



# **Influence of Plant Growth Regulators to Improve the Colour and Sugar Content of Grapes (*Vitis vinifera* L.). cv. Red Globe**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

## **Article Information**

DOI: 10.9734/IJECC/2021/v11i1130536

### Editor(s):

(1) Dr. Anthony R. Lupo, University of Missouri, USA.

### Reviewers:

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Complete Peer review History, details of the editor(s), Reviewers and additional Reviewers are available in this link:

<https://www.sdiarticle5.com/review-history/75676>

**Original Research Article**

**Received 20 August 2021**

**Accepted 27 October 2021**

**Published 23 November 2021**

## **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 bunches 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.

*Keywords: 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 [1]. 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 [2]. 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.

'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 [3]. Growth regulators viz., chlormequat chloride and ethephon have been employed in grapes

elsewhere to improve fruit quality [4,5,3]. 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° 58'49.17" N and 76° 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.

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 [6].

**Table 1. Treatment details**

Treatments	Details
T <sub>1</sub>	Application of Chloremquat chloride @ 250ppm
T <sub>2</sub>	Application of Chloremquat chloride @ 500ppm
T <sub>3</sub>	Application of Ethephon @ 100ppm
T <sub>4</sub>	Application of Ethephon @ 200ppm
T <sub>5</sub>	Application of Salicylic acid @ 100ppm
T <sub>6</sub>	Application of Salicylic acid @ 200ppm
T <sub>7</sub>	Control

### 3. RESULTS AND DISCUSSION

#### 3.1 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 2 and Fig. 1. Significant differences were observed in the yield parameters.

Among all the treatments, T<sub>4</sub> - 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 2). 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 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) (Figure 1). The results on berry width of grapes 'Red Globe' indicated the significant difference due to different plant growth regulator treatments (Fig. 1). Significantly higher berry width was recorded in T2 Application of Chloremquat chloride @ 500ppm (2.06 cm). The treatment T4 Application of Ethephon @ 200 ppm recorded the lower berry width and control (1.67 cm).

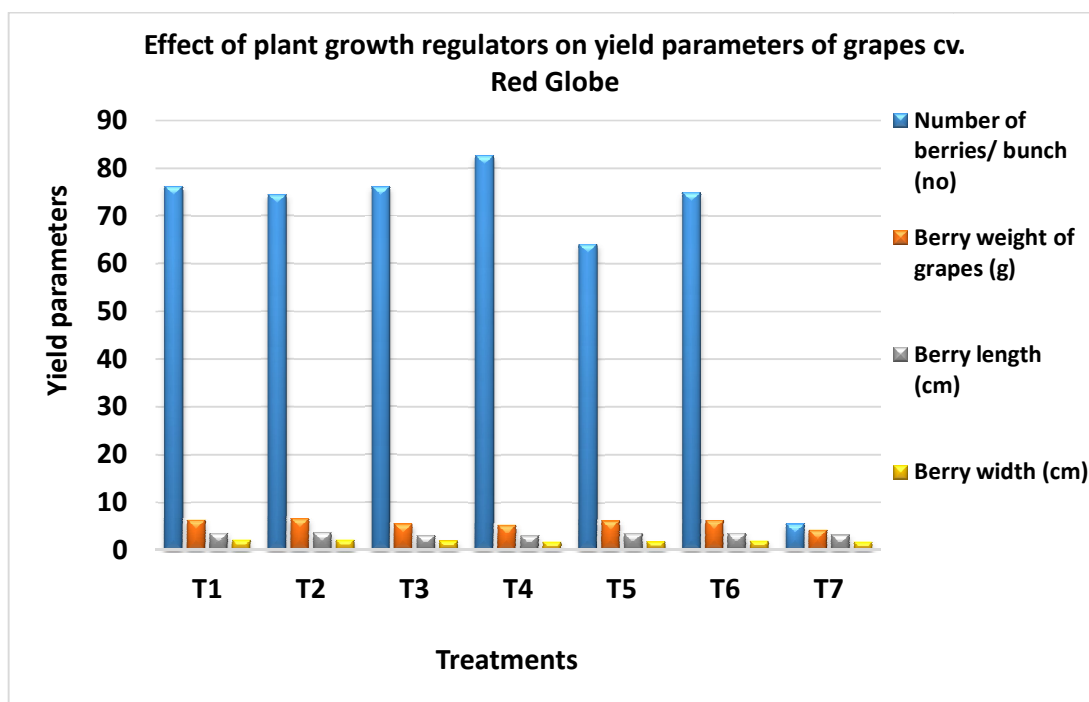
The maximum yield/vine was obtained in vines treated with chloremquat chloride at 500ppm This is in conformity with 600 ppm CCC in 'Cabernet Sauvignon', 'Roomy Red' variety, 'Thompson Seedless' grapes, Cycocel 500ppm in 'Tas-A-Ganesh', and 1000ppm CCC in 'Barrani' grapes. It was followed by vines treated with ethephon at 200ppm T4 (6.53Kg), T1 (5.97 Kg) and T6 (5.02 Kg). Control recorded the lowest (4.13 Kg) yield per vine. Similar findings were reported [4,7,8,9] with use of Cycocel 500ppm in 'Tas-A-Ganesh' grapes, 'Barrani' grapes.

#### 3.2 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 Figure 2. Significant differences were observed in Quality parameters.

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

Treatments	Yield parameters 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 <sub>1</sub>	131.75	5.97	12.5	0.47	16.05	11.35
T <sub>2</sub>	130.5	6.59	13.5	0.47	15.94	12.10
T <sub>3</sub>	125.5	4.16	11	0.37	18.00	11.00
T <sub>4</sub>	125.0	6.53	12	0.43	18.91	10.30
T <sub>5</sub>	138.5	4.23	10.5	0.39	17.11	11.19
T <sub>6</sub>	139.75	5.02	13.25	0.42	17.33	11.15
T <sub>7</sub>	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

**Fig. 1. Effect of plant growth regulators on yield parameters of grapes cv. Red Globe**

Among the various treatments the juice content in grapes were recorded maximum (65.12%) in T4 ethephon 200ppm which was on par with T3 ethephon at 100ppm (64.2%) which were on par on each other. Low juice content was recorded in control (60.30%). The 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 at 100ppm) (14.25%) and T2 (chlormequat 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. It was on par with T2 (4.16). It was followed by T3 (4.09), T6 (4.02), T1 (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 200 ppm 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 [10].

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 [11]. Steenkamp [12] findings 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 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 [7,13,14,15].

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 [16] and [14].

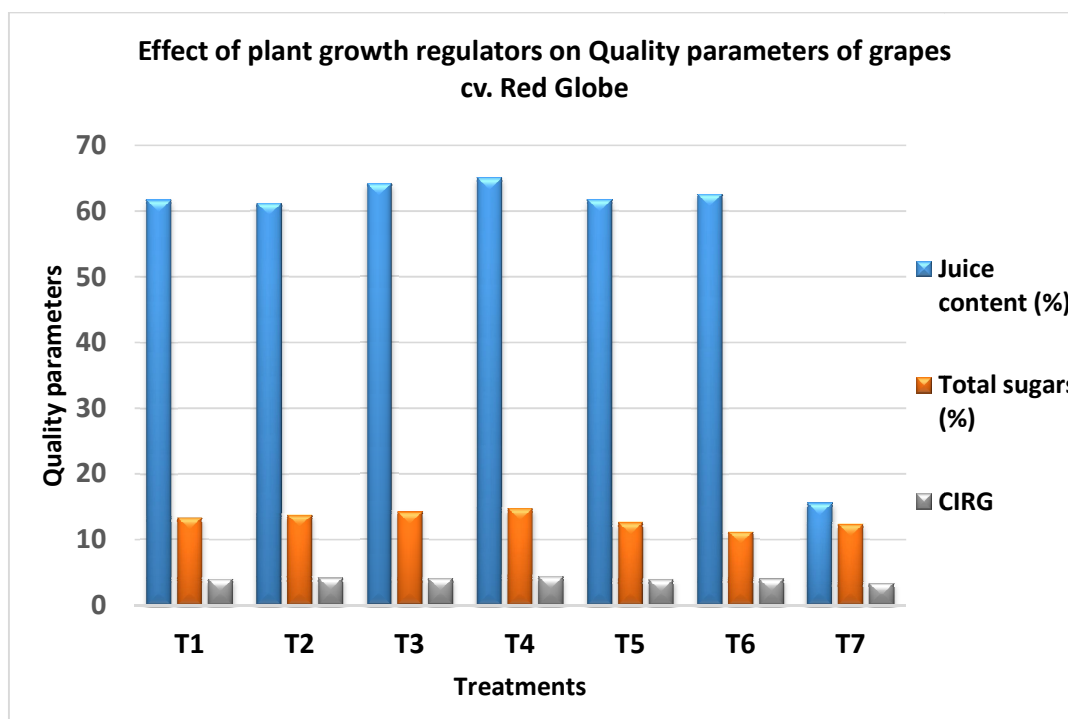


Fig. 2. Effect of plant growth regulators on Quality parameters of grapes cv. Red Globe

#### 4. CONCLUSION

Foliar application of ethephon at 100 ppm and CCC at 250 ppm 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 100 ppm or CCC 250 ppm alone or in combination besides modifying the pruning time and field practices thereby improving the value realization.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Chadha KL. Indian viticulture scenario. Acta Hort (ISHS). 2008;785:59-68.
2. Ferrara, Giuseppe, Andrea Mazzeo. "Potential and Actual Bud Fruitfulness: A Tool for Predicting and Managing the Yield of Table Grape Varieties. Agronomy. 2021; 11(5):841. Available: <https://doi.org/10.3390/agronomy11050841>
3. Chougule RA, Tambe TB, Kshirsagar DB. Effect of canopy management on yield and quality attributes of Thompson Seedless grapes. Acta Hort (ISHS). 2008;785:183-190.
4. Zhang Y, Zhang R. Effects of ABA content on the development of abscission zone and berry falling after harvesting of grapes. Agri. Sci. in China. 2009;8(1):59-67.
5. Panse UG, Sukhatme PV. Statistical methods for agricultural workers. 4<sup>th</sup> ed., ICAR Publication, New Delhi, India; 1985.
6. El-Rhman AIE. A study on some treatments which mitigate drought effects on Barrani grapevines cv. J. Applied Sci. Res. 2010;6(6):704-711.
7. Kumar H, Singh IJ. Effect of cycocel on floral drop, growth and fruit quality in grape (*Vitis vinifera* L.) cv Thompson Seedless. Haryana. J. Hort. Sci. 1984;13(3-4).
8. Ramteke SD, Somkumar RG. Effect of cycocel sprays on growth and yield of Tas-A-Ganesh grapes grafted on Dogridge rootstock, Karnataka J. Agric. Sci. 2005;18(1):18-20.
9. Kelany AE, Wahab SMA, Hafeez AAA, Emam IA. Effect of pre-harvest treatments on cluster quality of 'Flame Seedless' table grapes cultivar during cold storage. J. Hort. Sci. & Ornament. Plants. 2011;3(1): 11-21.
10. Lavee S. Usefulness of growth regulators for controlling vine growth and improve grape quality in intense vineyards. Acta Hort. 1987;206:89-108.
11. Steenkamp J, Blommaer J, Jooste JH. Effect of ethephon on the ripening of grapes (*Vitis vinifera* L.) Cv. Barlinka. Agro Plantae. 1977;9(2):51-54.
12. El Kereamy A, Chervin C, Souquet JM, Moutounet M, Monje MC, Nepveu F, Mondies H, Ford CM, Heeswijck RV, Roustan JP. Ethanol triggers grape gene expression leading to anthocyanin accumulation during berry ripening. Plant Sci. 2002;163:449-454.
13. Peppi MC, Fidelibus MW, Dokoozlian NK. Application timing and concentration of abscisic acid affect the quality of 'Red Globe' grapes. J. Hortic. Sci. Biotechnol. 2007;82:304-310.
14. Binisha S. Supplementary effect of bio-fertilizers in dendrobium. M.Sc. thesis, Kerala Agricultural University, Thrissur, Kerala, India; 2003.
15. Cantin CM, Fidelibus MW, Crisosto CH. Application of abscisic acid (ABA) at veraison advanced red color development and maintained postharvest quality of 'Crimson Seedless' grapes. Postharvest Biol. Technol. 2007;46:237-241.
16. Bhattacharjee SK. Effect of nutrition on growth and flowering of *Aerides multiflora* Rchb. Lalbaugh J. 1982;27(3): 13-18.

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The peer review history for this paper can be accessed here:  
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