Original Research Article

Influence of plant growth regulators to improve the colour and sugar content of Grapes (*Vitis vinifera* L.). cv. Red Globe

ABSTRACT

Studies on Effect of plant growth regulators to improve the colour and sugar content of Grapes" (*Vitis vinifera* L.).cv. Red Globe was conducted in the field of a progressive grape grower at Kaalampalyam (10 O 58'49.17" N and 76 O 55'

15. 81"E and elevation of 1352 ft from MSL) near Perur area of Coimbatore district in Tamil Nadu. The experiment was laid out in a randomized Block design with 7 treatments and each treatment was replicated four times. The data recorded on various parameters *viz.*, vegetative growth, flowering, fruit yield, Quality etc., were statistically analysed. Significant differences were observed among the growth regulators on various vegetative growth parameters in *Grapes (Vitis vinifera L.)*. cv. Red Globe.

Among all the treatments, number of bunchs per vine was significantly higher when sprayed with ethephon 200ppm (T4) compared to other treatments. (6.53 cm), the berry size and berry weight of the grapes were found to be maximum in the bunches treated with CCC 500ppm (T2) (6.57 g), There was no impact on the number of seeds by the treatments. The ethephon 200ppm (T4) treatment exhibited superior quality in terms of juice content, total sugars and colour value.

Key words: Nutrients, Growth regulator, Growth, Colour and Sugar content

1.INTRODUCTION

Grapes (*Vitis vinifera* L.) is an important commercial fruit crop in India and it occupies sixth position among the fruits produced in India [4]. Among the seedless types, Thompson Seedless is cultivated for table purpose in Tamil Nadu. The climatic condition of Tamil Nadu is unique and favours 'Muscat' production in large scale throughout the year. Harvest of almost five crops in two years is a common practice. However, the quality varied due to heavy load of crop and incidence of pests and diseases under warm humid conditions reducing the lifespan of the vines. Recently growers are keen to grow 'Red Globe', a seeded, red coloured, bold table grapes. The cultivar is being grown on Dogridge rootstock in Karnataka and Maharashtra. This variety does not require extensive berry thinning for obtaining export quality fruits. Owing to its size and appeal, several growers in Tamil Nadu have started cultivation of 'Red Globe' grapes commercially.

UNDER PEER REVIEW

'Red Globe' is likely to become the most important seeded table grape cultivar in the near future. 'Red globe' grapes are primarily used as table grapes and belong to the red group as it has red skin. This variety of grape is well-known and considered as good quality grape even though it is seeded. It is sweet, contains plenty of juice, the berries are firm and fleshy with a mild, sweet flavour. Under ideal conditions, it produces dark ruby red coloured berries.

Under Coimbatore conditions, however, 'Red Globe' grapes suffer due to lack of colouration besides low sugar (TSS) content. Colouration in grapes is governed by climate, nutritional and cultural practices and these aspects have to be rationalized to get the best quality especially in cultivars like 'Red Globe' which is cherished for the colour. As very little control over climatic conditions can be exercised in the open fields, the other practices need to be explored to moderate colour development.

Among several cultural practices, the use of plant growth regulators has been well recognized to improve fruit quality in several crops. Growth regulators viz., chloremquat chloride and ethephon have been employed in grapes elsewhere to improve fruit quality [5] [15]. Salicylic acid is another growth regulator with the potential application to improve fruit quality. Hence, a systematic study was presently undertaken in using different combination of growth regulators so as to maintain productivity and quality.

2.MATERIALS AND METHODS

This study was carried out at Horticulture College and Research Institute Coimbatore and Experiment was conducted in the field of a progressive grape grower at Kaalampalyam (10^{O} 58'49.17" N and 76 ^{O} 55' 15. 81"E and elevation of 1352 ft. from MSL) near Perur area of Coimbatore district in Tamil Nadu.

The study was conducted on four years old grapes (*Vitis vinifera*) 'Red Globe' plants grown on 'Dogridge B' root stock were planted at 10' X 5' (3 X 1.5m) spacing, trained on overhead arbour system (Plate 3). The vines are pruned twice in a year, once in summer for back pruning at 2 bud level followed by forward pruning at 5 bud level in winter. Apart from the regular dosage of fertilizers, at the time of pruning, the vines were applied with the bulk organic manures.15 MT of cow dung / year, 5 MT green leaf manuring, sun hemp and 300Kg neem cake. Apart from this, 400Kg Superphosphate and Calcium nitrate @ 1kg/plant were also applied to the soil. As a general practice, the grower supplies nutrients through fertigation. Besides, Potassium nitrate 1% is also applied by the grower during the veraison stage as foliar nutrition. The grower adopts regular plant protection measures.

UNDER PEER REVIEW

The experiment was laid out in a Randomized Block Design (RBD) with 7 treatments with 4 replications. The observations on growth parameters like Number of days from pruning to harvest (no), Yield per vine (Kg), Number of bunches per vine (No), Average bunch weight (g), Length of the bunch (cm), Width of the bunch (cm), Number of berries per bunch (No.), Average berry weight (g), Length of the berry (cm), Width of the bunch (cm), Juice content (%) and Estimation of sugars (%) and CIRG (Colour Index of Red Grapes) (Numerical units) were recorded. The experimental data were analysed statistically by ANOVA (Analysis Of Variance) technique [11].

Table 1. Treatment details

Treatments	Details
T_1	Application of Chloremquat chloride @ 250ppm
T_2	Application of Chloremquat chloride @ 500ppm
T_3	Application of Ethephon @ 100ppm
T_4	Application of Ethephon @ 200ppm
T_5	Application of Salicylic acid @ 100ppm
T_6	Application of Salicylic acid @ 200ppm
T_7	Control

3.Results and discussion

Yield parameters

The data pertaining to the effect of growth regulator on Number of days from pruning to harvest (no), Yield per vine (Kg), Number of bunches per vine (No), Average bunch weight (g), Length of the bunch (cm), Width of the bunch (cm), Number of berries per bunch (No.), Average berry weight (g), Length of the berry (cm) ,Width of the bunch (cm) are presented in Table 2and 3. Significant differences were observed in the yield parameters.

Table 2. Effect of plant growth regulators on yield of grapes cv. Red Globe

Treatments	Yield parmeters of grapes cv. Red Globe					
	Number of days from pruning to harvest (no)	Yield per vine (Kg)	Number of bunches per vine (No)	Average bunch weight (g)	Length of the bunch (cm)	Width of the bunch (cm)
T_1	131.75	5.97	12.5	0.47	16.05	11.35
T_2	130.5	6.59	13.5	0.47	15.94	12.10
T_3	125.5	4.16	11	0.37	18.00	11.00
T_4	125.0	6.53	12	0.43	18.91	10.30
T_5	138.5	4.23	10.5	0.39	17.11	11.19
T_6	139.75	5.02	13.25	0.42	17.33	11.15

UNDER PEER REVIEW

T_7	142.5	4.13	9.25	0.35	15.53	10.91
SE (d)	**0.70****	**0.51****	**1.01****	**0.03****	**0. 61****	**0.43***
CD (P = 0.05)	**1.48**	**1.08**	**2.12**	**0.06**	**1.28**	**0.92**

Table 3. Effect of plant growth regulators on yield parameters of grapes cv. Red Globe

Treatments	**Yield Parameters of grapes cv. Red Globe**			
	Number of berries/ bunch (no)	**Berry weight of grapes (g)**	**Berry length (cm)**	**Berry width (cm)**
T_1	76.17	6.25	3.51	2.05
T_2	74.47	6.57	3.65	2.06
T_3	76.07	5.42	3.02	1.83
T_4	82.65	5.2	3.01	1.66
T_5	64.12	6.07	3.43	1.73
T_6	74.9	6.17	3.45	1.86
T_7	5.42	4.13	3.15	1.67
SE (d)	**0.31****	**0.51****	**0.11 ****	**0.11 ****
CD (P = 0.05)	**5.05**	**0.66**	**0.23**	**0.23**

Among all the treatments, T_4 - Application of Ethephon @ 200 ppm has recorded significantly number of days taken from pruning to harvest (125 days), The maximum yield/vine was obtained in T2 Application of Chloremquat chloride @ 500ppm (6.59 Kg).

The data showed that number of bunches per vine in 'Red Globe' grapes was significantly influenced by plant growth regulator treatments (Table 1). Number of bunches per vine was significantly higher (13.5) in T2 Application of Chloremquat chloride 500ppm followed by (13.25) in T6 Application of Salicylic acid @ 200 ppm. The average bunch weight as influenced by different plant growth regulator treatments were significant in 'Red Globe' grapes. The bunch weight was significantly higher in T2 Application of Chloremquat chloride @ 500ppm (471.5g) and T1 Application of Chloremquat chloride @ 250ppm (470g) as compared to other treatments (Table 2). Rest of the treatments were on par with each other. Lower weight was recorded in control (355g), which was on par with T3 ethephon 200ppm (373 g). The data indicated that the differences in the fruit length as influenced by different

UNDER PEER REVIEW

plant growth regulator treatments were significant and the maximum fruit length was noticed in T4 Application of Ethephon @ 200ppm (18.91 cm). The higher bunch width was recorded in T2 Application of Chloremquat chloride 500ppm (12.10cm) which was on par with T1 Application of Chloremquat chloride @ 250ppm (11.35cm) and T5 Application of Salicylic acid @ 100ppm (11.19cm) and control (10.91cm). Number of bunches per vine was significantly higher in T4 Application of Ethephon @ 200ppm (82.65) as compared to other treatments. Berry weight was maximum in (6.57g) with the application of 500ppm CCC T2. The maximum berry length was noticed in T2 Application of Chloremquat chloride @ 500ppm (3.65 cm) (Table 3). The results on berry width of grapes 'Red Globe' indicated the significant difference due to different plant growth regulator treatments (Table 3). Significantly higher berry width was recorded in T2 Application of Chloremquat chloride @ 500ppm (2.06 cm). The treatment T4 Application of Ethephon @ 200ppm recorded the lower berry width and control (1.67cm).

In the present investigation, the fruit yield in 'Red Globe' grapes is expressed in terms of fresh weight since, the edible portion of fruit pulp contains large amount of water and sugars including seeds Yield in grapes is a multiplicate factor of number of bunches per vine and bunch weight. In the present study, the number of bunches per plant was significantly higher with chloremquat chloride 500 ppm and salicylic acid 200ppm This is in conformity with use of Cycocel 500ppm in 'Tas-A-Ganesh' grapes, 'Barrani' grapes [13] [7]. CCC also acts as promoter in lower concentration (50-100ppm) while it acts as growth retardant at higher concentrations. As the plant growth regulator treatments were imposed over the basic field practices, the variation in number of bunches may be attributed to the inherent variation between vines. Another important yield component *viz.*, the bunch weight was also significantly higher with the application of chloremquat chloride at 500ppm (T2) The increase in fruit yield is probably due to an increase in carbohydrate metabolism and accumulation of carbohydrates, auxin directed mobilization of metabolites from source to sink, moderating the source sink relation within the plant.

The results indicated the significant differences in the yield between the plant growth regulators treated plants and control. The maximum yield/vine was obtained in vines treated with chloremquat chloride at 500ppm This is in conformity with 600 ppm CCC in 'Cabernet Sauvignon', 'Roomy Red' variety, 'Thompson Seedless' grapes, Cycocel 500ppm in 'Tas-A-Ganesh', and 1000ppm CCC in 'Barrani' grapes [13][7]. It was followed by vines treated with ethephon at 200ppm T4 (6.53Kg), T1 (5.97 Kg) and T6 (5.02 Kg). Control recorded the

UNDER PEER REVIEW

lowest (4.13 Kg) yield per vine. In the present study, the berry weight in 'Red Globe' grapes was significantly affected by the different treatments. Berry weight was maximum with the application of 500ppm CCC followed by 250ppm CCC.

This is in conformity with 'Thompson Seedless' grapes with CCC 500 ppm and Cycocel 1000ppm in 'Barrani' grapes [5][7] gave the highest berry weight. Berry size is an important fruit trait especially in cv. Red Globe which is highly preferred in the market for its berry size. It is generally indicated by the length and width of the berries. In the present investigations, application of CCC 500ppm to the grape bunches and foliage resulted in increased the berry length and width.

This is in conformity with findings of Kumar and Singh (1984) and Chougule et al. (2008) where increase in berry length and width was noticed with CCC 250ppm and 500ppm over control in Thompson Seedless grapes. The weight and size of berries increase could be due to the favourable mobilisation of photosynthates towards berries due to the PGR modifying the source sink relation.

Quality parameters

The data pertaining to the effect of growth regulator on on Juice content (%)), Total sugars (%) and CIRG index of Red Globe' is presented in Table 4. Significant differences were observed in Quality parameters.

Table 4. Effect of plant growth regulators on Quality parameters of grapes cv. Red Globe

Treatments	Quality parameters of grapes cv. Red Globe		
	Juice content (%))	Total sugars (%)	CIRG = (180−h◦)/(C*+L*)
T_1	61.72	13.29	4.01
T_2	61.22	13.72	4.16
T_3	64.20	14.19	4.09
T_4	65.12	14.77	4.40
T_5	61.75	12.62	3.93
T_6	62.60	11.15	4.02
T_7	15.53	12.3	3.31
SE (d)	**0.99****	**0.20****	**0.11****
CD (P = 0.05)	**2.09**	**0.43**	**0.24**

The influence of various concentrations and different plant growth regulators on juice content of the 'Red Globe' grape berries are presented in (Table 11). Juice content in grapes were maximum (65.12 %) in T4 ethrel 200ppm which was on par with T3 ethephon at

UNDER PEER REVIEW

100ppm (64.2 %) which were par on each other. Low juice content was recorded in control (60.30 %).

The effect of various sources of plant growth regulator concentrations on total sugar content of 'Red Globe' grapes is presented in (Table 4). The results revealed that plant growth regulators significantly influenced the total sugar content of grapes. Highest content of total sugar in grapes was observed with application of ethephon 200ppm (T4) (15.42 %) which was significantly superior over rest of the treatments. It was followed by T3 (ethephon at100ppm) (14.25 %) and T2 (chloremquat chloride at 500ppm (13.6 %).

The CIRG index value for the 'Red Globe' grapes was higher in ethephon at 200ppm (T4) treatment (4.40) which was superior to other treatments (Table 4). It was on par with T2 (4.16). It was followed by T3 (4.09), T6 (4.02), T 1(4.01), T5 (3.93) which were on par with each other. Control (3.31) was lower to all the treatments.

Higher juice content is generally preferred in any table variety in grapes as it increases the palatability and also its use in juice preparations. In the present study, the juice content of the grapes 'Red Globe' was significantly increased by different plant growth regulator treatments. Juice content in grapes was high in treatment results of ethephon 200ppm which was on par with ethephon at 100ppm and salicylic acid 200ppm. Increase in sugar, juice content and colour are favourable attributes for consumer preference, thereby the market value.

The influence of different plant growth regulators on number of seeds of the 'Red Globe' grapes berries was insignificant. There was no impact of the treatments on the seed weight or the number. Total sugars were found to increase due to the application of plant growth regulators with a maximum in ethephon 200ppm treated bunches which was significantly superior over rest of the treatments. The increase in the sugar content with advancement in age could be due to stimulation of alpha-amylase and other hydrolytic enzymes promoting the hydrolysis of storage reserves due to senescence. Similar increase in sugar content by the application ethephon at 500ppm content in 'Flame Seedless' table grape was reported by [8].

Ethephon inhibits both extension growth and lateral bud growth. Ethephon could be used to direct the metabolite flow towards the growing bunches achieving more efficient conditions for fruit development [10]. [14] also showed that ethephon increased phenylalanine-ammonia-lyase (PAL) activity in table grapes, which was accompanied by increased colour development. Ethephon treatments have also been shown to enhance gene

UNDER PEER REVIEW

expression for enzymes involved in the anthocyanin biosynthesis such as UDP glucose-flavonoid 3-o-glucosyl transferase (UFGT) with concomitant increases in anthocyanin accumulation in Vitis vinifera cv. Cabernet Sauvignon (El-Kereamy et al., 2002; El-Kereamy et al., 2003). In the present study, quantification of colour was evaluated using colour density, chroma (C*), lightness (L*) and hue (ho) measurements. The CIRG index (Colour Index of Red Grapes) was high in ethephon 200ppm treatment and found superior to all other treatments The chroma values changed significantly over the treatments. The chroma value was also significantly influenced by the plant growth regulator treatments. Fruits treated with 200ppm ethephon had a lower C* than non-treated fruits which suggests that the treated fruits had a slightly less pure colour than the non-treated fruits, but this slight effect was not perceived by the naked eye. It is in conformity with 'Crimson Seedless' by [3] and [12]. Based on the CIRG color index, all grapes could be classified as pink-coloured (2<CIRG<4)

4.CONCLUSION

Foliar application of ethephon at 100ppm and CCC at 250ppm promoted productivity and quality of the produce in 'Red Globe' grapes. 'Red Globe' in Coimbatore conditions suffer due to lack of colouration and low sugar and TSS content which can be corrected by the application of these plant growth regulators – (CEPA) ethephon at 100pppm or CCC 250ppm alone or in combination besides modifying the pruning time and field practices thereby improving the value realization.

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UNDER PEER REVIEW

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UNDER PEER REVIEW