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# Improving Fruit Quality and Marketing of “Crimson Seedless” Grape Using Some Preharvest Treatments

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**Abstract:** The present study was carried out during 2011 and 2012 seasons to study the effect of some preharvest treatments on yield and fruit quality of “Crimson seedless” grape at harvest and postharvest under room temperature. The vine was subjected to foliar spray treatments (control, proline, boric acid, phenylalanine, calcium chloride, putrescine, ethrel and S-ABA (ProTone)). The vines were sprayed twice. The first spray when berry diameter was 16.05 mm, berry length 22.46 mm and colouration percentage 23.88%. The second spray was done 15 days later. Vines sprayed with S-ABA (ProTone) and calcium chloride applications showed an increase in average cluster weight, weight and volume of 100 berries and berry shape index. Berry diameter and length were significantly increased by putrescine and ethrel applications as compared with control. Firmness and acidity were not affected by preharvest foliar application substances. Phenylalanine and proline treatments showed an increase in TSS% in the second season only. Anthocyanin was significantly increased by phenylalanine and proline in both seasons. In respect of room temperature experiment, S-ABA (ProTone) treatment had the highest unmarketable berries percentage in both seasons. However, ethrel and putrescine applications gave the lowest value. Ethrel spray led to an increase shattering percentage as compared with the other treatments in both seasons. Concerning storage periods, weight loss %, shattering %, unmarketable berries percentage and TSS% were increased while firmness and anthocyanin were reduced by advancing storage periods. On the other hand, acidity was increased in the first season but it was reduced in the second one with increasing the days of storage.

**Key words:** Amino acids % Fruit quality % Grape % Putrescine % S-ABA (ProTone) % Shelf life

## INTRODUCTION

Crimson seedless cultivar is a late-season red seedless table grape. The fruit ripens in mid-September and, weather permitting, can be held on the vine through mid-November. The cultivar extends the availability into the late fall and early winter. “Crimson seedless” grape has superior eating characteristics, berry texture is firm and crisp, and its flavor is excellent. Poor color and small berry size are the primary fruit quality problems [1]. Treatment with either ethephon or ABA allowed early harvest and induced more rapid coloring of "Crimson seedless" grapes. Other quality attributes such as firmness, berry weight, decay incidence and shatter remained unaffected among treatments [2]. Farag *et al*. [3] treated “Flame seedless” grapevine with putrescine and found that a significant increase in anthocyanin production. Ezz [4] observed that TSS%, acidity, TSS/acid ratio, total sugars, reducing sugars and anthocyanin pigment of “Red roomy” grape were increased with increasing the concentration of phenylalanine application. Boron plays an important role in movement of the natural hormones and encouragement of both cell division and cell enlargement [5]. Pandy *et al*. [6] found that proline level in particular increased at the height of the ripening process. Ethrel treated for grapes improved fruit quality by increasing TSS% and TSS/acid ratio [7]. Al-Obeed [8] found that "Flame seedless" grape sprayed with preharvest calcium chloride caused an increase in firmness and TSS% and decreased shattering and weight loss percentage. The present study was

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designed to explore the effect of preharvest treatments in improving the physicochemical quality of "Crimson seedless" grape and maintaining postharvest quality under ambient temperature condition.

## MATERIALS AND METHODS

The present study was carried out during two successive growing seasons, 2011 and 2012 on "Crimson seedless" (*Vitis vinifera* L.) grape. Vines were grown in a private farm at Kafer El-Zyate, El-Gharbia Governorate, Egypt. Vines were 9 years old, uniform, grown in clay soil on wire trills system and under drip irrigation. They were planted at 4x3 m spacing. Eight canes with 8-14 buds were left on each vine at pruning time. The experimental design was the randomized complete blocks with three replications per treatment and two vines per replicate. The treatments applied in this study are as follows: Control (water spray only), putrescine at 3 Mm , proline at 500 ppm, phenylalanine at 500 ppm, boric acid at 500 ppm, calcium chloride at 1% , Ethrel at 100 ppm and S-ABA (ProTone) 10% at 2.5 ml/L .The surfactant agrasol was added to all treatments at 0.05 %, as wetting agent. The vines were sprayed twice. The first spray when berry diameter was 16.05 mm, berry length 22.46 mm and colouration percentage 23.88%. The second spray was done 15 days later. The harvest date was nearly mid October in both seasons when the checked berries reached maturity stage (16-17%) TSS % according to Tourkey *et al*. [9]. Yield expressed in weight (kg) and number of clusters per vine was recorded at harvest time, then cluster weight was estimated. Five clusters per vine were taken at random for the determination of initial physical and chemical properties. Physical parameters (cluster weight(g), length and width(cm), weight(g) and volume of 100 berries ($ml^3$), juice percentage, berry length (L) and diameter (D), average berry shape index(L/D), berry firmness ($g/cm^2$) using a grapes pressure tester. Chemical parameters (Refractometric total soluble solids, titratable acidity using 0.1 N NaOH was determined according to A.O.A.C. [10]. TSS/acid ratio was also determined. Anthocyanin in berries (mg/100g) was determined according to Husia *et al*. [11]. The other clusters (8 clusters each replicate) were kept at the room temperature (24-26ºC and 74-77% RH) to simulate marketing period. The shelf life experiment design was completely randomized block design in split-plot arrangement. Weight loss %, shattering %, unmarketable berries percent and firmness were detected at 2, 4 and 6 days. TSS %, acidity, TSS/acidity ratio and anthocyanin were estimated at 0 and 6 days (the termination of experiment temperature when 50% or more of pedicles were browning).The obtained data was statistically analyzed according to Snedecor and Cochran [12].

## RESULTS AND DISCUSSION

### Yield and Fruit Quality at Harvest

**Yield:** In both seasons, yield was not significantly affected by preharvest foliar application substances (Table 1). This effect was observed by Cantin *et al*. [2]; they reported that total yield was not affected by ethephon and abscisic acid treatments.

**Weight of 100 Berries**: The data in both seasons indicated that there were highly significant differences among tested treatments. S-ABA (ProTone) and calcium chloride significantly higher than control in the first and second season, respectively (Table1). Peppi and Fidelibus [13] observed that all tested ABA concentrations increased berry mass of "Flame seedless" grape. Colapietra and Alexander [14] treated "Italia" table grapes with Ca fertilizer which caused significantly increased in yield, average berry weight and sugar content.

**Berry Size:** S-ABA (ProTone) and calcium chloride treatments significantly increased berry size as compared with control in the first and second season, respectively (Table 1). These data were supported by Peppi and Fidelibus [13], During *et al*. [15] and Han *et al*. [16] who reported that berry size was increased by ABA treatment. Yu *et al*. [17] demonstrated that calcium plays a central role in mediating abscisic acid signaling, but many of the $Ca^{2+}$ binding with sensory proteins as the components of the ABA-signaling pathway in regulating development of the grape berry.

**Berry Diameter and Length**: In both seasons, the vines subjected to putrescine, calcium chloride and ethrel sprays had highly significant berry diameter as compared with the control (Table 2). The results presented in Table 2 showed that the vines received putrescine and ethrel sprays had very significant berry length when compared with the control in the first and second seasons, respectively. Shiozaki *et al*. [18]

Table 1: Effect of preharvest treatments on physical parameters at harvest of "Crimson seedless" grape in 2011 and 2012 seasons.

| | Parameter | | | | | |
|---|---|---|---|---|---|---|
| Treatment | Yield (kg)2011 | Yield (kg)2012 | Weight of 100 berries (g) 2011 | Weight of 100 berries (g) 2012 | Size of 100 berries ($cm^3$) 2011 | Size of 100 berries ($cm^3$) 2012 |
| Control | 7.93 | 8.99 | 337.49 | 384.34 | 313.33 | 360 |
| Putrescine | 6.2 | 7.27 | 364.57 | 411.75 | 346.67 | 393.33 |
| $CaCl_2$ | 8.64 | 11.86 | 383.01 | 450.13 | 360 | 430 |
| Boric acid | 6.45 | 9.06 | 371.66 | 418.64 | 360 | 400 |
| Ethrel | 5.92 | 7.06 | 366.31 | 459 | 353.33 | 393.33 |
| Proline | 6.11 | 5.34 | 296.88 | 349.79 | 280 | 330 |
| Phenylalanine | 6.38 | 7.33 | 302.65 | 345.25 | 246.67 | 326.67 |
| ProTone | 8.06 | 9.17 | 399.03 | 426.63 | 376.67 | 400 |
| LSD 0.05 | N.S | N.S | 37.68 | 61.78 | 67.21 | 41.7 |

Table 2: Effect of some preharvest treatments on physical parameters at harvest of "Crimson seedless" grape in 2011 and 2012 seasons.

| | Parameter | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Treatment | Cluster weight (g) 2011 | Cluster weight (g)2012 | Berry diameter (mm)2011 | Berry diameter (mm)2012 | Berry length (mm)2011 | Berry length (mm) 2012 | Firmness ($g/cm^2$) 2011 | Firmness ($g/cm^2$) 2012 |
| Control | 294.33 | 352.33 | 15.34 | 16.63 | 22.15 | 22.84 | 357.77 | 400 |
| Putrescine | 244.33 | 350.33 | 16.6 | 17.44 | 24.27 | 25.13 | 357.78 | 405 |
| $CaCl_2$ | 272.33 | 383.33 | 16.16 | 17.89 | 23.89 | 25.25 | 355.55 | 408.33 |
| Boric acid | 264.67 | 362 | 16.03 | 17.12 | 23.77 | 24.54 | 313.89 | 373.33 |
| Ethrel | 247 | 334.33 | 16.53 | 17.21 | 23.72 | 25.94 | 334.44 | 397.22 |
| Proline | 214 | 244.33 | 14.68 | 15.84 | 20.97 | 22.82 | 318.89 | 371.11 |
| Phenylalanine | 201.67 | 296 | 15.25 | 15.93 | 22.23 | 23.83 | 340.55 | 377.22 |
| ProTone | 330.67 | 394.33 | 15.91 | 16.42 | 24.01 | 25.59 | 343.89 | 379.89 |
| LSD 0.05 | 51.05 | 85.21 | 0.72 | 0.92 | 0.87 | 1.39 | N.S | N.S |

reported that high levels of free putrescine and spermdine during early development, therefore, be associated with cell proliferation in pericarp of "Muscat Bailey" grapes. Besides, Chervin *et al*. [19] observed that ethylene perception, at this time is required for at least increasing berry grape diameter. The beginning of the second growth phase, berry growth is mainly linked to phloem fluxes but it is not excluded that some sap canes from xylem tissues and Colapitra and Alexander [14] on "Italia" table grapes.

**Average Cluster Weight:** The data presented in Table 2 indicated that the vines received S-ABA (ProTon) and calcium chloride sprays had the highest cluster weight in both seasons. The data are supported by Peppi and Fidelibus [13] on "Flame seedless" cultivar and Colapietra and Alexander [14] on "Italia" table grapes.

**Berry Firmness:** The results in both seasons showed that firmness was not significantly affected by using foliar application (Table 2). The same line was found by Lurie *et al*. [20]; they found that firmness of "Crimson seedless'' grape was not affected by S-ABA (ProTon) treatment. Cantin *et al*. [2] reported that firmness of "Crimson seedless'' grape remained unaffected by ABA and ethephon treatments.

**Berry Shape Index (L/D):** The results in the first season showed that berry shape index was not significantly affected by the used foliar applications. However, S-ABA (ProTon) and calcium chloride led to higher berry shape index than control in the second season (Table 3). Similar results were observed by Peppi and Fidelibus [13] who found that no major differences in berry shape was detected under ABA treatment. On the other hand, During *et al*. [15], Han *et al*. [16] and Yu *et al*. [17] reported that calcium and ABA acid regulated development of the grape berry.

**Other Physical Parameters:** The data in both seasons indicated that juice percentage and length and width of cluster were not significantly affected by the used foliar applications (Table 3).

**Total Soluble Solids (TSS%):** In the first season, there were no significant differences among the tested treatments concerning TSS% but phenylalanine and

Table 3: Effect of preharvest treatments on physical parameters at harvest of "Crimson seedless" grape in 2011 and 2012 seasons.

| | Parameter | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Treatment | L/D ratio 2011 | L/D ratio 2012 | Juice % 2011 | Juice % 2012 | Cluster length (cm)2011 | Cluster length (cm) 2012 | Cluster width (cm) 2011 | Cluster width (cm) 2012 |
| Control | 1.44 | 1.37 | 63.17 | 77.67 | 16.16 | 18.66 | 12.16 | 14.16 |
| Putrescine | 1.46 | 1.43 | 70.63 | 74.02 | 12.66 | 18.66 | 11 | 16.33 |
| $CaCl_2$ | 1.47 | 1.4 | 78.83 | 79.63 | 17 | 23 | 13 | 15.5 |
| Boric acid | 1.47 | 1.42 | 75.36 | 79.07 | 14.83 | 16.66 | 12 | 13.66 |
| Ethrel | 1.43 | 1.5 | 71.56 | 76.98 | 15.33 | 16.33 | 10.66 | 14 |
| Proline | 1.42 | 1.43 | 59.22 | 71.06 | 14.66 | 17.83 | 11.66 | 12.66 |
| Phenylalanine | 1.45 | 1.49 | 67.39 | 68.98 | 15.66 | 18.5 | 13 | 15.16 |
| ProTone | 1.5 | 1.55 | 75.94 | 79.67 | 16.33 | 20 | 11.83 | 14.16 |
| LSD 0.05 | N.S | 0.07 | N.S | N.S | N.S | N.S | N.S | N.S |

Table 4: Effect of preharvest treatments on chemical parameters at harvest of "Crimson seedless" grape in 2011 and 2012 seasons.

| | Parameter | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Treatment | TSS % 2011 | TSS % 2012 | Acidity% 2011 | Acidity% 2012 | T/A ratio 2011 | T/A ratio 2012 | Antho-cyanine mg/100g 2011 | Anthocyanine mg/100g 2012 |
| Control | 15.86 | 16.33 | 0.5 | 0.59 | 31.91 | 27.55 | 0.39 | 1.13 |
| Putrescine | 16.06 | 16.8 | 0.47 | 0.56 | 34.37 | 29.99 | 1.1 | 2.22 |
| $CaCl_2$ | 16.2 | 16.66 | 0.42 | 0.6 | 38.28 | 28.12 | 1.41 | 1.96 |
| Boric acid | 15.8 | 16.93 | 0.44 | 0.53 | 36.07 | 31.66 | 2.49 | 3.36 |
| Ethrel | 16.06 | 16.26 | 0.4 | 0.49 | 39.85 | 33.21 | 2.48 | 4.71 |
| Proline | 16.66 | 17.06 | 0.42 | 0.48 | 39.45 | 35.41 | 3.46 | 6.12 |
| Phenyalalanine | 16.73 | 18.06 | 0.42 | 0.51 | 39.23 | 35.35 | 3.82 | 5.4 |
| ProTone | 15.66 | 16.86 | 0.42 | 0.5 | 36.72 | 33.54 | 1.86 | 3.64 |
| LSD 0.05 | N.S | 0.64 | N.S | N.S | N.S | N.S | 0.88 | 0.94 |

proline significantly increased TSS % than control in the second season (Table 4). The results were supported with those found by Lurie *et al*. [20], who found that soluble solids content (SCC) of "Crimson seedless" cultivars was not affect by S-ABA (ProTone). Farag *et al*. [3] treated "Flame seedless" cultivar with preharvest phenyalanine and found that TSS was not affected with phenylalanine in both seasons. On the other hand, Koval *et al*. [21] reported that preharvest phenylalanine application led to increase berry sugars content in Cabernet sauvignon grapevines. Besides, Ezz [4] observed that TSS % of "Red roomy" grape was increased with increasing the concentration of phenylalanine application. Ezz and El-Kobbia [22] treated Pairi mango fruits with phenylalanine that contained higher amount TSS%. Ezz [23] reported that proline foliar sprays significantly increased reducing sugars content of grapefruits.

**Acidity and TSS/ Acidity Ratio:** The data in both seasons indicated that acidity and TSS/acidity ratio were not significantly affected by the used foliar applications (Table 4). The same trend was found by Lurie *et al*. [20], who reported that SSC and acidity were not affected by S-ABA treatment. Peppi and Fidelibus [13] reported that application of abscisic acid or ethephon had little effect on the soluble solids or acidity of the fruits.

**Anthocyanin:** The data in both seasons showed highly significant differences among the tested treatments. Phenylalanine and proline, except ethrel treatment that did not significantly differ from phenylalanine in the second season, significantly increased anothocyanine as compared with the other treatments (Table 4). These results are in line with those reported by Kanellis [24], who found that phenylalanine was the primer compound in the pathway of anthocyanin biosynthesis. It requires the activity of the enzyme phenylalanine ammonia-lyase (PAL). Besides, a correlation was found between PAL activity in the skin of colored grapes and the accumulation of anthocyanin [16, 25, 26]. Ezz [4] found that anthocyanin pigment was increased with increasing the concentration of phenylalanine application in "Red roomy" cultivar. Moreover, phenylalanine treated Pairi mango fruits showed higher amount of carotene and anthocyanin than the control. Gibson [27] found that a

Table 5: Effect of some preharvest treatments on weight loss % and firmness at room temperature of "Crimson seedless" grape overall storage periods in 2011 and 2012 seasons.

| Treatment | Parameter | | | |
|---|---|---|---|---|
| | Weight loss % 2011 | Weight loss % 2012 | Firmness $g/cm^2$ 2011 | Firmness $g/cm^2$ 2012 |
| Control | 11.19 | 12.58 | 333.06 | 366.94 |
| Putrescine | 10.91 | 12.22 | 357.5 | 382.22 |
| $CaCl_2$ | 10.98 | 13.88 | 341.11 | 396.44 |
| Boric acid | 12.37 | 14.33 | 352.5 | 411.38 |
| Ethrel | 11.14 | 14.76 | 322.78 | 394.44 |
| Proline | 10.14 | 12.71 | 346.94 | 385.55 |
| Phenylalanine | 11.19 | 13.75 | 332.78 | 386.38 |
| ProTone | 11.07 | 12.55 | 327.22 | 400.27 |
| LSD 0.05 | 1.28 | 2.04 | 33.51 | 21.34 |

Table 6: Effect of storage periods on weight loss % and firmness at room temperature of "Crimson seedless" grape overall treatments in 2011 and 2012 seasons

| Period | Parameter | | | |
|---|---|---|---|---|
| | Weight loss % 2011 | Weight loss % 2012 | Firmness $g/cm^2$ 2011 | Firmness $g/cm^2$ 2012 |
| 2 days | 5.18 | 6.3 | 376.04 | 419.37 |
| 4 days | 10.13 | 12.16 | 328.12 | 392.08 |
| 6 days | 18.06 | 21.58 | 313.54 | 360.1 |
| LSD 0.05 | 0.48 | 0.87 | 12.23 | 14.12 |

link between proline and ABA might also be provided by sugars. Cantin *et al*. [2] reported that ABA is an effective alternative to ethephon for enhancing the color of "Crimson seedless" grape. Gollop *et al*. [28] reported that grape berry skin sugars were found to induce most of the genes involved in anthocyanin synthesis.

**Shelf Life Assessment**

**Weight Loss (%):** The data obtained from this study revealed that proline and putrescine application decreased weight loss percentage overall storage periods in the first and second seasons, respectively (Table 5). These data were in line with those reported by Farag *et al*. [3], who found that putrescine caused a significant delay in the loss of firmness and retention force of Flame seedless cultivar. . Serrano *et al*. [29] observed that putrescine decreased weight loss for plum. According to Costantini *et al*. [30] proline is produced a significant extend during postharvest water loss in "Malvasia" grapes. Ezz and El-Kobbia [31] found that preharvest phenylalanine foliar spray decreased weight loss for Pairi mango which fruits were stored at 10ºC and RH of 85%-90%. The results also showed that weight loss percentage was increased during room storage (Table 6). The obtained data are supported by many researchers worked on different varieties of grapes such as Al-Shoffe [32] on "Superior" variety, Ghawas [33] on "Flame seedless" and "Thompson seedless" varieties.

**Firmness:** Berries treated with putrescine and boric acid recorded the highest firmness overall storage periods in the first and second seasons, respectively (Table 5). The present results were supported by Farag *et al*. [3] who treated Flame seedless cultivar bunches with putrescine application at 2.5 mM. These substances caused a significant delay in the loss of firmness in both seasons. Valero *et al*. [34] explored that the effect of polyamines on increasing fruit firmness can be attributed to their cross- linking to the $coo^-$ of the pectic substances in the cell wall, resulting in rigidification that is detectable immediately after treatment. This binding also blocks the access of degrading enzymes reducing the rate of softening during storage. Besides, Niijar [5] reported that boron plays an important role in movement of natural hormones and encouragement of both cell division and cell enlargement. Firmness was decreased with advancing storage (Table 6). These results were supported by Ghawas [33], who found that there was an evident decrease in berry firmness with advancing of cold storage periods in "Thompson seedless" cultivar.

Table 7: Effect of some preharvest treatments on unmarketable berries % and shattering % at room temperature of “Crimson seedless” grape overall storage periods in 2011 and 2012 seasons

| Treatment | Parameter: Unmarketable berries % 2011 | Unmarketable berries %2012 | Shattering %2011 | Shattering %2012 |
|---|---|---|---|---|
| Control | 2.38 | 5.76 | 0.82 | 1.7 |
| Putrescine | 0.8 | 3.33 | 0 | 0.86 |
| $CaCl_2$ | 1.01 | 4.97 | 0.63 | 1.17 |
| Boric acid | 2.79 | 6.97 | 1.06 | 0 |
| Ethrel | 0.45 | 7.51 | 2.81 | 6.41 |
| Proline | 1.32 | 9.31 | 0.63 | 0.56 |
| Phenylalanine | 1.52 | 4.02 | 0 | 0.45 |
| ProTone | 3.16 | 11.42 | 1.02 | 1.65 |
| LSD 0.05 | 1.85 | 6.13 | 1.12 | 1.99 |

Table 8: Effect of storage periods on unmarketable berries % and shattering % at room temperature of “Crimson seedless” grape overall treatments in 2011 and 2012 seasons

| Period | Parameter: Unmarketable berries %2011 | Unmarketable berries %2012 | Shattering % 2011 | Shattering % 2012 |
|---|---|---|---|---|
| 2 days | 0.56 | 3.05 | 0.33 | 1.2 |
| 4 days | 1.04 | 6.42 | 0.71 | 1.48 |
| 6 days | 3.43 | 10.52 | 1.57 | 2.11 |
| L.S.D.05 | 0.77 | 1.64 | 0.71 | 1.8 |

Table 9: Effect of some preharvest treatments on TSS % and acidity at room temperature of “Crimson seedless” grape overall storage periods in 2011 and 2012 seasons.

| Treatment | Parameter: TSS % 2011 | TSS % 2012 | Acidity % 2011 | Acidity % 2012 |
|---|---|---|---|---|
| Control | 17.74 | 18.91 | 0.5 | 0.58 |
| Putrescine | 18.14 | 18.96 | 0.49 | 0.54 |
| $CaCl_2$ | 18.26 | 19.43 | 0.46 | 0.56 |
| Boric acid | 17.85 | 18.98 | 0.45 | 0.52 |
| Ethrel | 18.16 | 18.51 | 0.43 | 0.46 |
| Proline | 18.39 | 19.84 | 0.44 | 0.46 |
| Phenylalanine | 18.34 | 20.24 | 0.44 | 0.49 |
| ProTone | 17.97 | 18.58 | 0.44 | 0.48 |
| LSD 0.05 | 1.06 | 0.83 | 0.05 | 0.08 |

**Unmarketable Berries (%):** The results in both seasons showed that S-ABA (ProTon) spray had the highest unmarketable berries overall storage periods. However, ethrel and putrescine gave the lowest value in the first and second seasons, respectively (Table 7). The present results were supported by Peppi *et al*. [35] found that ABA increased berry softening of “Flame seedless” grapes. Unmarketable berries were increased during storage in both seasons (Table 8). Ghawas [33] pointed out that there was an evident increase in unmarketable berries % of “Thompson seedless” cultivar with the increasing of cold storage days.

**Shattering:** Ethrel spray significantly recorded a higher shattering than the other treatments in both seasons (Table 7). The same line was found by Wu *et al*. [36] who reported that postharvest abscission of grape berries usually occurs due ethylene , together with falling auxin levels that induce the formation of an abscission zone at the pedicel. Shattering was increased during storage period (Table 8). Ghawas [33] found that there was an increase in berry shattering of “Thompson seedless” grape with increasing the days of cold storage.

**Total Soluble Solids(TSS %):** Phenylalanine and proline application led to increase TSS % as compared with the control in the second season only overall storage periods (Table 9). These results agreed with those many investigations such as previously reported by Koval *et al*. [21] on "Cabernet sauvignon" grapevines, Ezz [4] on “Red roomy” cultivar, Ezz and

Table 10: Effect of storage periods on TSS% and Acidity% at room temperature of “Crimson seedless” grape overall treatments in 2011 and 2012 seasons

| | Parameter | | | |
|---|---|---|---|---|
| Period | TSS % 2011 | TSS % 2012 | Acidity % 2011 | Acidity % 2012 |
| 0 days | 16.13 | 16.87 | 0.44 | 0.53 |
| 6 days | 20.08 | 21.49 | 0.48 | 0.49 |
| LSD 0.05 | 0.44 | 0.34 | 0.03 | 0.02 |

Table 11: Effect of some preharvest treatments on TSS /acidity ratio and anthocyanin at room temperature of “Crimson seedless” grape overall storage periods in 2011 and 2012 seasons

| | Parameter | | | |
|---|---|---|---|---|
| Treatment | TSS /acidity ratio 2011 | TSS /acidity ratio 2012 | Anthocyanin mg/100g 2011 | Anthocyanin mg/100g 2012 |
| Control | 35.23 | 32.52 | 0.35 | 0.88 |
| Putrescine | 37.91 | 34.89 | 0.75 | 1.41 |
| $CaCl_2$ | 39.79 | 36.34 | 0.97 | 1.4 |
| Boric acid | 39.84 | 36.46 | 1.54 | 2.14 |
| Ethrel | 42.18 | 40.69 | 1.57 | 3 |
| Proline | 41.99 | 42.91 | 2.07 | 4.01 |
| Phenyalanine | 41.06 | 41.58 | 2.55 | 3.86 |
| ProTone | 40.06 | 39.04 | 1.22 | 2.47 |
| LSD 0.05 | 4.37 | 5.38 | 0.49 | 0.49 |

Table 12: Effect of storage periods on TSS/acidity ratio and anthocyanin at room temperature of “Crimson seedless” grape overall treatments in 2011 and 2012 seasons

| | Parameter | | | |
|---|---|---|---|---|
| Period | TSS /acidity ratio 2011 | TSS/acidity ratio 2012 | Anthocyanin mg/100g 2011 | Anthocyanin mg/100g 2012 |
| 0 days | 36.98 | 31.9 | 2.12 | 3.57 |
| 6 days | 42.53 | 44.21 | 0.63 | 1.23 |
| LSD05 | 3.32 | 2.83 | 0.21 | 0.27 |

El-Kobbia [22] on Pairi mango fruits and Ezz [23] on grapefruit. TSS was increased during room storage (Table 10). The results were supported by those obtained by Al-Shoffe [32] who found that there was a gradual increase in the juice SSC % as the time of storage increased in “Superior” grape. This gradual increase in juice SSC% can be attributed to moisture loss from grape during cold storage.

**Juice Acidity:** In the second season, control gave the highest acidity% while ethrel recorded the lowest value overall storage periods (Table 9). Fawzi *et al*. [7] reported that acidity was reduced by ethephon application in “Black Monukka” grape. In the first season, acidity was increased with advancing room storage. However, the trend was reversed in the second season (Table 10). These findings seem to be in agreement with those of Tyle [37], who found that the percentage of tartaric acid in the juice of “Red roomy” grape was increased during cold storage. On the contrary, Al-Shoffe [32] found that acidity of “Thompson seedless” cultivar was decreased with advancing in cold storage periods. This reduction could be attributed to consumption of acids in respiration with consequent decrease in titratable acidity.

**TSS/Acidity Ratio:** Proline, phenylalanine and ethrel sprays significantly were higher in this concern than control in both seasons overall storage periods (Table 11). These results are in line with those reported by Koval *et al*. [21] on “Cabernet Sauvignon” grapevines and Ezz [4] who reported that phenylalanine led to increase TSS/acid ratio. TSS acid ratio was increased during room storage (Table 12). Al-Shoffe [32] and Ghaws [33] reported that TSS/acid ratio in grape was increased as the storage period advanced.

**Anthocyanin:** The results in both seasons showed that phenyalanine and proline caused a higher significant than the rest treatments overall storage periods (Table 11). The same result was found by Ezz [4] on “Red roomy” grape and Ezz and El-Kobbia [22] on Pairi mango fruits. Anthocyanin was significantly decreased by advancing storage periods (Table 12) .These result was supported by Montgomery *et al*. [38] who reported that anthocyanin is degraded during storage. These changes in color are due to both Maillard reaction and anthocyanin degradation [39].

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