA_3. This promotes the elongation and expansion of the rachis to provide larger frame work for the grape cluster. Increased concentration of GA_3 causes the increased bunch breadth (Prasad and Kumar, 1998). These might be the reasons for increased bunch breadth in the present study. These results coincide with the findings of Singh *et al*. (1994), Pandita (1995), Tambe (2001) and Warusavitharana *et al*. (2008).

Bunch weight

Vines treated with 30 ppm GA_3 at pre-bloom stage and again 30 ppm GA_3 along with 10 ppm BA at berry set stage (T_5) had the highest bunch weight (570.87g), whereas lowest bunch weight (325.22g) was recorded in control. Increased bunch weight might be due to increase in berry weight, bunch size and number of berries per bunch with these treatments and may also be related with proper nutritional supply to the developing bunches associated with higher photosynthetic capacity, translocation of photosynthates to the bunches. Enhanced translocation of photosynthates and nutrients into treated site by the application of BA was also reported by Huang *et al*. (2002). Gibberellic acid increases the fruit weight (Mclaughlin and Greene, 1984) and urea phosphate enhances the action of GA_3 (Shulman *et al*., 1987). Present results are in conformity with the findings of Tambe (2001), Liu (2002), Warusavitharana *et al*. (2008), Meena *et al*. (2012), Khot *et al*. (2015) and Ramteke and Khot (2015).

Number of berries per bunch

Number of berries per bunch was significantly increased by all the treatments as compared to control. T_5 (30 ppm GA_3 applied at pre-bloom stage + 30 ppm GA_3 along with 10 ppm BA at berry set stage) had the maximum number of berries (166.00) per bunch which was statistically at par (165.33) with T_3 (30 ppm GA_3 applied at pre-bloom stage + 30 ppm GA_3 along with 1000 ppm urea phosphate at berry set stage). However, bunches from control vines had the lowest number of berries per bunch (133.67). The increased number of berries might be due to increased fruit set and decreased fruit drop with these treatments. Positive effects of combined application of GA_3 with BA on higher berry setting were also observed by Liu (2002) and Stephen *et al*. (2003). Application of 6-BA reduces the berry drop due to enhanced pedicel thickness (Ramteke *et al*., 2002). Liu (2002) showed that combined application of BA and GA_3 increased fruit set. Motomura and Hori (1978) reported that BA in combination with GA_3 was effective in development of the pistils. Huang *et al*. (2002) reported that application of 6-BA increased fruit set in grapes. The results obtained under the present investigation are also supported with the findings of Tambe (2001) in Thompson Seedless grapes by the application of GA_3, Liu (2002) in Fujiminori grapes with the combined application of 6-BA + GA_3 and Warusavitharana *et al*. (2008) in Thompson Seedless grapes by the combined application of GA_3 + BA + Brassinosteroid.

Number of bunches per vine

Number of bunches per vine was not influenced by the bio regulator treatments. However, more number of bunches per vine (39) was recorded in the treatment T_6 (40 ppm GA_3 applied

Table 1: Effect of GA_3, Urea phosphate and BA on physical parameters of grape cv. Thompson Seedless

Treat ments	Bunch length (cm)	Bunch breadth (cm)	Bunch weight (g)	Number of berries/ bunch	Number of bunches / vine	Berry length (cm)	Berry breadth (cm)	Berry weight (g)	Yield (kg/vine)
T_0	22.30	11.43	325.22	133.67	36	1.88	1.37	2.38	11.71
T_1	25.14	12.76	466.68	160.33	37	2.16	1.58	2.86	17.25
T_2	24.83	12.94	496.24	158.00	36	2.27	1.66	3.06	17.88
T_3	26.12	13.37	504.72	165.33	38	2.22	1.61	3.00	19.18
T_4	25.56	13.46	512.66	154.67	34	2.32	1.77	3.27	17.44
T_5	26.00	13.73	570.87	166.00	37	2.40	1.90	3.38	21.10
T_6	27.00	14.15	472.16	157.67	39	2.20	1.54	2.92	18.40
T_7	28.22	13.91	510.20	155.00	38	2.30	1.73	3.22	19.40
T_8	27.69	13.82	488.92	156.67	35	2.24	1.65	3.06	17.12
T_9	28.07	14.02	513.70	153.00	38	2.36	1.74	3.28	19.53
T_{10}	27.28	14.00	546.18	157.00	37	2.43	1.86	3.41	20.22
C.D. (p£ 0.05)	1.25	0.28	7.05	3.10	NS	0.12	0.10	0.15	0.04

at pre-bloom stage + 30 ppm GA_3 applied at berry set stage). Lowest number of bunches per vine (34) was recorded in the treatment T_4 (30 ppm GA_3 applied at pre-bloom stage and 40 ppm GA_3 + 1000 ppm urea phosphate applied at berry set stage).

Berry length

All the bio regulator treatments are significantly increased the berry length as compared to control. Highest berry length (2.43cm) was observed with 40 ppm GA_3 applied at pre-bloom stage and 30 ppm GA_3 along with 10 ppm BA at berry set stage (T_{10}) which was statistically at par (2.40cm) with T_5. This increase in berry length might be due to cell elongation and cell division with GA_3 and BA, respectively (Yuan and Greene, 2000). BA increases fruit size directly by stimulating additional cell division during the early stage of fruit development (Greene, 1993 and Wismer *et al*., 1995). Lowest berry length (1.88cm) was recorded under control. The results obtained under the present investigation are in conformity with the findings of El-Ghany (2000), Tambe (2001), Liu (2002), Warusavitharana *et al*. (2008), Souza *et al*. (2010), Meena *et al*. (2012), Khot *et al*. (2015) and Ramteke and Khot (2015).

Berry breadth

It was evident from Table 2 that all the bio regulator treatments significantly increased berry breadth as compared to control. The highest berry breadth (1.90cm) was recorded with 30 ppm GA_3 applied at pre-bloom stage and 30 ppm GA_3 along with 10 ppm BA at berry set stage (T_5) which was statistically at par (1.86) with T_{10}. However, the lowest berry breadth (1.37cm) was recorded in control. This increase in berry breadth might be due to cell elongation and cell division with GA_3 and BA respectively (Yuan and Greene, 2000). BA increases fruit size directly by stimulating additional cell division during the early stage of fruit development (Greene, 1993 and Wismer *et al*., 1995). These results nearly are in agreement with the findings of El-Ghany (2000), Tambe (2001), Liu (2002), Warusavitharana *et al*. (2008), Souza *et al*. (2010) and Marzouk and Kassem (2011).

Berry weight

Berry weight was increased significantly by all the treatments over control. Highest berry weight (3.41g) was recorded in the treatment T_{10}, which consisted of application at 40 ppm GA_3 at pre-bloom stage and 30 ppm GA_3 along with 10 ppm BA at berry set stage. It was statistically at par with T_5 (3.38g). This increase in berry weight might be due to significant increase in berry size and proper nutritional supply to the developing berries associated with photosynthetic capacity and translocation of photosynthates to the berries with the application of GA_3, urea phosphate and BA. Letham (1969) stated that cytokinins increase cell division and also enhance the mobilization of nutrients and amino acids to treated sites. Bangerth (2004) stated that GA_3 and cytokinin concentration in the pericarp may have several functions such as initiating cell division, stimulating cell growth and increasing sink activity. Huang *et al*. (2002) reported that BA translocates the C and N assimilates from treated leaves to fruits. Sivakumar and Virendra Nath (2000) reported that BA enhances the photosynthetic capacity. Shulman *et al*. (1987) reported that urea phosphate enhance the action of GA_3 thus influencing the increase in berry size as well as berry weight. The lowest berry weight (2.38g) was recorded under control. The results obtained under the present investigation are also in agreement with the findings of El-Ghany (2000), Tambe (2001), Liu (2002), Warusavitharana *et al*. (2008) and Meena *et al*. (2012).

Yield

All the bio regulator treatments increased the yield per vine significantly in comparison with control. Highest yield (21.10 kg/vine) was recorded with 30 ppm GA_3 applied at pre-bloom stage and 30 ppm GA_3 along with 10 ppm BA at berry set stage (T_5) which was followed by T_{10} (20.22 kg/vine) where 40 ppm GA_3 was applied at pre-bloom and 30 ppm GA_3 along with 10 ppm BA at berry set stage (T_{10}). Lowest berry yield (11.71 kg/vine) was recorded under control. This more yields might be due to higher fruit set, greater berry size, increased weight of berry, proper nutritional supply to the developing bunches, higher photosynthetic rate and less fruit drop with the application of GA_3, urea phosphate and BA. Bangerth (2004) pointed out that application of cytokinin with GA_3 increased the sink activity thus helping in improving the yield. GA_3 may act synergistically with urea phosphate and BA to increase the yield. These results are supported with the findings of Tambe (2001), Usha *et al*. (2005), Warusavitharana *et al*. (2008), Meena *et al*. (2012), Khot *et al*. (2015) and Ramteke and Khot (2015).

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