INFLUENCE OF SEAWEED EXTRACT (ACADIAN), EDTA-CALCIUM, ASCORBIC ACID AND GIBBERELLIC ACID PREHARVEST APPLICATION ON CRIMSON SEEDLESS TABLE GRAPE: I- MATURATION AND FRUIT QUALITY

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Abstract

This investigation was carried out during two successive seasons (2004 and 2005) in a private farm at El-Sadat City, Monofia governorate.

Some Crimson seedless grapevines were sprayed with 0.5, 1.0 or 1.5% Seaweed extract (Acadian) or EDTA- calcium or ascorbic acid or 25 ppm gibberellic acid 4 weeks after fruit set. Vines of the control were sprayed only with water. Fruit samples were taken during growth development, at veraison stage (4 weeks after spraying) and then weekly until fruit reached maturity stage.

Total soluble solids and TSS / acid ratio increased continuously while berry firmness and total acidity decreased gradually with the progress of fruit age. Berry color changed directly from red green to greenish red and then to red.

Preharvest application of Seaweed extract (Acadian) or EDTA-calcium or ascorbic acid significantly increased vine yield, bunch weight, berry weight and size, berry firmness, TSS percentage, TSS / acid ratio and anthocyanin contents of berry skin and decreased total acidity percentage of berry juice as compared with untreated vines. This effect was found to increase with the increase of the used doses of Seaweed extract (Acadian) and ascorbic acid. However, this trend was not true in case of EDTA- calcium treatment. On the other side preharvest application with GA_3 increased vine yield, bunch weight, berry weight, berry firmness and total acidity of berry juice and decreased TSS percentage, TSS / acid ratio and anthocyanin contents of berry skin in comparison with control.

Furthermore, Seaweed extract (Acadian) or ascorbic acid preharvest spraying accelerated berry color changes, grape maturation and improved berry color at harvest. This effect increased with the increase of the used concentrations from these compounds.

It can be concluded that, preharvest spraying with Seaweed extract (Acadian) at 1.5 % or ascorbic acid is necessary for increasing vine yield, bunch weight, berry weight and firmness and improving berry coloration and accelerating fruit maturation. It is to be noticed that, GA3 at 25 ppm or EDTA- Calcium at 1% were similar to the aforementioned compounds with the exception of delaying berry color transition and fruit maturation.

INTRODUCTION

Grape is one of the most important and favorable fruit crops in Egypt. The planted area in 2005 reached 160005 feddans, while the productive area amounted to 144624 feddans producing 1391749 tons according to the statistics of Ministry of Agriculture.

One of the most promising new cultivars planted in Egypt is Crimson seedless a late seedless ripening variety with colored berries. Scarce are the information necessary for the grape grower concerning some important practices which should be applied in vineyards planted with this new cultivar.

Mohamed and Hassan (2003), reported that, bunch weight, berry weight and size, juice percentage, TSS, and TSS / acid ratio increased continuously while total acidity and berry firmness decreased during the developmental stages of grapes.

Bio-fertilizers are being used as alternatives to improve the conditions of world-wide fields. Biological fertilizers don't contaminate the soil and atmosphere, and help to produce healthy food (Sanchez, *et al.,* 2003). Seaweed extract and its derivatives are used in agriculture as potential growth regulators.

Furthermore Seaweed extract increases plant resistance to pests and diseases, improves plant growth, yield and fruit quality (Fornes, *et al.,* 2002).

Jensen, (2004) mentioned that, spraying vines with Acadian, sea plants extract, at pre-bud break, pre-bloom, post-bloom and sizing stage resulted in an increase of 24 % of yield in comparison with control. Also he added that there was an increase in berry size and firmness. However, Brix levels tended to be slightly lower in treated grapes.

El-Abbasy and El-Morsy (2002) reported that, soluble solid contents of Thompson Seedless grape at harvest were increased while total acidity decreased significantly by using two sprays of Seaweed extract.

It has been reported that, the fruit yield increased as the concentration of the Seaweed extract increased (Fornes, *et al.,* 2002).

Shiang, *et al.,* (1997) reported that, Cytex [Seaweed extract containing cytokinins] treatment increased the firmness of berries of Honey Red grape. Also they added that, Treatment with 0.25% Calcium phosphate or EDTA-Ca also increased flesh firmness and increased Ca and pectin contents of berries compared with the control.

Mohamed (1998) found that, calcium spraying as foliar application 20 days before harvest had no significant effect on average berry weight and juice content of grapes during the growing season and at harvest. On the other hand, this treatment increased berry firmness of grapes at harvest but decreased total soluble solids and

total acidity contents in grapes during the growing season and at harvest. Also, the effect of the used concentrations increased with the increase of calcium compounds doses.

Giudice, *et al.,* (2004) claimed that, number of berries per bunch, berry weight, bunch weight, and number of bunches per shoot in the subsequent season were decreased by multiple, prebloom plus post bloom Ca applications. They also added that, prohexadione-Ca had minimal effects on berry weight or crop yield.

Preharvest application with ascorbic acid significantly increased vine yield, bunch weight, berry weight, total soluble solids contents and total soluble solids / acid ratio of Roomy Red grapes at harvest. (Ahmed and El-Hameed, 2004)

Gujar, *et al.,* (2001) in their study on grape cv. Tash-A-Ganesh, mentioned that, pre-harvest spraying with ascorbic acid at 500 ppm, during pre-bloom, bloom, fruit setting and fruit development reduced pink percentage by 12% over or gibberellic acid (GA_3) at 10, 20, 30 and 40 ppm. Furthermore, the total soluble solids content was positively correlated with the pink percentage.

Preharvest treatments with GA_3 significantly increased berry weight, size, diameter, adherence strength and firmness. (Omar & El-Morsy (2000) on Ruby Seedless and Ibrahim and Gaser (2005) on "Roumy Ahmer" grapes).

The purpose of this study is to determine the effect of preharvest foliar spraying with four compounds (Acadian, EDTA- calcium, ascorbic acid and GA_3) on Crimson Seedless maturation of grapes and quality at harvest.

MATERIALS AND METHODS

This investigation was carried out during the successive seasons (2004 and 2005) in a private farm at El-Sadat City, Monofia governorate,

Crimson Seedless grapevines chosen for this investigation were Six years old, nearly uniform in growth, planted in a sandy soil spaced 3×3 m, irrigated according to drip irrigation system. The vines were supported by Spanish Parron system and pruned at the third week of January to 12 canes, 10 buds / cane, and 8 renewal spurs of 2 buds each. Average number of bunches per vine was adjusted to 40. All vines were subjected to the same horticultural practices already applied in the vineyard.

Eleven treatments were applied 4 weeks after fruit set. Each treatment had six vines as three replicates, 2 vines per replicate. The treatments included the following:-

1- Spraying with tap water (control).
2- Spraying with Seaweed extract (Acadian*) at 0.5 %.
3- Spraying with Seaweed extract (Acadian) at 1.0 %.
4- Spraying with Seaweed extract (Acadian) at 1.5 %.

5- Spraying with EDTA- calcium at 0.5 %.

6- Spraying with EDTA- calcium at 1.0 %.

7- Spraying with EDTA- calcium at 1.5 %.

8- Spraying with ascorbic acid at 0.5 %.

9- Spraying with ascorbic acid at 1.0 %.

10- Spraying with ascorbic acid at 1.5 %.

*Acadian contains 13-16% organic mater, 4-7%k_2o, 1-1.5%Ca, .3-1.2%P_2O_5, and a little from cytokinins, Auxins, Gibberellins and Amino acids.

11- Spraying with gibberellic acid (GA_3) at 25 ppm.

The following estimates were carried out for evaluating the effect of different treatments:-

Dynamic of maturation:- at veraison stage, four weeks after spraying, two vines were specified for sampling, a representative sample of 20 berries from the apical, middle and basal parts of the bunch was picked from each vine every week to determine berry color and firmness, TSS, total acidity percentage , TSS / acid ratio till maturity stage.

At harvest studies:- six bunches were taken at random from each treatment for carrying out the following determinations:-

* Average bunch weight.

* Average berry weight, size, length and diameter.

* Berry color:- berry color was determined by using a Hunter color meter type (DP-900) for the estimation of L*, a*, b* value. Then Hue angles were estimated as described by McGuire, (1992).

* Average berry firmness:- berry firmness was estimated in 15 berries by Ifra texture analyzer instrument using a penetrating cylinder of 1 mm of diameter to a constant distance 1 mm inside the skin of berry and by a constant speed 2 mm per sec. and the peak of resistance was recorded per gram / cm.

* Juice Percentage was determined by weighting three replicates, each consists of sixteen berries. The juice percentage was calculated according to the following equation: - Juice percentage = Juice Weight * 100 / Berry Weight.

* Total soluble solids were estimated according to (A.O.A.C., 1980).

* Total acidity contents were measured according to (A.O.A.C., 1980).

* Total soluble solids / total acidity ratio.

* Total anthocyanin content: - according to the methods of Husia *et al* (1965).

From the statistical point of view, the complete randomized design was adopted: Data were statistically analyzed according to Snedecor and Cochran (1990) using the new LSD test at 5% level for comparison between means.

RESULTS AND DISCUSSION

I– Dynamics of maturation

1– Physical characteristics:

a - Berry firmness:-

Data presented in Table (1) clearly indicate that, berry firmness decreased gradually with the increase of fruit age. It is worthmentioning that, all preharvest treatments increased berry firmness during berry development and at harvest as compared with control.

It is to be observed that, this estimate was found to increase gradually with the increase of the used concentrations from all used compounds under this study. Data also revealed that, spraying GA_3 at 25 ppm and Seaweed extract at 1.5 % 4 weeks after berry set was the most effective treatments among the other used concentrations during the first season. In the second season however, GA_3 sprayed at 25 ppm and EDTA- calcium at 1.5 % were the most effective treatments in increasing berry firmness at harvest.

Table 1. Effect of spraying with Seaweed extract, EDTA- calcium, ascorbic acid and GA_3 on berry firmness of Crimson Seedless grapes during development and maturation.

Bunch age	Treatments											
	Cont.	Seaweed extract			EDTA- calcium			Ascorbic acid			GA_3	Means
		0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %		
First season												
56	73.7	73.4	74.8	81.1	75.0	74.3	75.0	70.3	75.0	75.5	78.5	75.2
63	66.2	70.5	74.0	74.4	73.8	73.1	74.3	65.7	73.8	72.6	74.4	72.1
70	65.7	69.3	72.7	73.2	72.4	69.1	67.4	60.9	65.4	70.6	71.3	68.9
77	56.9	66.1	66.4	67.1	60.2	67.2	67.2	59.1	62.5	69.4	71.1	64.8
84	51.0	53.6	63.1	61.9	53.3	61.1	66.7	56.6	61.6	67.4	70.9	60.7
Means	62.7	66.6	70.2	71.5	66.9	68.9	70.1	62.5	67.7	71.1	73.2	---
Second season												
56	75.9	79.0	83.8	87.5	81.8	79.9	87.4	75.4	84.0	79.0	81.7	81.4
63	70.9	82.2	78.4	83.3	77.6	70.8	81.1	73.6	82.7	81.3	81.1	78.5
70	68.5	77.6	81.4	75.3	70.5	72.9	82.7	68.2	69.9	69.0	77.6	74.0
77	60.9	70.7	60.9	71.8	67.4	74.0	70.8	66.2	70.0	67.1	77.4	68.8
84	41.5	44.7	49.1	50.2	44.9	48.4	52.2	46.1	51.0	58.7	58.0	49.5
Means	63.5	70.8	70.7	73.6	68.4	69.2	74.8	65.9	71.5	71.0	75.2	---

New LSD at 5 % level F.S.	Preharvest treatments = 3.113	Harvest date = 2.299	Interaction = 7.624
New LSD at 5 % level S.S.	Preharvest treatments = 4.046	Harvest date = 2.988	Interaction = 9.910

These results are in line with those obtained by Shiang *et al* (1997), Jensen (2004), and Abd El-Hafeez (2005) who reported that, preharvest spraying with Seaweed extract significantly increased fruit firmness.

Furthermore these results are in harmony with those obtained by Gaser *et al* (1998) and Omar & El-Morsy (2000) who found that, GA_3 significantly increased berry firmness.

Also these results are supported by those found by Shiang *et al* (1997) and Mohamed (1998) who pointed out that, preharvest application with calcium significantly increased berry firmness at harvest.

b- Berry color (Hue angle):-

According to data presented in Table (2) it is obvious that, berry color changed directly from orange yellow (version hue angle is less than 90°) to reddish orange (hue angle is more than 45°) and then continuously to red (hue angle is less than 45°).

Data also indicated that, all preharvest treatments under this investigation significantly accelerated color changes and improved berry color at harvest. Spraying Seaweed extract at 1.5% followed by EDTA- calcium and ascorbic acid at 0.5% was superior to the other treatments during the two seasons of this work. However, the highest doses (1.5 %) of EDTA- calcium and ascorbic acid retarded color changes during development and maturation in comparison with the other treatments, however it is still better than the control. In contrast, GA_3 significantly delayed color transition of berries compared with the other treatments and control.

Furthermore there was a significant interaction between preharvest treatments and harvest date during both seasons of this study.

These results disagree with those obtained by Abd El-Hafeez (2005), who reported that, preharvest spraying with Seaweed extract significantly delayed pear fruit color transition.

2 - Chemical characteristics:

a- Total soluble solids (TSS) %

Data of Table (3) clearly show that, TSS % increased gradually with the increase of fruit age during the two seasons of this study.

Data also indicated that, all sprayed compounds except GA_3 treatment significantly increased TSS percentage either during development or at maturation as compared with untreated vines (control). It is obvious that, TSS percentage increased gradually with the increase of the used concentrations of Seaweed extract and ascorbic acid. TSS percentage decreased gradually with the increase of the used doses of EDTA- calcium during the two seasons of this work.

Table 2. Effect of spraying with Seaweed extract, EDTA- calcium, ascorbic acid and GA_3 on Hue angles of Crimson Seedless grapes during development and maturation.

Bunch age	Treatments											
	Cont.	Seaweed extract			EDTA- calcium			Ascorbic acid			GA_3	Means
		0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %		
First season												
56	79.3	72.2	67.2	68.3	71.3	67.7	72.6	68.2	71.1	72.4	83.5	72.2
63	68.2	65.3	65.1	53.9	63.5	70.5	68.4	64.2	64.8	68.5	70.8	65.7
70	64.9	58.7	56.9	42.2	52.9	65.2	61.6	57.8	59.9	61.4	66.5	58.9
77	51.0	40.6	39.1	37.5	44.0	40.7	43.3	48.2	50.1	48.2	54.6	45.2
84	41.1	34.8	32.6	30.8	34.3	36.4	37.3	31.6	35.1	38.9	46.0	36.3
Means	60.9	54.3	52.2	46.5	53.2	56.1	56.6	54.0	56.2	57.9	64.3	---
Second season												
56	82.6	67.3	67.9	61.7	67.3	70.0	76.3	75.2	78.7	80.8	86.6	74.0
63	63.5	63.4	62.5	57.8	57.3	59.6	62.9	60.5	59.6	65.6	71.3	62.2
70	53.8	47.6	44.0	38.7	50.0	53.2	55.8	46.0	52.3	57.4	59.3	50.7
77	46.8	42.4	32.5	35.1	30.5	37.2	38.9	41.1	43.9	47.2	52.3	40.7
84	35.6	25.5	24.8	24.7	27.5	27.8	29.8	30.7	32.3	34.7	38.3	30.1
Means	56.5	49.2	46.3	43.6	46.5	49.6	52.7	50.7	53.4	57.1	61.6	---

New LSD at 5 % level F.S.	Preharvest treatments = 3.4	Harvest date = 2.5	Interaction = 8.2
New LSD at 5 % level S.S.	Preharvest treatments = 4.0	Harvest date = 3.0	Interaction = 9.9

Table 3. Effect of spraying with Seaweed extract, EDTA- calcium, Ascorbic acid and GA_3 on total soluble solid contents of Crimson Seedless grapes during development and maturation.

Bunch age	Treatments											
	Cont.	Seaweed extract			EDTA- calcium			Ascorbic acid			GA_3	Means
		0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %		
First season												
56	7.2	8.9	9.9	11.5	9.8	9.5	9.3	9.3	9.6	10.8	5.8	9.2
63	10.9	11.5	14.2	14.6	11.3	11.6	11.0	12.5	13.2	13.9	8.8	12.1
70	11.8	12.6	14.5	15.1	13.5	13.8	13.1	13.7	14.1	14.6	10.6	13.4
77	14.3	16.1	16.6	17.0	16.6	16.8	16.1	16.1	17.1	17.5	16.1	16.4
84	16.7	16.9	17.3	17.5	17.2	17.5	16.8	17.3	17.5	17.7	16.5	17.2
Means	12.2	13.2	14.5	15.1	13.7	13.8	13.2	13.8	14.3	14.9	11.6	---
Second season												
56	7.8	8.5	9.7	11.1	8.8	8.6	7.3	8.8	8.5	10.2	7.5	8.8
63	11.7	11.2	12.5	12.7	11.3	10.6	10.2	11.4	12.0	12.9	10.8	11.6
70	13.0	13.7	14.3	15.9	13.6	14.8	13.5	13.2	13.1	13.5	12.8	13.8
77	15.3	15.3	16.5	17.5	15.9	17.2	16.8	16.8	18.1	16.9	15.9	16.6
84	17.1	17.7	18	18.1	17.6	17.7	17.3	17.2	17.3	17.6	17.0	17.5
Means	13.0	13.3	14.2	15.1	13.4	13.8	13.0	13.5	13.8	14.2	12.8	---

New LSD at 5 % level F.S.	Preharvest treatments = 0.31	Harvest date = 0.24	Interaction = 0.80
New LSD at 5 % level S.S.	Preharvest treatments = 0.39	Harvest date = 0.29	Interaction = 0.95

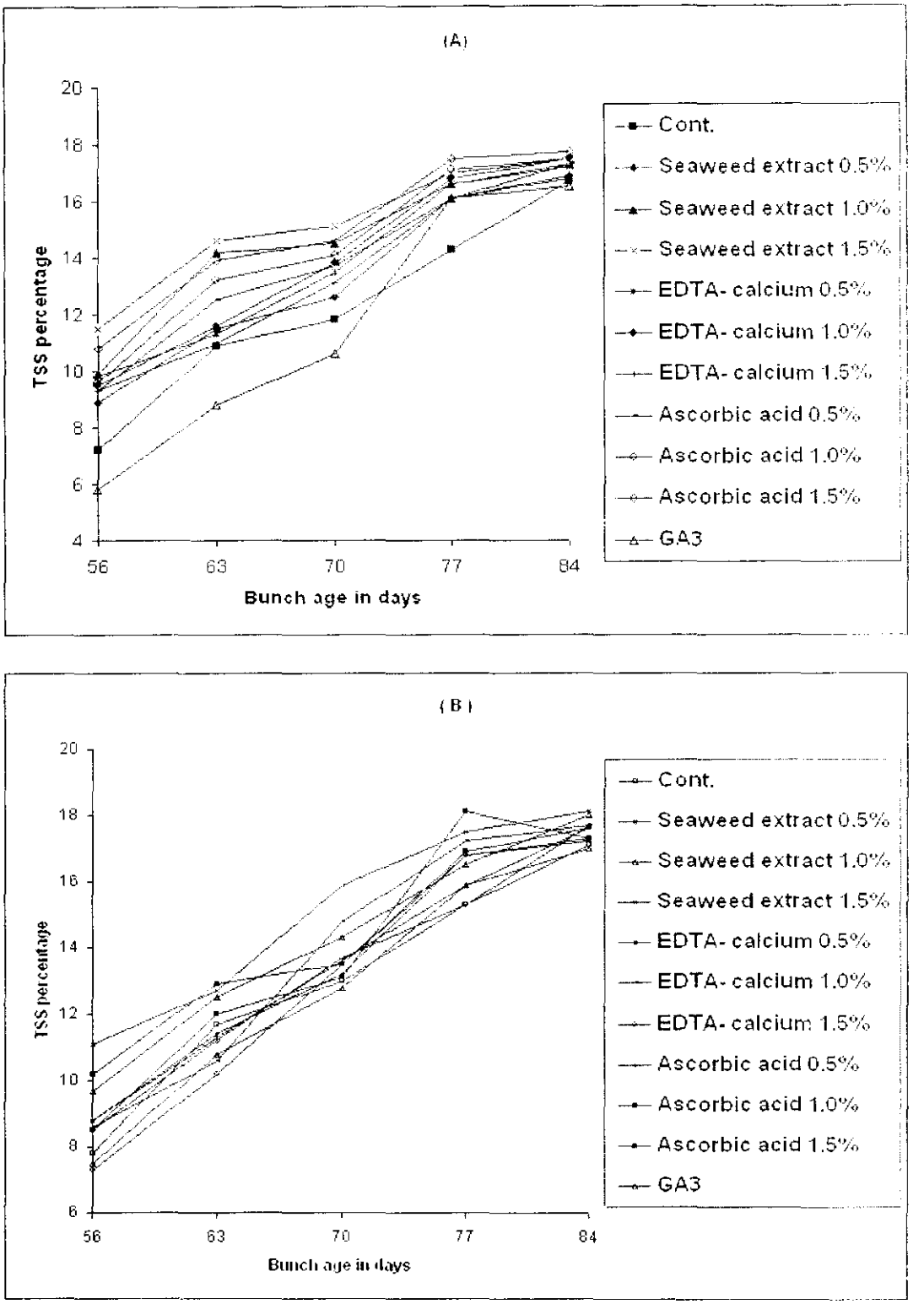

Figure 1. Effect of preharvest spraying with Seaweed extract, EDITA- calcium, ascorbic acid and GA3 on TSS percentage of Crimson Seedless grapes during growth development and maturation in (2004, A) and (2005, B).

In contrast, preharvest application of GA_3 decreased TSS percentage as compared with untreated vines in both seasons of this investigation.

It is worthy to note that, the interaction among all treatments in this investigation was significant.

These results are in line with those reported by Fornes *et al* (2002), Jensen (2004), El-Abbasy and El-Morsy (2002) and Abd El-Hafeez (2005). They found that, preharvest application with Seaweed extract significantly increased total soluble solids contents of fruits.

Furthermore, the results are in agreement with those mentioned by Mohamed (1998) who showed that preharvest application of Calcium significantly decreased total soluble solids contents in grapes during the growing season and at harvest. He also added that, the effect of the used concentrations increased with the increase of Calcium compounds doses.

The results are also accordance with those obtained by Abdel Hady & Ibrahim (2001) and Ahmed & El-Hameed (2004) who reported that, preharvest spraying of vines with ascorbic acid significantly increased total soluble solids contents of grape juice at harvest.

b- Total acidity content:-

According to data presented in Table (4) it is obvious that, total acidity contents of Crimson Seedless grapes decreased gradually and significantly with the progress of fruit age. Preharvest application of Seaweed extract and Ascorbic acid significantly decreased total acidity contents of grapes compared with that of GA_3 and untreated vines during the two seasons of this investigation. Moreover, the decrease of total acidity contents was increased with the increase of the used concentration. it is necessary to observe that, preharvest spraying with EDTA-calcium decreased total acidity contents of grapes during the first season. However, during the second season this trend was true only with the lowest doses but the highest dose was found to increase total acidity contents of grapes. On the contrary, preharvest application of GA_3 increased total acidity contents of grapes.

These results are in line with those obtained by Fornes *et al.* (2002), and El-Abbasy and El-Morsy (2002) who found that, preharvest application of Seaweed extract significantly decreased the acidity of grape berry juice. Moreover, these results agree with those reported by Abd El-Hafeez (2005), who cleared that, preharvest spraying of Seaweed extract decreased total acidity contents of pear fruit at harvest.

The results in this respect are in harmony with those mentioned by Mohamed (1998) who reported that, calcium spraying as foliar application before harvest significantly decreased total acidity content in grapes during growing season and at harvest.

Table 4. Effect of Spraying with Seaweed extract, EDTA- calcium, Ascorbic acid and GA_3 on acidity % of Crimson Seedless grapes during development and maturation.

Bunch age	Treatments											
	Cont.	Seaweed extract			EDTA- calcium			Ascorbic acid			GA_3	Means
		0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %		
First season												
56	2.27	1.99	1.84	1.76	2.05	2.09	2.27	1.97	1.87	1.79	2.43	2.029
63	1.80	1.45	1.33	1.16	1.53	1.62	1.70	1.42	1.39	1.23	1.94	1.506
70	1.24	1.03	0.94	0.86	1.11	1.08	1.14	1.16	1.08	1.04	1.16	1.076
77	.89	0.84	0.81	0.77	0.84	0.86	0.96	0.93	0.81	0.75	0.89	0.849
84	0.70	0.66	0.62	0.59	0.65	0.67	0.68	0.67	0.64	0.66	0.72	0.660
Means	1.380	1.194	1.107	1.027	1.236	1.263	1.350	1.231	1.156	1.092	1.429	---
Second season												
56	2.49	2.25	1.92	1.79	2.21	2.25	2.37	2.31	2.01	1.98	2.57	2.195
63	1.89	1.79	1.49	1.45	1.89	2.08	2.30	1.77	1.62	1.66	2.15	1.826
70	1.11	1.02	0.90	0.78	0.93	1.03	1.25	1.32	1.18	1.00	1.36	1.082
77	0.95	0.79	0.77	0.70	0.79	0.82	0.86	0.87	0.79	0.77	1.16	0.842
84	0.68	0.65	0.62	0.61	0.65	0.64	0.67	0.68	0.67	0.66	0.70	0.657
Means	1.424	1.301	1.139	1.067	1.294	1.364	1.489	1.392	1.255	1.213	1.587	---

Nee LSD at 5 % level F.S.	Preharvest treatments = 0.075	Harvest date = 0.056	Interaction = 0.184
New LSD at 5 % level S.S.	Preharvest treatments = 0.066	Harvest date = 0.049	Interaction = 0.162

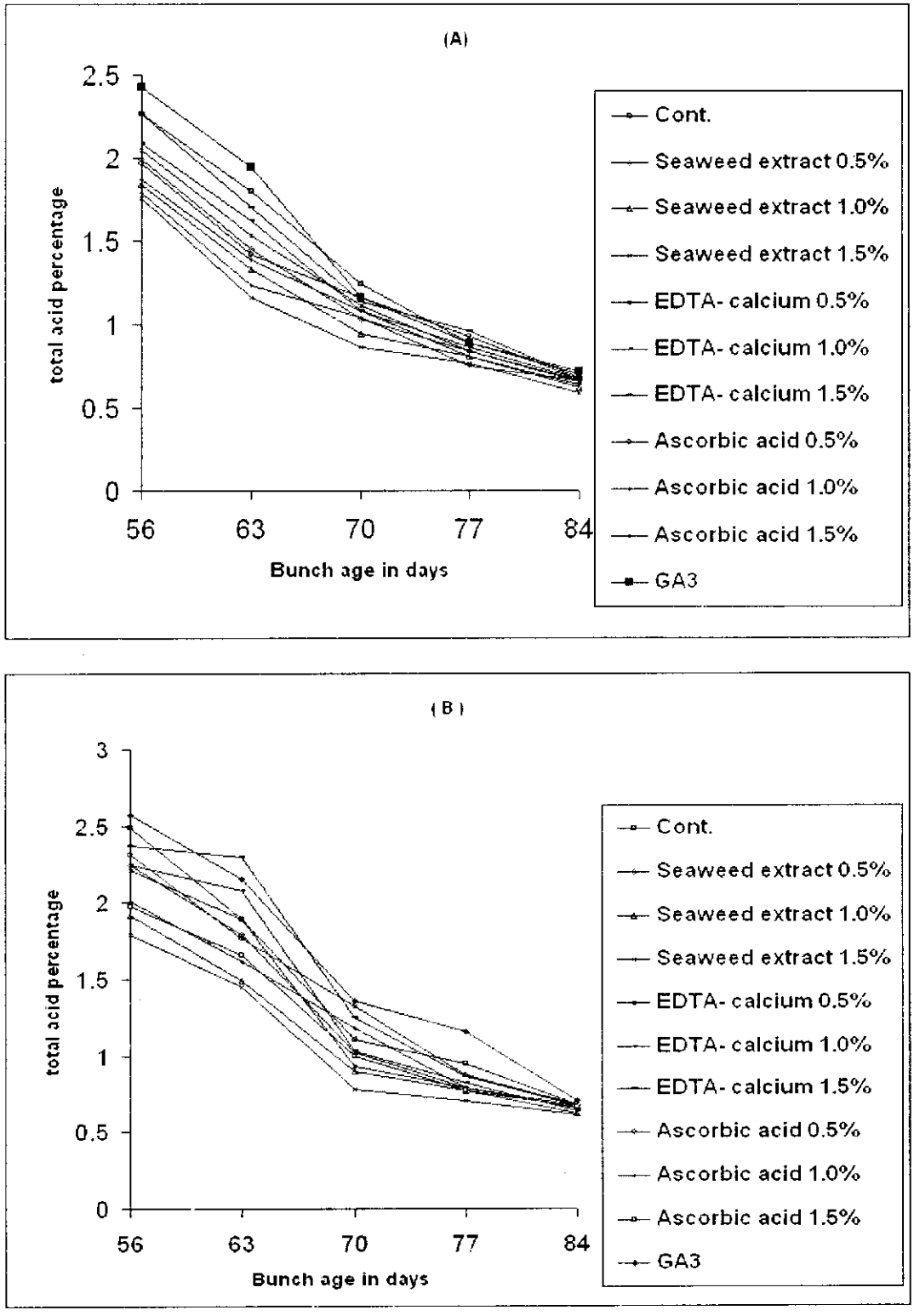

Figure 2. Effect of preharvest spraying with Seaweed extract, EDITA- calcium, ascorbic acid and GA_3 on total acid percentage of Crimson Seedless grapes during growth development and maturation in (2004, A) and (2005, B).

The results are supported by the findings of Abdel Hady & Ibrahim (2001) and Ahmed & El-Hameed (2004) who demonstrated that, preharvest spraying with ascorbic acid decreased total acidity percentage of grapes.

c- Total soluble solids / acid (TSS / Acid) ratio:-

Data concerning TSS / acid ratio are shown in Table (5). It is obvious that, the obtained results were similar to those of TSS.

These results are in line with those reported by El-Abbasy and El-Morsy (2002), who reported that, preharvest application with Seaweed extract significantly increased total soluble solids / total acidity ratio of grapes at harvest.

Also the results are in harmony with those obtained by Abdel Hady & Ibrahim (2001) who demonstrated that ascorbic acid increased total soluble solids / total acidity ratio in Red Roomy grapes at harvest.

The results are also in agreement with Gaser et al (1998) on Flame Seedless and Omar & El-Morsy (2000) on Ruby Seedless, who found that, GA_3 decreased total soluble solids / total acidity ratio of grapes.

II –Bunch and berry Caracteristics at harvest:-

1 – Yield per vine and bunch Characteristics:-

It is clear from Table (6) that, there were significant differences between the treatments under study. Preharvest application of gibberellic acid (GA_3) at 25 ppm recorded the greatest yield per vine as compared to the other treatments. The lowest values were obtained from the control. The results also indicated that, increasing Seaweed extract concentration resulted an increase in the yield per vine while the opposite was true with EDTA- calcium, where a decrease was noticed in the yield by increasing the used concentration with some burned leaves on vines sprayed with the highest doses (1.5%). Vines sprayed with Ascorbic acid showed an increase in the yield by increasing the used concentration but this decrease was not significant.

Average bunch weight was shown to have the same trend as mentioned for the yield per vine. GA_3 at 25 ppm gave the highest bunch weight as compared with the other treatments and control. Data also revealed significant differences in bunch weight between the three doses of EDTA- calcium in the first season, while in the second season no significant differences could be detected between 1 % and 1.5% concentrations. Generally, a decrease in bunch weight was noticed with increasing EDTA- calcium concentrations. Seaweed extract and ascorbic acid recorded an increase in bunch weight by increasing the applied concentrations in the two seasons.

As for bunch length, it is apparent that no significant differences were found between treatments and control.

The same result is also valid for average number of berries per bunch.

The above mentioned results are in agreement with those obtained by Gaser *et al* (1998), on Flame Seedless, Omar & El-Morsy (2000), on Roumy Ahmer grapes. Who found that, GA_3 increased yield per vine and bunch weight.

Table 5. Effect of Spraying with Seaweed extract, EDTA- calcium, Ascorbic acid and GA_3 on T.S.S / acidity ratio of Crimson Seedless grapes during development and maturation.

Bunch age	Treatments											
	Cont.	Seaweed extract			EDTA- calcium			Ascorbic acid			GA_3	Means
		0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %		
First season												
56	3.2	4.5	5.4	6.5	4.8	4.5	4.1	4.7	5.1	6.0	2.4	4.7
63	6.1	7.9	10.6	12.6	7.4	7.2	6.4	8.8	9.5	11.2	4.5	8.4
70	9.5	12.2	15.5	17.5	12.2	12.8	11.4	11.7	13.1	14.0	9.1	12.6
77	16.1	19.1	20.6	22.2	19.7	19.5	16.8	17.3	21.1	23.3	18.0	19.4
84	23.9	25.6	27.9	29.7	26.5	26.1	24.7	25.8	27.3	26.8	22.9	26.1
Means	11.7	13.9	16.0	17.7	14.1	14.0	12.7	13.7	15.2	16.3	11.4	---
Second season												
56	3.1	3.8	5.1	6.2	4.0	3.8	3.1	3.8	4.2	5.1	2.9	4.1
63	6.2	6.3	8.4	8.8	6.0	5.1	4.4	6.5	7.4	7.8	5.0	6.5
70	11.7	13.4	15.8	20.3	14.6	14.3	10.8	10.0	11.0	13.5	9.4	13.2
77	16.1	19.3	21.5	25.0	20.1	21.0	19.6	19.2	22.9	22.1	13.8	20.1
84	25.1	27.2	29.0	29.7	27.1	27.7	25.8	25.3	25.8	26.7	24.3	26.7
Means	12.5	14.0	16.0	18.0	14.4	14.4	12.8	12.9	14.3	15.0	11.1	---

New LSD at 5 % level F.S.	Preharvest treatments = 0.55	Harvest date = 0.44	Interaction = 1.35
New LSD at 5 % level S.S.	Preharvest treatments = 0.66	Harvest date = 0.49	Interaction = 1.66

Table 6. Effect of preharvest sprays with Seaweed extract, EDTA- calcium, Ascorbic acid and GA_3 on bunch and berry physical characteristics at harvest of Crimson Seedless grapes during seasons 2004 and 2005.

Bunch and berry characteristics	Season	Cont.	Seaweed extract			EDTA- calcium			Ascorbic acid			GA3	New LSD
			0.5%	1.0%	1.5%	0.5%	1.0%	1.5%	0.5%	1.0%	1.5%	25ppm	
Yield / vine (Kg)	1st	16.7	18.2	19.4	20.3	21.0	18.5	17.5	19.3	19.3	20.2	23.4	0.88
	2nd	16.9	18.9	19.6	20.7	20.5	17.6	17.7	18.8	19.3	20.9	23.5	1.19
Bunch weight (g)	1st	418	456	486	507	526	462	436	482	482	506	585	22.0
	2nd	422	472	490	518	513	441	441	471	482	523	589	29.9
Bunch length (cm)	1st	19.0	23.0	24.0	24.5	23.2	22.2	22.4	21.5	22.0	22.5	25.8	1.39
	2nd	19.5	22.7	23.8	24.9	23.5	22.7	22.4	22.5	22.8	23.0	26.5	0.80
Number of berries / bunch	1st	122	118	123	125	124	123	123	123	125	124	125	N.S
	2nd	123	120	123	124	123	121	119	125	123	126	128	N.S
Berry weight (g)	1st	3.40	3.80	3.92	4.00	4.17	3.70	3.50	3.90	3.80	4.00	4.60	0.26
	2nd	3.37	3.85	4.00	4.00	4.10	3.57	3.60	3.70	4.23	4.10	4.50	0.29
Berry size (cm^3)	1st	3.20	3.70	3.70	3.80	4.00	3.50	3.34	3.77	3.57	3.93	4.53	0.22
	2nd	3.20	3.70	3.90	4.00	4.00	3.50	3.50	3.50	3.73	4.00	4.30	0.20
Berry length (cm)	1st	1.70	2.27	2.25	2.30	2.32	2.16	2.25	2.25	2.10	2.25	2.55	0.09
	2nd	1.83	2.20	2.22	2.35	2.33	2.10	2.10	2.05	2.23	2.30	2.64	0.12
Berry diameter (cm)	1st	1.50	1.65	1.68	1.80	1.75	1.65	1.65	1.65	1.60	1.75	1.90	0.10
	2nd	1.45	1.60	1.74	1.82	1.73	1.60	1.63	1.67	1.70	1.78	2.03	0.07

Abdel Hady & Ibrahim (2001) on Red Roumy grape reported that, there was an increment in the yield per vine and bunch weight in response to the application of ascorbic acid. Jensen (2004) showed that, there was an increase of 24% in the yield over the control due to the application of Acadian (sea plants extract) on two grape verities. Also Fornes *et al* (2002) stated that, the fruit yield increased as the concentrations of Seaweed extract was increased. Giudice *et al* (2004) demonstrated that, prohexadione-Ca was shown to have the minimal effects on the yield of four grape cultivars.

2 – Berry characteristics:

a- Physical characteristics:

Data presented in Tables (6 & 7) revealed that, vines sprayed with GA_3 at 25% ppm resulted in a significant increase in berry weight and size in both seasons. Data also indicated that, all preharvest treatments were found to increase berry weight as compared with untreated vines. The highest concentration (1.5%) of Seaweed extract and ascorbic acid recorded the highest berry weight and size in comparison with the other concentrations (0.5% & 1.0%). Increasing EDTA- calcium concentration reduced berry weight and size, however they were still higher than the untreated vines.

Berry length and diameter for untreated vines had the lowest values in the two seasons. GA_3 at 25% ppm significantly increased berry length and diameter recording the highest values. The highest concentration (1.5%) of Seaweed extract and Ascorbic acid showed higher values of berry length and diameter than the other concentrations (0.5% & 1.0%). The opposite was true with EDTA- calcium, where vines treated with the lowest concentration (0.5%) had higher berry length and diameter than the other concentrations (1.0% & 1.5%).

Berry color at harvest represented as Hue angle was improved in all treatments. Data also showed that, spraying Seaweed extract at 1.5 % followed by Ascorbic acid at 0.5 %, Seaweed extract at 1.0 % and EDTA- calcium at 0.5 % was superior to the other treatments during the first season. While Seaweed extract at 1.5 %, 1.0 % and 0.5 % followed by EDTA- calcium at 1.0 % and 1.5 were superior to the other treatments during the second season.

Berry firmness significantly increased by GA_3 and EDTA- calcium treatments. Vines sprayed with GA_3 at 25% ppm gave the highest values of berry firmness in both seasons. On the other side the untreated vines (control) resulted in the lowest values of this estimate. Berry firmness increased significantly with the increase of EDTA- Calcium concentration in the first season. However, this increase was not significant in the second season. Seaweed extract sprayed at 1.5 % and 1.0 % gave higher values of berry firmness than 0.5%.

The above mentioned results are in accordance with the findings of Gaser *et al* (1998) and Omar & El-Morsy (2000) who found that, GA_3 significantly increased berry weight, size, diameter and firmness. Abdel Hady & Ibrahim (2001) on Red Roumy grape showed that, Ascorbic acid at 150 ppm increased berry weight and improved quality which could be attributed to its own auxinic action. Shiang *et al* (1997) reported that, Cytex (Seaweed extract containing cytokinins) increased the firmness of Honey Red grape berries. He added that, EDTA- calcium increased flesh firmness of berries as compared to the control.

In contrast, these results seem to disagree with those obtained by Abd El-Hafeez (2005) who reported that, preharvest spraying with Seaweed extract delayed pear fruit color transition.

Table 7. Effect of preharvest sprays with Seaweed extract, EDTA- calcium, Ascorbic acid and GA_3 on berry physical and chemical characteristics at harvest of Crimson Seedless grapes during seasons 2004 and 2005.

Berry characteristics	Season	Cont.	Seaweed extract			EDTA- calcium			Ascorbic acid			GA3	New LSD
			0.5 %	1.0 %	1.5%	0.5 %	1.0%	1.5 %	0.5 %	1.0 %	1.5 %	25ppm	
Berry color (Hue angle)	1st	41.1	34.8	32.6	30.8	34.3	36.4	37.3	31.6	35.1	38.9	46.0	2.91
	2nd	35.6	25.5	24.8	24.7	27.5	27.8	29.8	30.7	32.3	34.7	38.3	3.65
Berry firmness (g/cm)	1st	51.0	53.6	63.1	61.9	53.3	61.1	66.7	56.6	61.6	67.4	70.9	3.51
	2nd	41.5	44.7	49.1	50.2	44.9	48.4	52.2	46.1	51.0	58.7	58.0	4.62
TSS	1st	16.7	16.9	17.3	17.5	17.2	17.5	16.8	17.3	17.5	17.7	16.5	0.28
	2nd	17.1	17.7	18.0	18.1	17.6	17.7	17.3	17.2	17.3	17.6	17.0	0.32
Total acidity percentage	1st	0.70	0.66	0.62	0.59	0.65	0.67	0.68	0.67	0.64	0.66	0.72	0.07
	2nd	0.68	0.65	0.62	0.61	0.65	0.64	0.67	0.68	0.67	0.66	0.70	0.06
TSS / TA ratio	1st	23.9	25.6	27.9	29.7	26.5	26.1	24.7	25.8	27.3	26.8	22.9	0.59
	2nd	25.1	27.2	29.0	29.7	27.1	27.7	25.8	25.3	25.8	26.7	24.3	0.63
Anthocyanen (mg/g)	1st	0.68	0.79	0.83	0.86	0.84	0.77	0.74	0.77	0.75	0.77	0.64	0.05
	2nd	0.70	0.81	0.90	0.94	0.87	0.80	0.75	0.79	0.74	0.70	0.67	0.05

b- Chemical characteristics:

1– Total soluble solids, total acidity and total soluble solids / total acidity ratio:

It is obvious from data given in Table (7) that spraying with Seaweed extract, EDTA- calcium and Ascorbic acid at all doses (0.5%, 1.0% and 1.5%) significantly increased total soluble solids percentage in berry juice and TSS / acid ratio while decreased the acidity in comparison with GA_3 and control treatments.

These results are also in agreement with those obtained by El-Abbasy & El-Morsy (2002) who mentioned that, preharvest spraying with Seaweed extract significantly increased TSS percentage and decreased acidity. The same trend was shown by Abdel Hady & Ibrahim (2001) on Red Roumy grape by spraying Ascorbic acid at 150 ppm.

The results are also in accordance with Gaser *et al* (1998) on Flame Seedless and Omar & El-Morsy (2000) on Ruby Seedless, who found that, GA_3 decreased TSS percentage and increased acidity in berry juice.

2 – Anthocyanin contents of berry skin:

Data presented in table (7) cleared that, spraying Seaweed extract recorded the highest values of anthocyanin contents of berry skin as compared with the other treatments. A significant increase in anthocyanin content was observed by increasing Seaweed extract concentrations, the highest concentration of Seaweed extract (1.5%) gave the highest value, while GA_3 was shown to have the lowest value in this respect in. On the other side, with increasing EDTA- Calcium concentration anthocyanin content of berry skin was decreased. Ascorbic acid treatment increased anthocyanin contents with the increase of it's concentration during the second season, while in the first season this trend was not clear.

The results in this respect are in agreement with Gujar *et al* (2001), who found that total soluble solids content was positively correlated with the pink percentage.

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تاثير المعامله بكل من مستخلص الطحالب البحريه و الكالسيوم المخلبى و حمض الاسكوربيك و حمض الجبريليك على العنب "كريمسون سيدليس":- أ - اكتمال النمو و جودة الثمار.

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أجرى هذا البحث خلال موسمين متتاليين (٢٠٠٤ و ٢٠٠٥) حيث تم رش كرمات العنب صنف "كريمسون سيدليس" بعد ٤ أسابيع من اكتمال العقد تقريباً بمستخلص الطحالب البحرية أو الكالسيوم المخلبى او حمض الاسكوربيك بتركيزات ٠,٥٪ أو ١ ٪ أو ١,٥٪ او حمض الجبريليك بتركيز ٢٥ جزء في المليون بالإضافة إلى رش كرمات الكنترول بالماء فقط.

تم دراسة خواص الثمار الطبيعية والكيماوية خلال مرحلة النمو والتطور وذالك من بداية التلوين وحتى وصول الثمار إلى مرحلة اكتمال النمو و عندئذ تم حصاد الثمار .

أوضحت النتائج ان نسبة المواد ألصلبه الذائبة في عصير ثمار العنب صنف "كريمسون سيدلس" و كذلك نسبة المواد الصلبه الذائبه الى نسبة الحموضة زادت تدريجيا بتقدم الثمار في العمر بينما تناقصت صلابة الحبات و نسبة الحموضة تدريجيا مع تقدم الثمار في العمر و كذلك تغير لون الحبات تدريجيا من اللون الأخضر المحمر عند الرش إلى الأحمر المخضر مع تقدم الثمار نحو اكتمال النمو ليتحول إلى الأحمر عند اكتمال النمو.

أوضحت النتائج ايضا أن رش كرمات العنب صنف "كريمسون سيدلس" قبل الحصاد بمستخلص الطحالب البحرية أو الكالسيوم المخلبى أو حمض الاسكوربيك أو حمض الجبريليك قد أدى إلى زيادة محصول الكرمات ووزن العنقود ووزن و صلابة الحبات. كذلك أدت المعاملة بكل من مستخلص الطحالب البحرية أو حمض الاسكوربيك الى زيادة محتوى الحبات من المواد الصلبه الذائبه و بالمثل نسبة المواد الصلبه الذائبه االى نسبة الحموضه والانثوسيانين كما أدت الى نقص محتوى الحبات من الحموضه الكليه بالمقارنة بالكنترول ولقد لوحظ ان هذا التأثير ازداد تدريجيا بزيادة التركيز المستخدم من الماده. وعلى العكس من ذالك كان لزيادة التركيز المستخدم من الكالسيوم المخلبى تأثير عكسى على محتوى الحبات من المواد الصلبه الذائبه كما ادى الى زيادة محتواها من الحموضه الكليه. ومن ناحية اخرى فأن رش كرمات العنب بحمض الجبريليك أدى إلى زيادة محتوى الحبات من الحموضه الكليه كما أدى الى انخفاض النسبه المئويه للمواد الصلبه الذائبه بعصير الحبات و بالمثل نسبة المواد الصلبه الذائبه االى نسبة الحموضه وكذالك الانثوسيانين بالمقارنة بالكنترول.

و أوضحت النتائج المتحصل عليها أيضا أن رش كـرمـــات العنب قبل الحصاد (بعـد ٤ أسابيـع من اكتمال العقد) سواء بمستخلص الطحـــالب البحرية او حمـــض الاسـكـوربيك أدى إلى تحسين تلوين الثمار والإسراع بالوصول الى اكـتمال النمو. وعلى العكس من ذلك كان للمعاملة بكل من الكالســـيوم المخلبى أو حمـــض الجـــبريليـــك تاثير عكسى فى هذا الصدد.

و عموما يمكن القول بأن رش كـرمـــات العنب صنف "كريمـــســـون سيدلس" قبل الحصاد (بعد ٤ أسابيـع من اكتمال العقد تقريبا) سواء بمستخلص الأعشاب البحرية بتركيز ١,٥٪ او حمـــض الاسـكـوربيك بتركيز ١,٥٪ ضرورى لزيادة محصول الكرمات ووزن العنقود ووزن و صلابة الحبات و كذلك تحسين تلوين الحبات و الاسراع بوصول الثمار الى مرحلة اكتمال النمـو (النضج). كذلك فأن الرش بحمـــض الجـــبريليـــك بتركـيز ٢٥ جـزء فـى المليـون او بالكالســـيوم المخلبى بتركيز(١٠٠٪) ضروريا لزيادة محصول الكرمات ووزن العنقـود إلا انـه يؤدي إلى تأخير وصول الثمار الى مرحلة اكتمال النمو (النضج).