IMPACT OF GIBBERELLIC ACID ON GAS EXCHANGE PARAMETERS AND YIELD COMPONENTS OF MANJRI NAVEEN GRAPES

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Abstract: A field experiment was conducted at National Research Centre for Grapes, Pune on Manjri Naveen grapes during 2012-2013 to see the impact of GA on gas exchange parameters and yield components. Foliar application of GA (2, 5, 10, 15, 20 and 25 mg/liter) were given at flowering stage and its effect were studied at flowering, berry development stages (3-4 mm and 6-8 mm berry size), veraison stage and at harvest. The data recorded on photosynthesis, stomatal conductance were improved at various concentrations and sprays of GA as compared to control. Notably maximum photosynthetic rate was recorded when 5 ppm of GA was applied at flowering stage. However, 20 ppm GA was showed better results at veraison stage. No phytotoxicity symptoms were noticed on leaves, stem and berries with the application of various concentrations of GA. The result from the present studies suggested that GA could be utilized as a biostimulant or growth enhancer for obtaining high yield and quality of Manjri Naveen grapes.

Keywords: Gibberellic Acid, Manjri Naveen, Photosynthesis, Quality, Stomatal Conductance, Yield.

Introduction: Improvement in quality and yield are the most important aspects of grape production. The quality is mainly determined by berry size, colour, and pulp content while yield is govern by number of bunches per vine and bunch weight. Considerable interest has been stimulated by growers to improve the quality and yield of table grapes using plant growth promoter. In recent years an increasing range of use of growth promoting hormone have been noticed with their positive response on the crop productivity. Growers often use Gibberellic acid (GA), Silixol, CCC (Chlormequat Chloride), CPPU (Forchlorfenuron) and various other growth regulators to improve the quality and yield in field crops. Gibberellic acid is plant hormone that stimulates and regulates plant growth. Particularly, this hormone promotes cell division and elongation, resulting in a taller plant (United States Environmental Protection Agency, 1995). Foliar application of GA counteracted some of the adverse effects of NaCl salinity with the accumulation of proline which maintained membrane permeability and increased macro and micronutrient levels. (Tuna *et al.* 2008). Some studies have indicated that plant growth regulators (PGRs), such as gibberellic acids (GA), stimulate seed germination at low
temperatures (Durrant and Mash, 1991). Berry size also increased with the applications of several gibberellic acids (GA), at the time of prior to anthesis, at anthesis, at berry set (approximately 2 weeks) and after anthesis (Harrell and Williams, 1987). Therefore, for better understanding the mechanism, the present investigation was carried out on impact of GA in improving quality and yield of Manjri Naveen variety of grape.

Materials And Methods: The experiment was conducted at National Research Centre for Grapes during fruiting season of 2012-2013 on Manjri Naveen grape variety grafted on Dog Ridge rootstock. Grapevines were planted at 10' x 6' spacing and pruned by retaining by a maximum of 7-9 nodes/vine. The experiment was completely randomized. Standard cultural practices were conducted during the experiment. The following six concentrations of GA were sprayed with three replications. Each replication consisted of 10 plants.T1= 2 ppm, T2= 5ppm, T3= 10 ppm, T4= 15 ppm, T5= 20 ppm, T6= 25 ppm, T7= Control (water only). GA was sprayed at developmental stages, flowering and berry size (3-4mm, 6-8mm), veraison. The GA was applied with a handheld sprayer.

Photosynthetic rate and stomatal conductance were measured using Infra Red Gas Analyzer (IRGA) system (LICOR 6400, USA) at different stages and prior to harvesting. Berries were harvested on March 2013. At harvesting the bunch weight was measured. Total 50 berries were taken for the measurement of berry weight (g). Berry length and berry diameter of 10 berries in each treatment were measured with the help of Vernier caliper (0-300mm, RSK™) and average was calculated and expressed in millimeter. Total soluble solids (TSS) were measured using hand refractometer and expressed as °Brix. Total acid (grams/liter) was measured in grapes juice with phenolphthalein indicator and titrated against 0.1 N NaOH. The data was analyzed by one-way analysis of variance (ANOVA) using SPSS software version 7.0.

Result And Discussion: Effect of GA on photosynthetic rate and stomatal conductance is depicted in Table 1 and Table 2 respectively. The maximum photosynthesis rate (18.33µmol/mg/s) were found with the application of GA 5 ppm and stomatal conductance (0.57 mm/s) with the application of GA 15 ppm were recorded at flowering stage and veraison stage respectively. Kaleem (2010) reported that the maximum photosynthetic rate was accompanied by

an increase in chlorophyll contents, thus enhancing the ability of plant for higher assimilation rate and biomass production (dry matter content). The results on effects of GA on photosynthesis revealed that the increase photosynthetic rate leads to increased dry matter content. A positive correlation between photosynthesis rate and stomatal conductance revealed that the increased stomatal conductance leads to increased photosynthetic rate. Similar studies were conducted by Farquhar and Wong (1984) and Reynolds *et al*., (1988) they reported that the linear correlation between stomatal conductance and photosynthetic rate has on the basis for models of leaf gas exchange but a stable intercellular CO_2 concentration is not observed in all plants under all cultural conditions. Radin *et al*., (1988) reported that when plants was grown in an atmosphere enriched to about 650 micro liters per liter of Co_2, however, photosynthetic capacity remained strongly correlated with stomatal conductance even though the procedure discounted any effect of variable intercellular CO_2 concentration. It is clear from this study that GA increased photosynthetic rate and stomatal conductance resulted into increased yield in Manjri Naveen grapes (Table 4). The effect of GA on berry characteristics is presented in Table 3. Various GA concentrations had significant effects on berry characteristics. Irrespective of GA concentration, bunch weight, berry weight, berry diameter and berry length were significantly decreased, however, pedicel thickness was significantly increased as compared to control (Table 3). Maximum bunch weight (182.10 g) was recorded at 5 ppm concentration whereas, for control it recorded with 256.10 g (Table 3). The maximum berry length had noticed with the treatment of 25 ppm which similar to control with 20.10 mm berry length. The maximum 50 berry weight (128.50 g) was observed when 25 ppm of GA was applied and for control it ranges to 129.60 g (Table 3). As compared to control (16.20 mm) the maximum berry diameter (16.20 mm) was recorded when 25 ppm GA was sprayed. As compared to control (1.12 µm) the maximum pedicel thickness (1.83 µm) was recorded when 10 ppm GA was sprayed (Table 3). Results on TSS and total acid are presented in Table 3. TSS was found to be constant (18.0 °Brix) at various concentrations of GA except at 5ppm concentrations (17.6 °Brix).The berry quality parameters such as berry length, berry diameter and berry weight were improved with the application of other growth regulators such as CPPU (Peppi and Fidelibus,2008) and GA_3 (Jawanda *et al*.,1974) in Thompson Seedless grapes. Bhavya *et al*., (2012) reported significantly influenced sugar content and acidity in Bangalore blue grapes. Jawanda *et al*., (1974) and Fathi *et al*., (2011) studied the increased TSS and low acidity and reported when other growth regulators such as Para chlorophenoxy acetic acid sprayed on different grape cultivars. Data on yield/vine and yield/ha is depicted in Table 4. Yield/vine was significantly increased with the application of various concentrations of GA in all the treatments. Similar results were noted for yield/ha. The highest yield/vine (12.53 kg) and yield/ha (24.43 tones) were recorded for both with application of 15 ppm concentration (Table 4).

Conclusion: Overall results indicate that for Manjri Naveen variety of grape, the application of GA is not required for enhancing the physiological parameters. It may be due to the particular characteristic of the cultivar or the climatic conditions available during growth and developmental period. Nevertheless, various concentrations of GA may increase the yield of grapes. In order to attract international market where the best prices of table grapes can be obtained, it is important to use the growth regulators. Therefore it can be concluded that GA can be used as a biostimulant or growth enhancer that generally improve the quality and yield in grapevine.

In summary the data represented in this work demonstrated the impact of GA in improving photosynthesis, stomatal conductance and yield of Manjri Naveen grapes. It is apparent that it is possible to enhance the yield of other grape cultivars if GA is used in an appropriate concentration.

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Table 1: Impact of GA on photosynthetic rate (µmol/mg/s) on Manjri Naveen grapes

No.	Flowering	3- 4 mm	6 – 8 mm	Veraison	Harvest
T1	15.47±1.03ab	15.17±0.51a	13.97±1.50a	15.17±2.16a	10.29±0.67a
T2	18.33±0.55a	14.53±0.59ab	12.83±0.40ab	16.23±1.50a	7.41±0.65b
T3	16.13±0.55b	13.77±0.68ab	11.97±2.56ab	16.53±1.16a	5.93±0.96cd
T4	15.87±1.20c	12.32±2.84b	12.03±0.93ab	14.77±1.27a	6.70±0.42bc
T5	14.20±1.94d	12.67±2.14ab	13.23±2.83ab	16.77±2.06a	5.36±0.58d
T6	17.33±0.55a	13.43±0.81ab	13.43±0.92ab	10.60±1.17b	10.53±0.93a
T7	13.58±0.99d	12.17±0.40b	10.70±0.46c	6.73±0.50c	6.30±0.45bcd

Table 2: Impact of GA on stomatal conductance (mm/s) on Manjri Naveen grape

No.	Flowering	3- 4 mm	6 – 8 mm	Veraison	Harvest
T1	0.13±0.02b	0.28±0.02a	0.30±0.06ab	0.14±0.01ab	0.07±0.02b
T2	0.14±0.00b	0.24±0.01ab	0.21±0.01bc	0.10±0.02b	0.12±0.01a
T3	0.11±0.01b	0.18±0.02cd	0.30±0.07ab	0.50±0.37ab	0.10±0.00a
T4	0.26±0.01a	0.12±0.03e	0.17±0.07c	0.57±0.31a	0.10±0.00a
T5	0.11±0.02b	0.21±0.04bc	0.32±0.01a	0.43±0.08ab	0.07±0.00b
T6	0.14±0.00b	0.17±0.01cd	0.11±0.04c	0.20±0.04ab	0.08±0.01b
T7	0.12±0.01b	0.15±0.01de	0.20±0.07c	0.44±0.34ab	0.03±0.02c

Table 3: Impact of GA on physiological parameters of Manjri Naveen grapes

No.	Mean bunch weight (g)	50 berry weight (g)	Berry length (mm)	Berry diameter (mm)	T.S.S. (°Brix)	Acidity (g/liter)
T1	178.40cd	125.60bc	16.10d	14.50d	18.00a	0.4400b
T2	182.10b	125.10bc	16.90c	15.30cb	17.60d	0.4500ba
T3	180.60cb	126.60bac	19.90ba	15.30cb	18.00a	0.4500ba
T4	168.10d	123.30c	19.80ba	15.00c	18.00a	0.4400b
T5	172.90cd	124.80c	19.50b	15.50b	18.00a	0.4400b
T6	176.70cb	128.50ba	20.10a	16.20a	18.00a	0.4600a
T7	256.10a	129.60a	20.10a	16.20a	18.00a	0.4400b

Table 4: Impact of GA on yield of Manjri Naveen grapes		
Treatment	Yield / Vine (kg)	Yield/ Ha (tones)
T1	9.12±0.16c	17.79±0.31c
T2	11.72±0.27b	22.85±0.53b
T3	8.03±0.28d	15.66±0.54d
T4	12.53±0.14a	24.43±0.28a
T5	5.89±0.17e	11.49±0.33e
T6	8.10±0.23d	15.80±0.46d
T7	8.38±0.15d	16.34±0.28d

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