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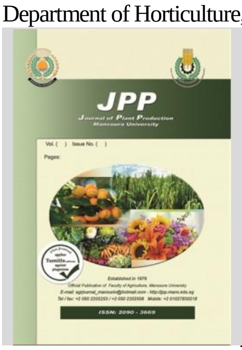
Effect of Spraying Paclobutrazol (PP_{333}) on Yield and Fruit Quality of Crimson Seedless Grape

Samaan, M. S. F. and M. A. Nasser*

Department of Horticulture, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.



ABSTRACT

Six concentrations of Paclobutrazol (PP_{333}) were experimented (0, 10, 30, 60, 90, 120 ppm) as foliar spray on three years old Crimson seedless grape vines grown in private orchard at El Qattah, Giza Governorate, Egypt to find out its influence on yield and a fruit quality. The mentioned treatments were conducted at veraison stage in compare to the traditional treatment with Ethrel. The cluster weight, total yield/vine, 100 berries weight, berry firmness, total acidity, TSS, TSS/acid ratio and total anthocyanine content were measured. The results referred to an ascending increase in anthocyanine content and a reduction in acidity % went in parallel to Paclobutrazol concentrations increase. Spraying of 10 ppm of PP_{333} led to a significant increase in berry weight whereas120 ppm concentration achieved the highest TSS/acid ratio.

Keywords: Crimson seedless, grape, Paclobutrazol, PP_{333}, spraying, yield, fruit quality.

INTRODUCTION

Crimson Seedless is a late-season red seedless table grape cultivar developed by David Ramming and RonTarailo of the USDA Fruit Genetics and Breeding Research Unit, Fresno, CA. USA. Its berries are like Thompson Seedless in size and shape; by harvest the berries develop a light red or crimson color. A main factor leading the spread of this cultivar is the high retail request. Crimson Seedless has surpassing eating advantages; the berry has a firm and crisp texture and excellent flavor as well (Dokoozlian *et. al.,* 1995_b). Getting proper fruit color for harvest is a main problem. The observations advocated that 30% or more of this cultivar fruit yield may hold unharvested because of inferior color development. In California, Ethrel (ethephon) must be used for ideal color development to all Crimson Seedless vineyards approximately, but it reduces berry firmness compared to untreated fruit. (Dokoozlian *et. al.,* 1995_b). Several reasons for insufficient color formation in table grapes have been described for the common conditions in Egypt, such as high temperatures (Kliewer and Torres, 1972; Kliewer, 1977; Mori *et al.*, 2005; Yahuaca *et al.*, 2006) and vigorous growth with crowded, shaded canopies (Smart *et al.*, 1988; Hunter *et al.*, 1991).

Paclobutrazol [(2RS, 3RS)-1-(4-chlorophenyl-4 ,4 - (dimethyl-2-(1H-1, 2, 4-trizol-1-yl)-pentan-3-ol], is one of the members of triazole family having growth regulating property. Paclobutrazol regulating properties are compromised by changes in the levels of important plant hormones including the gibberellins (GAs), abscisic acid (ABA) and cytokinins (CK). Paclobutrazol (PBZ) influences the isoprenoid pathway and adjusts the degrees of plant hormones by repressing gibberellin blend and expanding cytokinins level. Abscisic acid was produced off as a result of more precursors in the terpenoid pathway collect when gibberellins synthesis is blocked (Soumya *et. al.,* 2017). paclobutrazol application enhances the synthesis of abscisic acid much like it stimulates the synthesis of phytol. At the point when gibberellins union is restrained, more progenitor in the terpenoid pathway are accumulated and shunted to promote the genesis of abscisic acid (Rademacher 1997).

Further contextual investigations demonstrated that ABA not only improved the anthocyanin content in the grape skin but also enhanced the expression of *Chs*, *Chi*, *Dfr* and *Ufgt* genes in the anthocyanin biosynthesis pathway, and the coordinating factors *VvmybA1* (Jeong, S.T., *et al.,* 2004 and Ban, T. *et al.,* 2003) . Recently it has been recommended that spraying grape clusters with ABA could essentially hasten improve the anthocyanin content with no negative consequences for the commercial traits of the harvested grapes (Quiroga, A.M., *et al.*, 2009).

Ethephon applications have likewise been proven to promote gene expression of enzymes associated with anthocyanin biosynthesis, such as UDP glucose-flavonoid 3-o-glucosyl transferase (UFGT) with accompanying increases in anthocyanin accumulation in *Vitis vinifera cv*. Cabernet Sauvignon (El-Kereamy *et al.*, 2002; El-Kereamy *et al.*, 2003). Cabernet Sauvignon grapes were achieved the highest anthocyanin levels at harvest when treated with ethylene due to increase the content of anthocyanins, namely malvidin-3-glucoside (El-Kereamy *et al.*, 2002 and El-Kereamy *et al.*, 2003).

The aim of this research work was to estimate the effects of spraying Paclobutrazol (Cultar) at different levels on yield and fruit quality of Crimson seedless grape vines.

MATERIALS AND METHODS

This experiment was carried out in a private orchard at El Qattah, Giza Governorate, Egypt in two successive seasons (2018 and 2019). The vines were of three years old, mature and uniform 'Crimson Seedless' budded on Richter rootstock. The planting distance was 2 x 3 meter apart, grown in sandy soil under drip irrigation system, trellised by Spanish Parron system, trained by the “two arm” system pruned by the Guyot system. Each vine was pruned to six fruitful canes and each one contained ten eyes. Thus, the bud load was sixty eyes/vine. The experiment was arranged in complete

* **Corresponding author.**
E-mail address: Mohamed_21884@agr.asu.edu.eg T. : 01025224908
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randomized blocks design with five replicates and each replicate was exemplified by one vine. Twenty clusters were left on each vine. At veraison the following treatments were applied as fallow:

(1) 0 ppm paclobutrazol (tap water spray only)
(2) 10 ppm paclobutrazol
(3) 30 ppm paclobutrazol
(4) 60 ppm paclobutrazol
(5) 90 ppm paclobutrazol
(6) 120 ppm paclobutrazol
(7) Control (Ethephon 480 ppm) as used traditionally in the same orchard.

For all treatments (Tensotec – K_2O) was used as surfactant and pH adjuster to be around 6 by rate of 0.5 ml l^{-1} and each vine had received 3.5 L of spraying solution (to the runoff).

The effect of the experimental treatments on yield and fruit quality in the two studied seasons was investigated as follow: clusters were harvested at ripe stage on mid September as practiced for ethryl treatment (the common date in the orchard) in each season, 5 clusters from each vine (replicate) were weighted and then the vine yield was theoretically calculated (kg). 100 berries were randomly selected and weighted. Fruit firmness was measured with fruit texture analyzer model GS-, serial NO. FTA2 expressed as Lb. /inch^2. The total soluble solids (TSS) were determined as % by means of hand refractometer model HR-110. Total acidity percentage was determined in fruit juice as percentage of anhydrous citric acid by titration with standard 0.1 N sodium hydroxide solutions and phenolphthalein 1% as indicator according to (A.O.A.C. 1990). The acidity percentage was calculated as mg tartaric acid per 100 ml of juice. Then TSS/ Acid ratio was calculated. Anthocyanin was determined according to the method of Fuleki and Francis (1968).

The data were submitted to the proper statistical analysis of variance according to Snedecor and Cochran (1980). Tukey test was used to compare between means. Data were statistically analyzed using the analysis of variance adopting a SAS package.

RESULTS AND DISCUSSION

Data in Table (1) showed the effect of spraying Paclobutrazol on Cluster weight, yield/vine, weight of 100 berries and berry firmness of Crimson seedless in 2018 and 2019 seasons. Cluster weight and yield/vine were not significantly affected by paclobutrazol treatment in both seasons.

Spraying paclobutrazol at 10 ppm significantly achieved the highest values of weight of 100 berries in both seasons. Whereas; the lowest significant values obtained by 60 ppm and control.

Concerning the berry firmness, 0 ppm of PP_{333} in the first season and 10 ppm concentration in the second season gave the greatest firmed berries significantly. While, the softest berries were significantly obtained by 120 ppm and the control in the two seasons respectively.

The effect of spraying Paclobutrazol (Cultar) on TSS%, acidity and TSS/acid ratio of Crimson seedless in 2018 and 2019 are presented in fig. (1, 2,3,4,5 and 6).

Spraying Paclobutrazol at 90 and 120 ppm (PP_{333}) as well as the control achieved the highest percentage of TSS significantly in both seasons.

Table 1. Effect of Paclobutrazol on Cluster weight, yield/ vine, weight of 100 berries and berry firmness of Crimson seedless in 2018 and 2019 seasons.

Treatment	Cluster weight (g)	Yield (kg) /vine	Weight of 100 berries (g)	Berry firmness (Lb. /inch^2)
Season 2018				
0ppm (PP_{333})	470.67A	9.41A	460.67AB	0.851A
10ppm (PP_{333})	470.00A	9.41A	478.33A	0.722B
30ppm (PP_{333})	481.67A	9.63A	458.33AB	0.709BC
60ppm (PP_{333})	429.00A	8.58A	439.00B	0.703BC
90ppm (PP_{333})	436.00A	8.72A	448.00B	0.715BC
120ppm (PP_{333})	446.67A	8.93A	461.00AB	0.719B
Control	450.67A	9.01A	446.33B	0.680C
Season 2019				
0ppm (PP_{333})	454.33A	9.09A	456.33AB	0.647AB
10ppm (PP_{333})	456.33A	9.13A	468.33A	0.673A
30ppm (PP_{333})	437.00A	8.74A	452.00AB	0.639A-C
60ppm (PP_{333})	426.67A	8.53A	443.33B	0.575BC
90ppm (PP_{333})	439.67A	8.79A	449.67AB	0.580BC
120ppm (PP_{333})	443.00A	8.86A	448.67AB	0.568C
Control	445.67A	8.91A	442.33B	0.590BC

Means followed by the same letter (s) in each column are not significantly different at 5% level.

Regarding the acidity percentages in berries juice; control treatment proved to be the lowest value followed closely by 60, 90 and 120 ppm of PP_{333} in the two seasons significantly. **Concerning TSS/acid ratio;** data showed that, control gained the highest significantly values followed closely by 120ppm Paclobutrazol in both seasons.

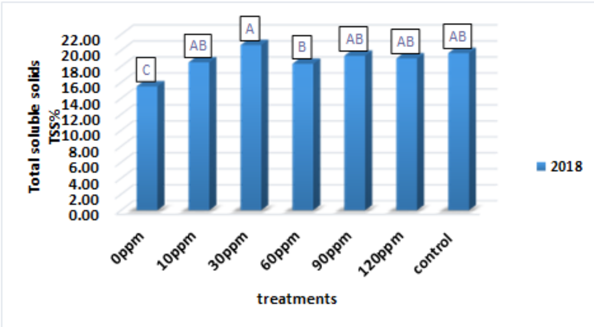

Fig. 1. Effect of spraying Paclobutrazol (PP_{333}) on TSS% of Crimson seedless in 2018 season.

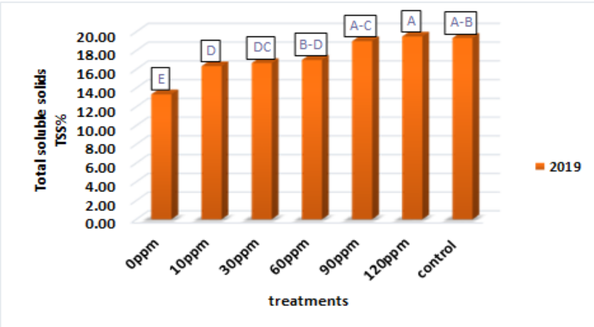

Fig. 2. Effect of spraying Paclobutrazol (PP_{333}) on TSS% of Crimson seedless in 2019 season.

The effect of spraying Paclobutrazol (PP_{333}) on total anthocyanin content (mg/100g fresh weight) of Crimson seedless in 2018 and 2019 are presented in fig. (7 and 8).

The highest significant values of total anthocyanin content were obtained by using control (Ethephon 480 ppm) in the two seasons. However ,there was a positive effect of spraying Paclobutrazol (PP_{333}) on the fruit content of total anthocyanin.

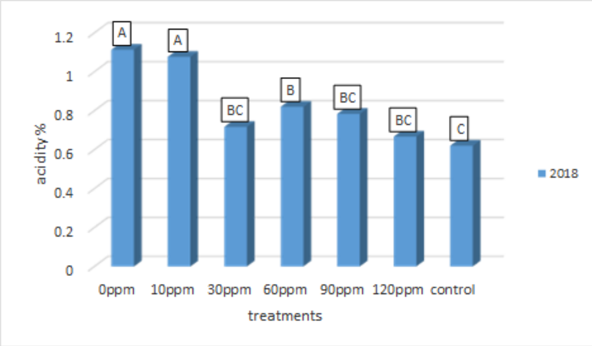

Fig. 3. Effect of spraying Paclobutrazol (PP_{333}) on acidity % of Crimson seedless in 2018 season.

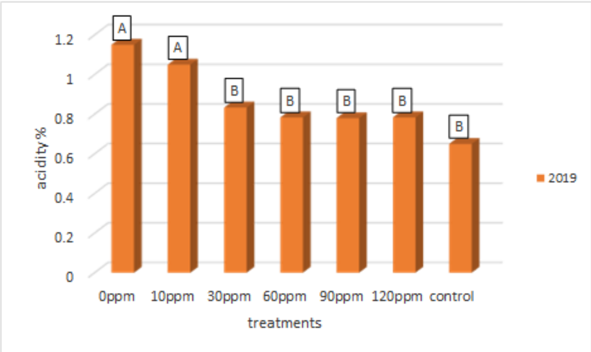

Fig. 4. Effect of spraying Paclobutrazol (PP_{333}) on acidity % of Crimson seedless in 2019 season.

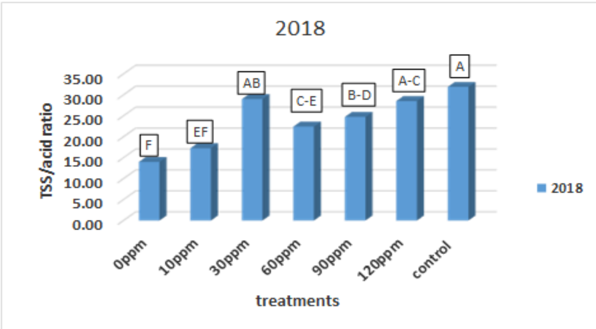

Fig. 5. Effect of spraying Paclobutrazol (PP_{333}) on TSS/acid ratio of Crimson seedless in 2018 season.

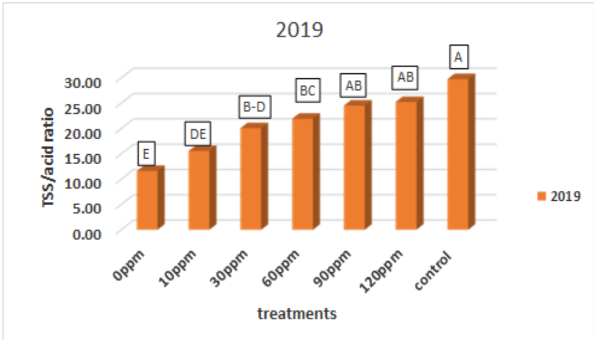

Fig. 6. Effect of spraying Paclobutrazol (PP_{333}) on TSS/acid ratio of Crimson seedless in 2019 season.

From the aforementioned results, it could be concluded that using Paclobutrazol as foliar application had no effect on vine productivity but spraying at 10 ppm concentration led to a significant increase in berry weight but didn't affect the vine yield. Thus, one can deduce that such treatments decreased the number of berries/cluster. In this concern (Rahman *et al.* 1989b) working on tomato found that paclobutrazol gave a different impact as it significantly enhanced number of fruit per plant but also could not increase the fruit yield. Soumya *et. al.*, 2017 claimed that the increase in berry weight might due to change in the levels of plant hormones.

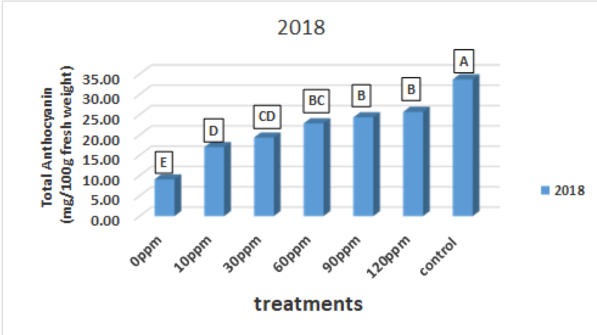

Fig. 7. Effect of spraying Paclobutrazol (PP_{333}) on Total Anthocyanin content (mg/100g fresh weight) of Crimson seedless in 2018 season.

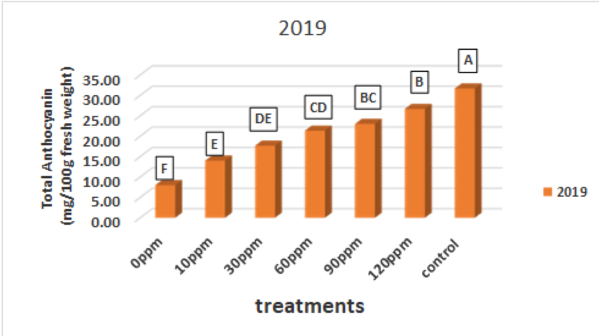

Fig. 8. Effect of spraying Paclobutrazol (PP_{333}) on Total Anthocyanin content (mg/100g fresh weight) of Crimson seedless in 2019 season.

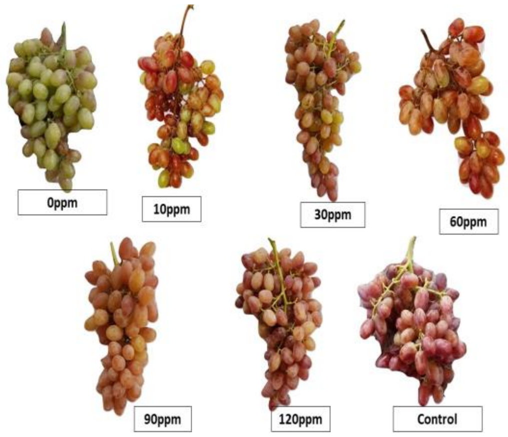

Fig. 9. Effect of spraying Paclobutrazol (PP_{333}) on berry color of Crimson seedless clusters at ripe stage on mid-September in 2019 season.

Paclobutrazol treatments showed irregular increase in firmness but generally, it was better than Ethrel treatment (control). In this concern, Dokoozlian *et. al.*, 1995_b mentioned that Ethrel reduces berry firmness compared to untreated fruits. Accordingly, low berry firmness will affect shelf life extremely.

On the other hand, the berries resulted from 120 ppm and 90 ppm of PP_{333} treatments had the highest TSS% because of the effect of Paclobutrazol in enhancing leaf photosynthesis and level of proline (Soumya *et. al.*, 2017); this situation may lead to increase the synthesis of carbohydrates by photosynthesis from side and the accumulation of soluble solids in plant cell as a result of proline level increase as an osmolyate from the other side.

Also, one can observe that acidity percentages decreased in parallel with increasing of the applied concentrations of Paclobutrazol especially in the second season. Also; 120 ppm treated berries got the highest ratio of TSS/acid.

Moreover, there was a good impact on total content of anthocyanine in Crimson berries as it had an ascending increase in parallel with Paclobutrazol concentration; this result could be explained through the finding of Soumya *et. al.*, (2017) who stated that Paclobutrazol (PBZ) influences the isoprenoid pathway and alters the levels of plant hormones and that resulted to the production of abscisic acid. Also, Jeong *et. al.* (2004) reported that application of abscisic acid (ABA) to 'Cabernet Sauvignon' (*Vitis vinifera* L.) berries encouraged the accumulation of mRNA coding for several enzymes associated with anthocyanin biosynthesis, comprehensive UFGT, after treatment about two or four weeks. Consequantly, Paclobutrazol may has a similar effect on the formation of anthocyanins with grape berries; either directly through the activation of the formation of UFGT enzyme or indirectly through promotes the production of abscisic acid.

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تأثير رش الباكلوبيترازول (الكلتار) على المحصول وجودة ثمار عنب كريمسون اللابذرى

مينا سمعان فرج سمعان و محمد عبد الحميد ناصر*

قسم البساتين – كلية الزراعة – جامعة عين شمس–القاهرة – مصر

ستة تركيزات من الباكلوبترازول (صفر، 10، 30، 60، 90، 120 جزء في المليون) تم تجربتها كرش ورقي على نباتات عنب بعمر ثلاث سنوات من صنف كريمسون اللابذري لدراسة أثاره على المحصول وجودة الثمار. طبقت المعاملات المذكورة في مرحلة نزول الماء في الحبات Veraison في مقارنة مع المعاملة التقليدية (الرش بالاثيريل). تم قياس وزن العنقود، المحصول الكلي/ كرمة، وزن مائة حبة، صلابة الحبات، الحموضة الكلية، نسبة المواد الصلبة الذائبة الكلية، نسبة المواد الصلبة الذائبة / الحموضة، المحتوى الكلي من الانثوسيانين. وقد اشارت النتائج الى زيادة تصاعدية في مستوى الانثوسيانين وانخفاض في نسبة الحموضة على التوازي مع زيادة تركيزات الباكلوبترازول المستخدمة. كذلك فان الرش بتركيز 10 جزء في المليون أدى الى زيادة معنوية في وزن الحبة بينما سجلت الحبات المعاملة بتركيز 120 جزء في المليون اعلى نسبة مواد صلبة ذائبة / الحموضة.