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Using Some Nutrients and Essential Oils for Improving 'Crimson Seedless' Grape Color

Magda, Mahmoud, A.[1], Reham, Magdi, M.A[1]. Samah, Ibrahim.N,[2]

1 Horticulture Research Institute, Agriculture Research Center

2 Agriculture, Co Operation Institute, Ain Shams University

ABSTRACT

Crimson Seedless exhibits inadequate red color development, causing economic losses due to lower product quality. this study was conducted to evaluate efficacy of Essential oil Rosemary oil and Camphor oil with two concentrations (100 and 200 mg/L), plant growth regulators such as Abscisic (ABA) and boric acids (BA) with concentrations (100 mg/L and 200 mg/L) and ethephon (200 gm/ L) during in coloring period to increases the anthocyanin content of the skin, improving the color of the berry. In current study, a randomized block design.

Clusters were sprayed twice. The first one in version stage, the second application was performed for all treatments, 15 days after the first application. The plant growth regulators of Abscisic acid 1% or Boric acid 1% and the essential oils of Camphor oil 2% were the most effective in grape coloring development and lower costs.

Key wards: Crimson Seedless, Grape, Abscisic acid, Boric acid, Rosemary oil, Camphor oil

INTRODUCTION

Grape (*Vitis vinifera L.*,) is considered one of the oldest known edible fruits which mentioned in the Bible and Quran. Grapes grown under warm climate conditions tend to show less color development, and this phenomenon is attributed to low anthocyanin accumulation in berry skin in response to high temperature during ripening. 'Benitaka' (Vitis vinifera L.) is a table grape that shows poor color development when grown under a subtropical condition, In part, this is due to high night temperatures that inhibit accumulation of anthocyanins (**Muhammad *et al* 2020**).

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High temperatures at the beginning of grape ripening may decrease the levels of abscisic acid (ABA), and during this process may reduce the accumulation of anthocyanins and increase their degradation **(Koshita *et al.*, 2015).** Anthocyanins are synthesized by the phenylpropanoid pathway; several structural genes and encoding enzymes of this pathway have been well described (**Villegas *et al.*, 2016).** Accumulation of anthocyanins begins at veraison, this accumulation appears to be related to the actions of two endogenous PGRs, auxins which inhibit anthocyanin synthesis, and abscisic acid (ABA) which enhances anthocyanin accumulation **(Ban *et al*., 2003; Lund *et al.*, 2008; Ferrara *et al.*, 2015;).** The accumulation of anthocyanin in the grape skin has been shown to be stimulated by exogenous application of sugar (**Olivares, *et al* 2017).** Application of ethephon can increase the accumulation of anthocyanins, while also advancing ripening **(Lichter *et al.*, 2004).** Ethephon is also usually applied to red-colored Table grapes in order to improve berry color, but its effect is not consistent. Moreover, ethephon application can cause berry softening, which reduces the value of exported grapes (**Peppi *et al.*, 2007**).

Therefore, it is necessary to identify other cost-effective management practices capable of enhancing berry color, without causing excessive softening. During plant evolution, ABA conserved its ancestral role in cellular responses modulation to stimuli affecting the cell water status, but acquired new functions in the regulation of different processes, sometimes also in a species specific way **(Takezawa et al., 2011; Wanke, 2011).** Boric acid is a mild acid that is commonly used for sterilization and disinfection. Due to its disinfectant, bactericidal and wall strengthening properties boric acid reduces the post-harvest rotting in many fruits**. (Wang 1971)** had been observed that boric acid inhibited the ethylene production, ripening process and disease incident. The inhibition of ethylene production, ripening and disease. **(Besong and Lawanson 1991)** confirmed that the activity of respiratory enzymes was intensified under boron deficiency, but lowered by boron application. Ethylene production in boron treated fruit was reduced, most effectively after boron and calcium application. The functions of boron and calcium on the structure of cell walls and cell membranes. Essential oils are volatile, natural, complex compounds characterized by a strong odor and are formed by aromatic plants as secondary metabolites.

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Essential oils are also aromatic oily liquids obtained by steam or hydro distillation from plant materials such as flowers, buds, seeds, leaves, twigs, bark, herbs, wood, fruits and roots. An estimated 3000 Essential oils are known, of which about 300 are commercially important (**Solgi1 and Ghorbanpour 2014).** Essential oils have antimicrobial and antioxidant properties, which could greatly aid in the extension of the shelf life of fresh-cut products **(Valero *et al*., 2006; Serrano *et al.*, 2008). Lee *et al.* (2005)** identified the aromatic compounds of different essential oils, reporting that thymol, carvacrol, 4-aliphenol and eugenol showed a high level of antioxidant activity, inhibiting hexanal oxidation by 95-99% at 5 μ/mL over 30 days. The chemical composition of *Eucalyptus olida* shows significant interspecies variability which appears to depend on both the genetic characteristics of the plants as well as the conditions under which they are grown (**Gilles *et al* 2010**). Essential oil "basil" is a member of the Lamiaceae family, it is an annual herb which grows in many countries Recently the potential uses as antimicrobial and antioxidant agents have also been investigated **(Lee, *et al* 2005: Politeo *et al.*, 2007: Suppaku *et al.*, 2003).** The genus Lavandula (lavender) is comprised of about 25–30 species of flowering plants in the Lamiaceae.

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(Labiatae) family is a well-known essential oil about its antimicrobial and antifungal properties **(D'auria , *et al.,* 2005).** "Mentha piperita" is another essential oil which has high antimicrobial. Essential oil is expected to depend on the relative occurrence of its individual constituents. In general, cytotoxicity of EOs is mostly due to alcohols, phenols and aldehydes. (**Bakkali *et al*,. 2008).**

MATERIALS AND METHODS

Grapevines and growing conditions

The trail was conducted during years 2018 and 2019 in the Experimental Farm of Mansoura Research Station on Crimson seedless grapes (*Vitis vinifera L*.,) spaced at 4 × 2 m and trained in pergola system. Vines were 8 years old growing in a clay soil. A randomized complete block design was used as a statistical model with ten treatments and four replications, each plot consisting of one grapevine. The crop management practices adopted for plant nutrition, weed control, and pest and disease management were those commonly used in the region.

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Treatments and experimental design

The treatments were applied by spraying only the clusters in the morning, using a knapsack sprayer with hollow cone spray nozzles JA1, providing complete and uniform coverage. Treatments were: 1- Control (C), 2- 100 mg/L Abscisic acid (ABA), 3 - 200 mg/L Abscisic acid (ABA), 4- 100 mg/L Boric acid (BA), 5 –200 mg/L Boric acid (BA), 6- 100 mg /L, Rosemary oil (RO), 7- 200 mg/L Rosemary oil (RO), 8- 100 mg/L camphor oil oil (CO), 9- 200 mg /L camphor oil (CO), 10- 200 gm/ L ethephon.. Treatments, applied on different timings of ripening were tested: first one at veraison (V); and at postveraison (POV) (at 7 days after V). When berries were ripening stage (TSS ≈ 14 – 15 %) and (0.4 – 0.5 %) acidity and complete red color of berries skin clusters hand harvest the clusters of all treatments were harvested in the same day. In the summer season, the harvest was performed in early September. 5 cluster per vine were taken at random for the determination of harvest physical and chemical properties. Physical parameters cluster weight (g), volume of 25 berries (ml), juice percentage and berry firmness (g/cm) using a grapes pressure tester. Chemical parameters (Refractometric total soluble solids (T.S.S), titratable acidity (TA) using 0.1 N NaOH was determined according to A.O.A.C. TSS/acid ratio was also determined. The evaluation of the total anthocyanin concentration in the grape berry skin was performed according to a method described by **(Peppi *et al*.2006)**. From each sample, 3g of the berry skin was peeled off and washed with distilled water, followed by a quick wash with ed-ionized water and then dried with sterilized tissues. Further, 30 mL acidified methanol (HCl 1% + methanol 99%) was added to the peeled berry skin and kept in the dark for 48 h.

The values were recorded using a spectrophotometer at 520 nm, and the results were expressed as milligrams of total anthocyanin sasmalvidin-3-glucoside per gram of berry skin (mg.g−1). The evaluation of the total polyphenol concentration in the pulp and skin of berries was based on the Folin Ciocauteau method **(Bucic-Kojic *et al*., 2007; Borges *et al*., 2013).** The samples were macerated and 5g of this sample was homogenized with 50 mL of 50% ethanol in a blender for 2 min and centrifuged at 3500rpm for 5min. A 0.2mL aliquot of the extract was mixed with 1.8 mL distilled water and 10 mL of 10-fold diluted Folin-Ciocalteau reagent. In addition, after 30 s to 8 min, 8 mL of 7.5% Na2CO3 solution was added. All test tubes containing the mixture were shaken for10 s on the vortex and kept in the darkness for 2h. Further, the absorbance of each sample was measured after 15min using a spectrophotometer at 765nm against a blank sample. Total polyphenols was determined from the calibration curve obtained with gallic acid; readings were expressed as mg.100g−1 of berries (gallic acid equivalents). On harvest day also clusters were packed in carton boxes (2 kg grapes each) three replicates of nine samples from every treatment were taken to be held at room temperature (25-30 °C and R.H 45%) simulate marketing period. Samples were examined at 2 days interval to be objected weight loss %, shattering% unmarketable berries percent and firmness were detected at 2, 4 and 6 days. T.S.S %, acidity, T.S.S/acidity ratio and anthocyanin were estimated at harvest and after 6 days (the termination of experiment temperature when 50% or more of pedicles were browning).

The obtained data throughout the two seasons were subjected to analysis of **SAS Computer Program (1998)** according to Duncan's multiple range.

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Results and Decoctions

Harvest date

It is known that Crimson seedless grape under Egypt climate harvest at mid of September in delta. Crimson seedless grapes treated by boric acid, abscisic acid, rosemary oil, camphor oil in their concentration (1%, 2%) and ethephon 2%, clusters of grapes attained marketable quality between first week to third week on August depending on the treatments they received. Grapes treated colored quickly and thus were harvestable earlier than untreated grapes.

Physical quality attributes

Softening of fruits is caused either by the breakdown of insoluble protopectin into soluble pectin or by the cellular disintegration leading increased membrane permeability (**Matto *et, al.*, 1975).** Tables 1 and 2 shows a significant decrease in berry firmness and increasing on shatter berries in the end of the trail for all treatments in the two seasons for all treatments and increasing concentration to 2% in boric or abscisic acids or essential oils (rosemary and camphor) not more affective. We noticed that rosemary oil and camphor oil were in the line of ethaphon 2% with no significant deference between them.

The reduction in fruit softening with boric acid application may be due to decrease in Physiological loss in weight (PLW) and cell wall degenerating enzyme (PME) activity (**Kaur *et, al.*, 2016).** While Anthocyanin accumulation by Abscisic acid which due to imply these compounds are stored inside the cell vacuole, thus increasing the solute concentration. As water flows from the area of low concentration towards the area of high concentration the cell vacuole must have absorbed more water from the surrounding cytoplasm and decreased the cell turgidity. This could be the reason behind the decrease in the firmness of grape berries in response to S-ABA treatments. (**Muhammad *et al.*, 2020**). It is also important to mention that a hormonal balance controls the senescence process, so, it is possible that the S-ABA regulated this balance, decreasing the shatter (**Ferrara *et al.*, 2016**).

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Table 1: Effect of Using Some Nutrients and Essential Oils on Crimson Seedless Grape in Berry Firmness Shelf Life Period During 2019 and 2020 Seasons.

Berry firmness (ib/in^2)								
Season	**2019**				**2020**			
	Period in days							
Treatments	**H**	**2**	**4**	**6**	**H**	**2**	**4**	**6**
T_1	9.3 a	9.2 a	8.5 c	6.8 f	9.8 a	9.5 a	8.8 b	7.3 e
T_2	9.3 a	9.3 a	8.6 c	8.0 d	9.6 a	9.5 a	9.1 b	8.2 c
T_3	9.2 a	9.1 ab	8.6 c	7.9 d	9.5 a	9.4 a	8.9 b	8.0 c
T_4	9.3 a	9.1 ab	8.5 c	7.7 e	9.7 a	9.5 a	9.0 b	8.0 c
T_5	9.2 a	9.0 ab	8.6 c	7.7 e	9.4 a	9.2 ab	8.4 c	7.8 c
T_6	9.4 a	9.1 ab	8.5 c	7.7 e	9.6 a	9.3 a	8.8 b	8.0 c
T_7	9.0 ab	9.0 ab	8.5 d	7.5 f	9.4 a	9.2 a	8.6 c	7.8 d
T_8	9.0 ab	9.0 ab	8.2 d	7.5 f	9.3 a	9.0 b	8.5 c	7.8 d
T_9	9.0 ab	8.9 b	8.0 d	7.7 e	9.2 ab	9.0 b	8.6 c	7.8 d
T_{10}	9.0 ab	8.8 b	8.0 d	7.1 f	9.7 a	9.3 a	8.5 c	7.5 e

T_1 = control T_2 = boric acid 1% T_3 = boric acid 2%
T_4 = abscisic acid 1% T_5 = abscisic acid 2% T_6 = rosemary oil 1%
T_7 = rosemary 2% T_8 = camphor oil 1% T_9 = camphor 2%
T_{10} = ethephon 2%

Table 2: Effect of Using Some Nutrients and Essential Oils on 'Crimson Seedless' Grape in Berry shatter percentage Shelf Life Period During 2019 and 2020 Seasons.

Shatter (%)						
Season	**2019**			**2020**		
	Period in days					
Treatments	**2**	**4**	**6**	**2**	**4**	**6**
T_1	2.06 h	5.03 e	10.50 a	2.54 m	5.95 f	11.32 a
T_2	0.41 l	2.16 h	5.06 e	0.34 r	2.68 m	4.74 j
T_3	0.19 m	2.00 h	5.56 d	0.68 q	2.25 m	4.38 I
T_4	0.56 k	3.83 g	6.60 d	0.98 p	3.67 k	7.88 d
T_5	1.04 j	3.40 g	6.56 d	1.76 n	4.14 j	6.93 e
T_6	1.74 i	4.60 f	9.50 b	1.91 n	4.84 i	10.12 b

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T_7	1.93 i	4.66 f	8.30 c	3.03 l	4.97 h	9.38 c
T_8	1.70 i	4.83 d	9.66 b	2.38 m	5.87 f	10.00 b
T_9	2.00 h	4.91 f	8.46 c	2.29 m	6.66 e	9.27 c
T_{10}	0.83 k	3.50 g	9.30 b	1.33 o	5.72 g	10.16 b

T_1 = control T_2 = boric acid 1% T_3 = boric acid 2%
T_4 = abscisic acid 1% T_5 = abscisic acid 2% T_6 = rosemary oil 1%
T_7 = rosemary 2% T_8 = camphor oil 1% T_9 = camphor 2%
T_{10} = ethephon 2%

Loss in weight due to metabolic activity, respiration and transpiration. According to **(Yaman 2002)** the vapor phase diffusion driven by a gradient of water vapor pressure is a reason for moisture loss from fresh fruits and vegetables. **(Jawandha, *et, al.*, 2012).** Ehthaphon 2% and abscisic acid were reduced loss in weight in first season where abscisic was 1% and in second season abscisic 2%, (Table 3). While according to decayed berries Ehthaphon 2% and control treatments were have great value of decayed berries and the best treatment reducing decay were boric 2% for two season (Table 4). Decay percentage increased as the advancing of shelf life period in the two seasons of study. Rosemary 2% reduced decayed berries as similar of abscisic acid in two concentrations without any difference. It could be due to activating enzymatic carbohydrate synthesis during berry development.

Therefore, the activation processes such as Calvin cycle, the pentose phosphate, and Glycolysis pathway might constitute the increase sugar content in berry development. So, total sugars increased (Glucose and fructose) which it could be a precursor toward to increase AA synthesis in berry juice. The increases of TP might be explained that the increases of AA berry content by which maintaining the amount of TP as antioxidant properties also, cyanocobalamin may modulate the active oxygen) species **(Lo'ay, 2017).**

Table 3: Effect of Using Some Nutrients and Essential Oils on loss in weight percentage on Crimson Seedless Grape at Shelf Life Period During 2019 and 2020 Seasons.

Loss in weight (%)						
Season	**2019**			**2020**		
Period in days						
Treatments	**2**	**4**	**6**	**2**	**4**	**6**
T_1	3.00 j	5.81 g	11.56 a	2.57h	6.56 d	10.59 a
T_2	1.88 k	4.48 h	9.75 d	2.01 i	5.46 e	9.88 ab
T_3	1.06 k	3.48 h	9.63 d	1.93 j	3.06 gh	9.21 b
T_4	1.34 k	3.65 i	8.59 f	1.95 j	3.06 gh	7.56 d
T_5	1.76 k	3.48 i	9.79 cd	1.86 j	3.10 g	8.83 c
T_6	1.90 k	4.24 hi	9.07 e	2.03 i	3.63 g	9.20 b
T_7	1.37 k	4.25 hi	10.22 b	1.81 j	4.75 ef	9.83 ab
T_8	1.75 k	4.44 hi	10.74 ab	1.69 j	4..81 ef	9.95 ab
T_9	1.64 k	4.20 hi	11.12 ab	1.67 j	5.16 e	10.79 a
T_{10}	1.75 k	3.54 i	8.54 f	1.58 j	4.03 f	8.93 c

T_1 = control T_2 = boric acid 1% T_3 = boric acid 2%
T_4 = abscisic acid 1% T_5 = abscisic acid 2% T_6 = rosemary oil 1%
T_7 = rosemary 2% T_8 = camphor oil 1% T_9 = camphor 2%
T_{10} = ethephon 2%

Table 4: Effect of Using Some Nutrients and Essential Oils on Decay percentage on Crimson Seedless Grape at Shelf Life Period during 2019 and 2020 Seasons.

Decay (%)						
Season	**2019**			**2020**		
	Period in days					
Treatments	**2**	**4**	**6**	**2**	**4**	**6**
T_1	1.33 h	4.10 e	8.40 a	0.33 i	1.70	7.46 a
T_2	0.00 k	1.50 h	5.16 c	0.00 k	1.90 f	4.63 c
T_3	0.66 j	1.27 h	3.61e	0.00 k	1.36 g	3.33 e
T_4	0.66 j	1.76 h	4.13 d	0.00 k	1.10 g	4.90 c
T_5	0.00 k	1.43 h	4.63 d	0.00 k	0.86 h	4.30 d
T_6	0.83 j	2.26 g	5.20 c	0.17 j	1.70 f	4.41 d
T_7	0.00 k	2.66 f	4.56 d	0.25 i	1.60 f	4.61 c
T_8	0.66 j	2.33 g	5.16 c	0.13 j	1.33 g	5.05 c
T_9	0.00 k	2.00 h	5.86 b	0.00 k	1.03 g	5.35 b
T_{10}	0.00 k	2.00 h	6.83 b	0.00 k	0.80 h	5.93 b

T_1 = control T_2 = boric acid 1% T_3 = boric acid 2%
T_4 = abscisic acid 1% T_5 = abscisic acid 2% T_6 = rosemary oil 1%
T_7 = rosemary 2% T_8 = camphor oil 1% T_9 = camphor oil 2%
T_{10} = ethephon 2%

Chemical quality attributes

Berry color decreased with increasing shelf life time, from Table 5 data in both seasons showed highly significant differences among the tested treatments boric and abscisic acids in their concentration (1%, 2%) have a large value on anthocyanin accumulation flowed by camphor oil (1%, 2%), ethephon 2% and rosemary oil (1%, 2%) while control have lower value.

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The color of grape berry skin depends on the anthocyanin synthesis pathway **(Boss, *et al.*, 1996).** Anthocyanins are synthesized from the precursor phenylalanine and acetate through the path of phenyl propanoids **(Dixon *et al.*, 2005, Winkel, 2004** and **Zhang, 2005)**. Studies on Kyoho grape cultivar have shown that ABA stimulates the expression of genes involved in the path of the phenylpropanoids when applied at the veraison stage. The increase in anthocyanins follows the increase of enzymes synthesis involved in secondary metabolism **(Ban *et al.*, 2003).** Anthocyanins are synthesised during veraison; a stage which corresponds to change in color (**Keller and Hrazdina 1998)**. It accumulates in the vacuoles of tissue, particularly in the first four cell layers in the hypodermis of the berries; and in some cases, in the mesocarp and seeds (**Cantos *et. al.*, 2002)**. The development of color in the berry skin is also affected by factors such as diurnal temperature, light intensity, berry quality, leaf surface area, shoot length, carbohydrates, mineral nutrition and plant hormones (**Kliewer and Lider 1970, Wheeler, 2009**, **Zamora *et, al.*, 2003).** A stronger correlation exists between anthocyanin and color development, as well as on daily basis. TSS, TA, index of maturation, and total polyphenols were not significantly affected by the use of S-ABA. Similarly, other physical attributes like length, width, and berry mass did not show any significant change.

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However, berry firmness slightly varied in response to these treatments, but not to the extent where it compromised the berry quality for commercial use. There is a slight difference in berry color between the two seasons evaluated, and this difference is probably due to the different weather conditions in which the ripening. Boric acid 1% increase total phenols than all treatments flawed by rosemary oil 2% and camphor oil 1%. The application of ABA induces the synthesis of phenolic compounds in grape berries (**Dry, 2000**: **Jeong, 2004. Rufato *et al.*2016)** applied different doses of ABA to Isabel grapes and found that the concentration of 800 mg L-1 resulted in a 95% increment in the content of polyphenols in berries. These results support the findings in this research with Cabernet Franc. Studies conducted in Chile, had determined that an application of ABA in Carmenere grapes five days before the veraison stage, increased the content of sugars and anthocyanins and decreased the acidity in the berries; an effect which is associated with an increasing concentration of phenolic compounds (**Villalobos, 2011)**

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(Daniela *et, al.*, 2017) demonstrated that the applications of ABA and/or sucrose had a significant effect on the development of color, being able to advance the harvest by 37 and 15 days, respectively. Interestingly, this increase in color did not affect other important quality attributes in grapes such as firmness, soluble solids and acidity, unlike the effects observed with other growth regulators such as ethephon. anthocyanins are metabolic products of flvanones and hence are placed in the flavonoids group. flavonoids are one of natural compounds group and are probably the most natural phenolics. whereas there are several flavonoids and phenolics compounds in rosemary and camphor Which promote improvement of coloring in the grapes **(Denys J. Charles, 2013).**

Table 5: Effect of Using Some Nutrients and Essential Oils on Total anthocyanin (mg. g−1) and total phenols on Crimson Seedless Grape at Shelf Life Period During 2019 and 2020 Seasons.

	Total anthocyanin (mg. g−1)				Total phenols			
Season	**2019**		**2020**		**2019**		**2020**	
	Period in days							
Treatments	**H**	**6**	**H**	**6**	**H**	**6**	**H**	**6**
T_1	16.42 f	15.17g	17.69 e	16.22 f	0.45 ab	0.42 bc	0.46 a	0.44 b
T_2	20.68 b	18.50 d	20.25 b	18.72 d	0.46 a	0.39 bc	0.46 a	0.42 c
T_3	21.39 a	17.87 e	22.25 a	20.13 b	0.42 bc	0.33 c	0.45 ab	0.39 d
T_4	20.12 b	17.58 e	19.00 c	16.72 f	0.42 bc	0.38 cd	0.45 ab	0.36 e
T_5	20.06 b	17.69 e	20.76 b	19.33 c	0.36 d	0.32 de	0.38 c	0.32 f
T_6	19.72 c	17.81 e	19.88 c	17.67 e	0.41bc	0.37 cd	0.44 b	0.39 d

T_7	19.96 c	17.29 e	20.01 b	17.68 e	0.44 b	0.39 bc	0.47 a	0.40 c
T_8	20.18 b	16.87 f	20.80 b	17.76 e	0.45 ab	0.38 cd	0.48 a	0.37 e
T_9	20.17 b	17.85 e	20.39 b	18.00 d	0.39 bc	0.35 d	0.41 b	0.34 f
T_{10}	20.60 b	17.31 e	20.28 b	18.44 d	0.45 ab	0.37 cd	0.46 a	0.41 b

T_1 = control T_2 = boric acid 1% T_3 = boric acid 2%
T_4 = abscisic acid 1% T_5 = abscisic acid 2% T_6 = rosemary oil 1%
T_7 = rosemary 2% T_8 = camphor oil 1% T_9 = camphor 2%
T_{10} = ethephon 2%

All treatment have no effect on S,S.C or acidity or maturation index (SS.C / acid), that shown in Tables 6 and 8. The increase in T.S.S with advancement of storage period may be due to the numerous catabolic processes taking place in the fruits during ripening and senescence processes. The increase in T.S.S could also be attributed to water loss, hydrolysis of starch and other polysaccharides to soluble form of sugar (**Wills, *et, al.*, 1980). (Bhakare *et al.* 2006)** reported increasing S.S.C values and decreasing acidity values with increasing boric acid treatments. Whoever (**Bilir *et, al.*, 2018**) indicted that maturity index is an important criterion for assessing in this respect. 0.1% boric acid dose was found to be most suitable in terms of the maturity index. The soluble solid content consistently increased throughout the process of berry ripening (**Marquette**, ***et, al.*, 1999**: **Reynier 2002**, **Tesic, *et, al.*, 2001**). There is a rapid accumulation of sugar in the berries from the veraison stage due to the migration of photosynthetic products through the grape bunches.

Additionally, sugar reserves such as fructose are also mobilized through the shoots and root system. **(Ball, 1997)** suggested that decrease in titrable acidity of fruits is a result of breakup of acids to sugars during respiration

Table 6: Effect of Using Some Nutrients and Essential Oils for on Soluble Solid Content on Crimson Seedless Grape at Shelf Life Period During 2019 and 2020 Seasons.

S.S.C								
Season	**2019**				**2020**			
	Period in days							
Treatments	**H**	**2**	**4**	**6**	**H**	**2**	**4**	**6**
T_1	15.6 b	16.1 ab	16.3 ab	16.8 ab	15.8ab	16.0 ab	16.3 ab	17.0 a
T_2	16.3 ab	16.5 ab	16.9 ab	17.1 ab	15.6 b	15.9 ab	16.2 ab	16.6 a
T_3	15.8 b	16.0 ab	16.0 ab	16.2 ab	15.3 b	15.6 b	16.0 ab	17.0 a
T_4	15.6 b	16.0 ab	16.8 ab	17.3 a	15.9ab	16.1 ab	16.3 ab	17.0 a
T_5	15.5 b	15.7b	16.3 ab	16.8 ab	15.6 b	16.0 ab	16.3 ab	17.0 a
T_6	16.0 ab	16.3 ab	16.5 ab	17.0 a	15.6 b	15.9 ab	16.3 ab	17.0 a
T_7	15.6 b	15.8 ab	16.0 ab	16.3ab	15.3 b	15.5 b	16.0 ab	16.7 ab
T_8	15.6 b	15.9 ab	17.0 ab	18.0a	15.6 b	16.0 ab	16.6 ab	17.3 ab
T_9	16.0 ab	16.6 ab	17.3 ab	18.3 a	15.0 b	15.3 b	16.0 ab	17.0 ab
T_{10}	16.0 ab	16.6 ab	17.6 ab	180.6 a	16.2 ab	16.4 ab	17.3 ab	18.3 a

T_1 = control
T_2 = boric acid 1%
T_3 = boric acid 2%
T_4 = abscisic acid 1%
T_5 = abscisic acid 2%
T_6 = rosemary oil 1%
T_7 = rosemary 2%
T_8 = camphor oil 1%
T_9 = camphor 2%
T_{10} = ethephon 2%

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Table 7: Effect of Using Some Nutrients and Essential Oils for on Total Acidity Percentage on Crimson Seedless Grape at Shelf Life Period During 2019 and 2020 Seasons.

Acid (%)								
Season	**2019**				**2020**			
	Period in days							
Treatments	**H**	**2**	**4**	**6**	**H**	**2**	**4**	**6**
T1	0.66 b	0.63 b	0.57 f	0.49 i	0.68 b	0.63 f	0.59 j	0.53 n
T2	0.65 b	0.64 b	0.59 e	0.52	0.65 d	0.62 g	0.58 k	0.51 p
T3	0.64 b	0.60 d	0.56 f	0.43	0.64 e	0.61 h	0.56 l	0.51 p
T4	0.69 ab	0.62 c	0.58 f	0.49 i	0.66 d	0.62 g	0.57 l	0.52 o
T5	0.75 a	0.70 ab	0.63 b	0.59 e	0.73 ab	0.67 c	0.62 g	0.55 m
T6	0.74 ab	0.68 ab	0.61 d	0.52 h	0.74 ab	0.69 ab	0.65 d	0.56 l
T7	0.76 a	0.70 ab	0.63 b	0.57 f	0.75 a	0.69 ab	0.63 f	0.52 n
T8	0.66 b	0.61 d	0.54 g	0.49 i	0.70 ab	0.71 ab	0.64 e	0.56 l
T9	0.65 b	0.64 b	0.56 f	0.49 i	0.68 b	0.64 e	0.58 k	0.51 p
T10	0.64 b	0.59 e	0.51 h	0.46 j	0.69 ab	0.67 c	0.62 g	0.58 k

T_1 = control T_2 = boric acid 1% T_3 = boric acid 2%
T_4 = abscisic acid 1% T_5 = abscisic acid 2% T_6 = rosemary oil 1%
T_7 = rosemary 2% T_8 = camphor oil 1% T_9 = camphor 2%
T_{10} = ethephon 2%

Table 8: Effect of Using Some Nutrients and Essential Oils for on S.S.C/Acid ratio **on Crimson Seedless Grape at Shelf Life Period During 2019 and 2020 Seasons.**

S.S.C/Acid ratio							
Season	**2019**				**2020**		
	Period in days						
Treatments	**H**	**2**	**4**	**6**	**H**	**2**	**4**
T1	24.88 i	25.53 h	29.5 f	36.28 ab	22.62 e	25.42 d	27.65
T2	26.66 h	25.72 h	28.58 g	33.16 c	23.96 e	25.65 d	29.62 bc
T3	24.81 i	23.94 j	29.91 f	35.84 ab	23.71 e	25.73 d	28.30 c
T4	22.48 j	25.02 i	29.88 f	40.14 a	24.28 d	24.95 d	28.52 c
T5	20.46 l	22.29	27.13 h	30.22 e	21.48 h	23.3 e	26.13 cd
T6	21.68 k	24.56 i	28.72 g	35.17b	21.02 h	22.98 e	25.04 d
T7	20.41 l	25.96 h	26.99 h	31.41 d	20.26 g	22.36 e	25.29 d
T8	23.49 j	26.06 h	31.08 d	36.80 ab	22.20 e	21.41 f	25.98 d

T_9	24.16 i	26.01 h	30.93 e	36.70 ab	22.10 e	23.97 e	27.70 cd
T_{10}	24.77 i	28.18 g	34.54 c	40.84 a	23.45 e	25.15 d	28.66 c

T_1 = control T_2 = boric acid 1% T_3 = boric acid 2%
T_4 = abscisic acid 1% T_5 = abscisic acid 2% T_6 = rosemary oil 1%
T_7 = rosemary 2% T_8 = camphor oil 1%
T_9 = camphor 2% T_{10} = ethephon 2%

From present study it can be concluded that the exogenous application of abscisic acid (1% or 2%), boric acid (1% or 2%) and rosmary oil 1% significantly improves the color of berries on Crimson seedless grape, particularly at a concentration of in two applications, on version stage and 7 days after version, resulting in clusters with greater consumer acceptance through visual-sensory analysis. Regardless of the concentration or application timing, there is no change in the physicochemical characteristics of the berries or clusters.

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