

INFLUENCE OF SEAWEED EXTRACT (ACADIAN), EDTA-CALCIUM, ASCORBIC ACID AND GIBBERELIC ACID PRE HARVEST APPLICATION ON CRIMSON SEEDLESS TABLE GRAPE: II- STORABILITY

MOHAMED, M.A.A.¹, AISHA S. A. GASER² AND A.A. ABD ELGHANY²

1- Fruit Handling Department, Hort. Res. Institute, ARC, Giza

2- Viticulture Department, Hort. Res. Institute, ARC, Giza

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Abstract

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

Crimson Seedless grapevines were sprayed with 0.5, 1.0 or 1.5% seaweed extract (Acadian) or EDTA- calcium or ascorbic acid or with 25 ppm gibberellic acid at four weeks after full setting, grapevines of control treatment were sprayed only with water. At maturity stage, grapes of each treatment were picked and packed into carton box (2Kg / box) lined with perforated polyethylene (40 μ , 400 walls / m², 1hall = 0.5cm) with a half SO₂ generator sheet and then stored at 0°C. and R.H. 90- 95% up to 12 weeks.

Weight loss, decay, shatter , total spoilage percentage, percentage of total soluble solids and total soluble solids / total acidity ratio of Crimson Seedless grapes increased while berry firmness, juice percentage and total acidity decreased gradually and significantly with the increases of time during the storage period.

All pre harvest treatments except GA3 treatment decreased weight loss, decay, shatter, total spoilage percentage and softening rate of grapes during storage. The highest concentration (1.5 %) of seaweed extract, EDTA- calcium or ascorbic acid was the most effective among all treatments in reducing weight loss, decay, shatter, total spoilage percentage and softening rate of stored grape. However, in most cases there was no significant difference among treatments in this respect when the low dose (1.0%) was applied.

It can be concluded that, pre harvest spraying with either seaweed extract (Accadian) or Ascorbic acid at 1.5 % reduced losses, deterioration rate while increased storage life of Crimson Seedless grape during storage.

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 reached 144624 feddans producing 1391749 tons according to Ministry of Agriculture statistics.

One of the most promising new cultivars planted in Egypt is Crimson Seedless as a late seedless variety with colored berries. However, there is a lack of available knowledge for Egyptian producers about its suitable agricultural practices.

There are some reports which pointed out that, seaweed extract has been used as a food, fertilizer and for medicinal purposes for a long time. Like some other plants, seaweed contains various kinds of inorganic and organic substances which probably benefit human health. It has also been reported that seaweed contains high levels of minerals, vitamins, essential amino acids, indigestible carbohydrates, and dietary fiber (Jimenez and Goni, 1999) from (Ismail and Hong, 2002).

Bio-fertilizers are being used as chemical fertilizer 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 and their derivatives are used in agriculture as potential growth regulators.

El-Abbasy and El-Morsy (2002) in their study on Thompson seedless grapevines sprayed with seaweed extracts at 4 ml. / liter after full bloom and / or at verasion, reported that these pre-harvest treatments significantly increased TSS / Acid ratio, shattering and decay during cold storage. Also, they mentioned that, two sprays of seaweed extract significantly increased weight loss and decay during storage compared with one spray and control (unsprayed vines).

Seaweed extracts and yeast were examined for the control of fruit rots in strawberries in 5 field trials in Victoria, Australia. All treatments were applied as foliar sprays at weekly intervals. Seaweed extracts and yeast treatments significantly reduced grey mould during the 3 days storage at room temperature (15 -25 °C) after harvest (Washington, *et. al.*, 2004).

Abdel-Hafeez, (2005) reported that, pre-harvest spraying with 0.5, 1.0 and 1.5% concentrations of either seaweed extracts or active dry yeast significantly reduced pear fruit weight loss and decay percentage incidence during storage. Also these treatments reduced the deterioration rate of fruit firmness and transition of fruit color during storage, while they had no clear effect on the other fruit properties during storage, such as the contents of T. S. S. % and acidity.

Mohamed (1998) found that, spraying calcium compounds 20 days before harvest significantly reduced weight loss, decay, shatter and total spoilage incidence in grapes during storage. Furthermore, pre harvest spraying with calcium compounds significantly increased berry firmness and significantly reduced the increasing rate of total soluble solids percentage of the stored grapes. Also he added that, grapes treated with calcium compounds were significantly less in acid contents during storage compared with untreated grapes.

Miceli, *et. al.* (1999) mentioned that, calcium treatments increased calcium content in both the whole berries and in the skin, resulting in a reduction of total rots and Botrytis rots (caused by *Botrytis cinerea*) in the bunches left on the vines under

plastic covering for two months after the harvest season. Moreover, treated bunches stored in the cold room at 0 degree C for 50 days, followed by 7 days of shelf life, showed a 50% reduction of Botrytis rots compared with the controls. The same results were shown by Strydom, *et. al.* (1999).

Chardonnet, *et. al.* (2000) cleared out that, calcium (CaCl₂) inhibited polygalacturonase activity at 1 g litre⁻¹ for C and C77:4 and at 16 g litre⁻¹ for B. [three isolates of *B. cinerea* from decayed apple (B) and grape (C and C77:4) fruits.] Calcium infiltration reduced decay caused by all the three isolates by three to five times.

Ramprasad, *et. al.* (2004) showed that, grapes treated with ascorbic acid plus antioxidants (salicylhydroxamic acid, n-propyl gallate and sodium benzoate) recorded lower cumulative physiological loss in weight. In all treatments, increased shelf life reflected the reduction in weight loss. Berry shattering was significantly reduced in ascorbic acid at 1000 ppm plus both AOX-inhibitors and sodium benzoate compared with the control.

Mohamed *et. al.* (1998) reported that, weight loss, decay, shatter, total spoilage, stem browning, and dryness, total soluble solids percentage of grapes increased while berry firmness, general bunch appearance and total acidity decreased with prolonging the storage period. The same results were given by Young *et. al.* (1998) and Mohamed & Hassan (2003).

The purpose of this study is to determine the effect of pre harvest foliar spraying with four compounds (Seaweed extract (Acadian), EDTA- calcium, ascorbic acid and GA₃) on Crimson Seedless grape storability.

MATERIALS AND METHODS

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

Six years old Crimson Seedless grapevines were chosen for this experiment. The vines were nearly uniform, planted in a sandy soil at 3×3 m, drip irrigated. 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 cultural practices already applied in the vineyard.

Eleven treatments were carried out 4 weeks after fruit set. Each treatment had six vines as three replicates, as 2 vines per one replicate. The treatments applied were as follows:-

- 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 %.
- 11- Spraying with gibberellic acid (GA₃) at 25 ppm.

At maturity stage, samples from all treatments in both seasons, were picked in the early morning and directly transported to the laboratory and sorted to obtain uniform samples then stored at 0°C. and 90- 95% R.H. up to 12 weeks. Fruits were packed into 55 carton boxes (2Kg / box) lined with perforated polyethylene (40 µ, 400 walls / m², 1hall = 0.5cm) with a half SO₂ generators sheet. Each treatment had five carton boxes, representing three replicates as to be used for estimating the weight loss, decay, shatter, total spoilage percentage and bunch freshness. Another two carton boxes were used for the determination of the physical and chemical properties of the stored grapes.

The determination procedures were as follows:

Decay, shatter, weight loss percentage were calculated according to the equation (weight of decayed or shattered berries or weight loss per box X 100 / the initial weight of box).

Total spoilage percentage was calculated as the sum of the last three parameters (weight loss, decay and shatter percentage).

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).

Berry firmness was estimated in 15 berries by lfra 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.

Juice percentage was determined by weighing the juice of three single replicates taken randomly from the whole bunches. The Juice percentage was then calculated.

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.

Data were subjected to analysis of variance as two factorial experiments in complete random design and all means were compared using the new LSD at the 5% level of probability in the two seasons of the experiment as described by Snedecor and Cochran (1980).

*Acadian contains 13-16% organic matter, 4-7% k_2O , 1-1.5%Ca, .3-1.2% P_2O_5 , and a little from cytokinins, Auxins, Gibberellins and Amino acids.

RESULTS AND DISCUSSION

I - Physical characteristics:

a- Weight loss percentage

Data presented in table (1) clearly indicate that, weight loss percentage increased gradually and significantly with prolonged storage period. Also data show that, all pre harvest treatments except GA_3 treatment decreased weight loss percentage of Crimson seedless during storage. Moreover, it is obvious that, the highest concentration 1.5 % of either seaweed extract EDTA- Calcium or Ascorbic acid was the most effective among all treatments in reducing weight loss percentage of stored grape. Although all used pre harvest treatments reduced weight loss incidence during storage, it is apparent that, the lowest doses of Ascorbic acid and the only used dose of GA_3 were also effective during the two seasons and seaweed extract during the second season.

The results in this respect are in harmony with those obtained by Abd El-Hafeez (2005) who reported that, pre harvest spraying with 0.5 % and 1.5 % of seaweed extract significantly reduced weight loss percentage of pear fruit during storage.

These results are also in line with those founded by Kumar *et. al.* (1990) who found that, pre harvest application with calcium (1% ca $(NO_3)_2$ or $CaCl_2$ at 0.6 or 1.0 %) decreased weight loss incidence of grapes during storage.

Also, the results are in agreement with the finding of Ramparasad *et. al.* (2004) who reported that, pre harvest application with Ascorbic acid significantly reduced weight loss incidence of Thompson seedless grapes during storage.

Similar results were also obtained by Mohamed (1998), Young *et. al.* (1998) and Mohamed and Hassan (2003). They found that, weight loss percentage of grapes increased gradually and significantly with prolonging the storage period.

b- Decay percentage

Data illustrated in table (2) show that, decay percentage of Crimson seedless grapes increased gradually and significantly with the increasing of the storage period. Data also cleared that, all pre harvest application except GA₃ treatment significantly decreased decay incidence during storage in the two seasons of this study. Also it is obvious that, the highest concentration of EDTA- Calcium 1.5 % followed by the highest doses of ascorbic acid and seaweed extract were the most effective treatment in reducing decay incidence of grapes during the first season. During the second season however, the highest dose of ascorbic acid followed by that of seaweed extract and the highest dose of EDTA- Calcium were the most effective treatments in reducing decay incidence of stored grapes.

Table 1. Effect of pre harvest spraying with Seaweed extract, EDTA- calcium, ascorbic acid and GA₃ on weight loss percentage of Crimson Seedless grapes during storage.

St. Period / days	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												
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1.4	0.8	0.9	0.9	0.6	0.4	0.6	1.0	1.2	1.0	1.1	0.9
28	2.1	1.6	1.8	1.6	1.4	0.9	1.0	2.1	1.8	2.0	2.1	1.7
42	3.6	2.9	3.0	2.8	2.4	1.6	1.9	3.9	3.0	3.1	4.1	2.9
56	5.2	4.8	4.4	4.0	3.8	2.6	3.0	5.2	4.3	4.4	5.6	4.3
70	6.6	5.9	6.1	5.7	4.9	4.3	4.2	6.6	6.3	5.7	7.3	5.8
84	8.9	7.1	6.6	6.2	6.6	5.9	4.5	7.7	7.5	6.5	7.7	6.8
98	9.6	8.9	7.4	7.0	8.7	7.5	7.2	8.8	8.6	7.4	9.0	8.2
Means	4.68	4.00	3.77	3.53	3.57	2.91	2.79	4.40c	4.09	3.76	4.62	---
Second season												
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.89	0.43	0.91	0.53	0.51	0.76	0.66	0.64	0.63	0.81	0.63	0.67
28	1.44	0.86	1.57	1.05	1.01	1.09	1.3	1.28	1.25	1.81	1.25	1.26
42	2.86	2.21	2.37	2.25	2.42	2	2.44	2.45	2.22	2.46	2.84	2.41
56	4.33	3.88	3.42	3.11	3.76	2.49	3.49	3.65	3.19	3.21	4.42	3.54
70	5.45	5.54	4.8	4.41	4.76	5.99	4.37	5.52	5.19	4.88	6.37	5.21
84	7.83	7.21	5.99	5.31	6.64	6.95	5.42	6.78	6.37	6.14	7.76	6.58
98	9.58	8.81	7.51	6.49	7.72	7.13	6.77	8.36	8.59	7.7	9.64	8.03
Means	4.05	3.62	3.32	2.89	3.35	3.30	3.06	3.58	3.43	3.37	4.11	---

New LSD at 5 % level F.S.	Pre harvest treatments = 0.42	St.period = 0.36	Interaction = N.S.
New LSD at 5 % level S.S.	Pre harvest treatments = 0.49	St.period = 0.42	Interaction = N.S.

However, the variations among these treatments at the highest doses were not significant during the first season and only significant with the highest dose of EDTA- Calcium during the second season.

These results agree with those obtained by Washington *et. al.* (2004) on Strawberries and Abd El-Hafeez (2005) on Pear fruits. They reported that, pre harvest application with seaweed extract reduced decay incidence of fruits during storage.

These results are also in agreement with those found by Mohamed (1998), and Miceli *et. al.* (1999), Strydom *et. al.* (1999) and Chardonnet *et. al.* (2000) they reported that, pre harvest application of Calcium significantly decreased decay incidence of grape during storage.

Similar results were also obtained by Miceli *et. al.* (1999) they reported that, the effect of CaCl_2 pre harvest spraying for reducing total rots of grapes during storage increased with the increasing of the used doses.

These results are in line with those obtained by Ramprasad *et. al.* (2004) who mentioned that, pre harvest spraying with Ascorbic acid significantly reduced the incidence of rots in Thompson seedless grapes during storage.

These results are in line also with those mentioned by Mohamed (1998), Young *et. al.* (1998) and Mohamed and Hassan (2003) who found that, decay percentage of grapes increased significantly with the increases of the storage period. In contrast these results disagree with those reported by El-Abbasy and El-Morsy (2002) who mentioned that, pre harvest treatments with seaweed extract at 4 liter after full bloom and or at version significantly increased decay incidence of grapes during storage.

c- Shatter percentage

According to data shown in table (3) it is clear that, shatter percentage of Crimson seedless grape increased gradually and significantly with prolonging the storage period during the two seasons of this work.

Also data indicated that, all pre harvest treatments significantly decreased shattering incidence of grapes during storage in the two seasons of this investigation. The reduction of shattering incidence increased with increasing the used concentration of these compounds. However in most cases these increments were not significant. Data also indicate that, pre harvest treatment with seaweed extract at 1.5 % followed by EDTA- calcium at 1.5 % were the most effective pre harvest treatments in reducing shattering incidence during the first season. Pre harvest spraying with EDTA- calcium at 1.5 % concentration followed by seaweed extract at 1.5 % were the most effective treatments during the second season.

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Table 2. Effect of pre harvest spraying with Seaweed extract, EDTA- calcium, ascorbic acid and GA₃ on decay percentage of Crimson Seedless grapes during storage.

St. Period / days	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												
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	1.2	0.4	0.3	0.0	0.8	1.0	0.2	0.5	0.3	0.5	0.6	0.5
56	2.3	0.9	0.5	0.0	1.6	1.9	0.3	0.9	0.5	0.7	1.4	1.0
70	5.6	2.5	2.0	1.1	3.4	2.5	1.1	1.8	1.5	0.9	3.3	2.3
84	6.2	3.9	3.0	2.2	5.2	2.9	1.4	3.2	2.1	1.9	5.3	3.4
98	13.3	9.4	8.0	7.0	7.8	6.4	2.1	9.5	6.0	4.2	13.2	7.9
Means	3.58	2.14	1.73	1.29	2.35	1.83	0.65	1.98	1.31	1.00	2.97	---
Second season												
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01
42	1.03	0.36	0.37	0.24	1.2	0.98	1.07	0.46	0.89	0.21	1.76	0.78
56	2.16	1.62	0.68	0.45	2.45	1.77	2.17	0.88	1.69	0.4	3.58	1.62
70	4.89	3.81	4.04	2.06	3.99	3.82	3.66	2.6	2.9	1.47	5.25	3.50
84	7.56	7.11	5.98	3.51	7.79	6.34	5.24	4.23	4.15	2.46	7.07	5.59
98	17.56	9.9	9.37	4.45	11.48	9.16	7.6	9.4	6.9	5.99	9.8	9.24
Means	4.16	2.85	2.55	1.34	3.36	2.76	2.47	2.20	2.07	1.32	3.43d	---

New LSD at 5 % level F.S.	Pre harvest treatments = 1.20	St.period = 1.02	Interaction = N.S.
New LSD at 5 % level S.S.	Pre harvest treatments = 0.85	St.period = 0.72	Interaction = 2.40

Table 3. Effect of pre harvest spraying with Seaweed extract, EDTA- calcium, ascorbic acid and GA₃ on shatter percentage of Crimson Seedless grapes during storage.

St. Period / days	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												
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
42	2.3	1.2	1.2	0.2	1.1	0.9	0.6	1.0	1.1	0.9	1.4	1.1
56	4.7	2.5	2.1	0.5	1.9	1.5	1.3	2.3	2.2	1.6	2.6	2.1
70	6.7	4.0	2.1	1.5	3.5	2.5	2.0	3.6	2.8	2.8	3.5	3.2
84	8.8	5.2	3.1	1.9	3.8	3.2	2.5	5.4	4.2	3.4	4.9	4.2
98	12.1	7.7	6.8	2.3	6.3	4.7	4.8	7.7	5.4	4.9	8.1	6.4
Means	4.43	2.58	1.91	0.81	2.06	1.60	1.40	2.51	1.96	1.70	2.55	---
Second season												
0	0	0	0	0	0	0	0	0	0	0	0	0.0
14	0.05	0	0	0	0	0	0	0	0	0	0	0.0
28	0.17	0	0	0	0	0	0	0.58	0	0	0	0.07
42	1.26	0.15	0.38	0.15	0.52	0.2	0	1.17	0.8	0.23	0.22	0.46
56	2.43	0.28	0.7	0.32	1.05	0.4	0	2.49	1.6	0.47	0.46	0.93
70	4.07	3.15	3.41	2.02	3.0	1.73	1.48	4.09	3.95	1.95	1.76	2.78
84	8.09	5.78	5.65	3.67	4.79	3.02	3.01	6.44	6.28	3.83	3.16	4.88
98	13.07	11.55	10.48	5.53	9.42	7.75	5.27	10.52	8.65	7.06	6.41	8.70
Means	3.64	2.62	2.58	1.46	2.35	1.64	1.22	3.16	2.66	1.69	1.50	---

New LSD at 5 % level F.S.	Pre harvest treatments = 0.92	St.period = 0.79	Interaction = N.S.
New LSD at 5 % level S.S.	Pre harvest treatments = 0.93	St.period = 0.79	Interaction = N.S.

These results are in line with those obtained by Mohamed (1998), Young *et. al.* (1998) and Mohamed & Hassan (2003) who found that, shatter percentage of grapes increased gradually and significantly with prolonging the storage period.

The results are also in agreement with those obtained by Mohamed (1998) who reported that, pre harvest application of Calcium significantly decreased shattering incidence of grape during storage. Similar results were also mentioned by Ramprasad *et. al.* (2004) who indicated that, pre harvest application with Ascorbic acid decreased shatter incidence of stored grapes.

On the contrast these results disagree with those mentioned by El-Abbasy and El-Morsy (2002) who stated that, pre harvest spraying of Thompson seedless vines with seaweed extract significantly increased shatter incidence of grapes during storage.

d- Total Spoilage percentage

Data presented in table (4) show that, total spoilage percentage in stored Crimson seedless table grapes increased gradually and significantly with the extension of storage period during the two seasons of this research. It is clear that, all pre harvest applications significantly reduced total spoilage of grapes during the two seasons of this study. Data also revealed that, the reduction of total spoilage significantly increased with the increases of the used doses from these compounds during the two seasons in this work.

Moreover, there were only significant differences between the highest and the lowest doses during the two seasons in this investigation. On the other side no significant differences could be detected between the highest and the medium doses and between the medium and the lowest doses during the two seasons in this work.

It is interesting to note that, vines sprayed with EDTA- calcium at 1.5 % followed by that sprayed with seaweed extract at 1.5 % had the least total spoilage percentage during the first season. In the second season however, spraying with seaweed extract at 1.5 % followed by Ascorbic acid at 1.5 % resulted in the least total spoilage percentage.

These results are in-line with those mentioned by Mohamed (1998), Young *et. al.* (1998) and Mohamed and Hassan (2003) who reported that, total spoilage percentage of grapes increased gradually and significantly with prolonging the storage period.

The results are also in harmony with those obtained by Mohamed (1998) who found that, pre harvest spraying of vines with Calcium compounds significantly reduced total spoilage percentage of grapes during storage.

Table 4. Effect of pre harvest spraying with Seaweed extract, EDTA- calcium, ascorbic acid and GA₃ on of total spoilage percentage of Crimson Seedless grapes during storage.

St. Period / days	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												
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1.4	0.8	0.9	0.9	0.6	0.4	0.6	1.0	1.2	1.0	1.1	0.9
28	3.0	1.6	1.8	1.6	1.4	0.9	1.0	2.1	1.8	2.0	2.1	1.7
42	7.1	4.6	4.5	3.0	4.3	3.5	2.6	5.4	4.4	4.5	6.1	4.6
56	12.2	8.1	7.0	4.5	7.3	6.0	4.6	8.4	7.1	6.7	9.5	7.4
70	18.8	12.4	10.1	8.3	11.8	9.4	7.4	12.0	10.6	9.4	14.1	11.3
84	23.9	16.3	12.8	10.4	15.6	11.9	8.5	16.2	13.8	11.7	17.9	14.5
98	35.0	26.0	22.2	16.3	22.8	18.6	14.2	26.1	20.0	16.4	30.3	22.5
Means	12.68	8.71	7.41	5.63	7.98	6.34	4.84	8.90	7.36	6.47	10.14	---
Second season												
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.9	0.4	0.9	0.5	0.5	0.8	0.7	0.6	0.6	0.8	0.6	0.7
28	1.7	0.9	1.6	1.1	1.0	1.1	1.3	1.9	1.3	1.8	1.3	1.3
42	5.2	2.7	3.1	2.6	4.2	3.2	3.5	4.1	3.9	2.9	4.8	3.7
56	8.9	5.8	4.8	3.9	7.2	4.7	5.7	7.0	6.5	4.1	8.5	6.1
70	14.4	12.5	12.3	8.5	11.8	11.5	9.5	12.2	12	8.3	13.4	11.5
84	23.5	20.1	17.6	12.5	19.2	16.3	13.7	17.4	16.8	12.4	18	17.1
98	40.2	30.5	27.4	16.5	28.6	24	19.6	28.3	24.1	20.8	25.8	26.0
Means	11.85	9.08	8.45	5.70	9.07	7.70	6.74	8.94	8.16	6.38	9.05	---

New LSD at 5 % level F.S.	Pre harvest treatments = 1.49	St.period = 1.27	Interaction = 4.20
New LSD at 5 % level S.S.	Pre harvest treatments = 1.64	St.period = 1.40	Interaction = 4.63

Similar results were also obtained by Ramprasad *et. al.* (2004) who found that, pre harvest application with Ascorbic acid significantly reduced total spoilage percentage of grapes during storage.

e- Berry Firmness

It is obvious from data shown in table (5) that, berry firmness decreased gradually and significantly with prolonged storage period during both seasons. Data also cleared that, all pre harvest applications significantly reduced the softening rate of grapes during storage compared with control.

It is interesting to note that, the decreases in softening rate was found to increase significantly with the increase of the used doses from all sprayed compounds in the two seasons. It is also clear from the same data that, grapes of the grapevines treated with Ascorbic acid at 1.5 % had the highest berry firmness during storage. However, there were no significant differences in this parameter in all stored grapes of vines treated with any of the highest doses 1.5 % from all studied compounds during the second season. On the other side grapes of vines treated with the highest doses 1.5 % of seaweed extract had berry firmness significantly less than that treated with the highest doses of Ascorbic acid at 1.5 % during the second season.

These results are in agreement with those mentioned by Abd El-Hafeez (2005) who mentioned that, pre harvest application of Pear trees with seaweed extract significantly increased fruit firmness during storage.

These results also are in line with those demonstrated by Mohamed (1998) and Lime *et. al.* (2002) who showed that, pre harvest application with Calcium Chloride significantly reduced softening rate of grapes during storage.

The results agree also with those obtained by Mohamed (1998), Young *et. al.* (1998) and Mohamed & Hassan (2003) who reported that, berry firmness of grapes decreased gradually and significantly with prolonged storage period.

f- Berry color (Hue angle)

According to data shown in table (6) it is obvious that, berry color changed directly from red (Hue angle is around 30) to Purplish Red (Hue angle is around 15) during storage in the two seasons of this investigation.

Data also indicated that, Although all grapes obtained from pre harvest sprayed grapevines had significantly darker color than untreated grapes (Hue angles associated with grape presented from pre harvest spraying grapevines were less than that were associated with presented from control grapevines) it is clear that, these differences were due to the effect of these treatments at harvest because

Table 5. Effect of pre harvest spraying with Seaweed extract, EDTA- calcium, ascorbic acid and GA₃ on berry firmness of Crimson Seedless grapes during storage.

St. Period / days	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												
0	51.0	53.6	63.1	61.9	53.3	61.1	66.7	56.6	61.6	67.4	70.9	60.65
14	49.7	47.0	54.7	55.0	50.4	59.3	61.7	52.8	57.7	59.6	60.1	55.26
28	47.4	50.4	51.3	52.0	47.9	56.5	54.6	48.4	54.0	56.8	55.9	52.28
42	44.1	45.8	46.1	49.7	42.5	45.1	52.3	47	46.5	54.7	50.2	47.63
56	41.6	42.5	45.3	46.6	41.4	43.5	47.5	42.9	46.3	49.8	45.3	44.79
70	39.2	41.5	43.5	44	40.6	39.1	41.6	39.3	42.2	46.1	41.1	41.65
84	33.2	35.8	40.2	41.3	36.6	37.9	40.8	36.9	41.4	42.4	38.3	38.60
98	27.1	32.1	35.9	39.5	31.8	34.7	38.9	35.3	36.6	39.1	35.4	35.13
Means	41.7	43.6	47.5	48.7	43.1	47.2	50.5	44.9	48.3	52.0	49.6	---
Second season												
0	41.5	44.7	49.1	50.2	44.9	48.4	52.2	46.1	51.0	58.7	58.0	49.53
14	40.3	43.8	47.5	49.3	40.8	44.5	51.1	42.4	44.8	51.6	56	46.54
28	34.7	39.5	40.1	43.1	39.5	42.6	45.3	39.4	41.1	47.6	47.3	41.83
42	33.5	38.2	38.0	44.0	35.3	37.9	39.7	35.6	37.9	40.9	43.8	38.62
56	34.7	34.1	36.4	39.3	32.5	37.5	37.3	33.6	34.6	35.0	35.6	35.51
70	29.1	28.4	30.7	34.4	34.9	35.2	34.3	31.6	32.7	35.7	32.9	32.72
84	24.6	29.3	32.0	34.9	23.5	28.6	34.7	26.7	28.0	32.0	27.8	29.28
98	24.1	28.6	31.0	33.9	23.1	26.3	32.0	25.8	27.9	28.4	26.2	27.92
Means	32.8	35.8	38.1	41.1	34.3	37.6	40.8	35.1	37.3	41.2	40.9	---

New LSD at 5 % level F.S.	Pre harvest treatments = 2.19	St.period = 1.87	Interaction = 6.21
New LSD at 5 % level S.S.	Pre harvest treatments = 2.00	St.period = 170	Interaction = 5.65

color of grape presented from sprayed grapevines was darker than that of control in the two seasons of this work.

These results disagree with those obtained by Abd El-Hafeez (2005) who mentioned that, pre harvest spraying with seaweed extract significantly reduced color transitions of Pear fruit during storage.

II - Chemical characteristics:

a- Total soluble solids, Total acidity and Total soluble solids / acid ratio

According to data presented in tables (7, 8 and 9) it is clear that, TSS percentage of grapes and TSS / acid ratio increased gradually with prolonged storage period in the two seasons. Data also indicated that, grapes of vines sprayed with seaweed extract and Ascorbic acid had higher TSS and TSS / acid ratio higher than those of untreated vines where as they had less total acidity percentage than that of untreated vines during storage. However it is obvious that, these variations among these parameters are due to the effect of these treatments at harvest. On the other hand, grapes of vines treated with EDTA- Calcium at 1.5% and GA₃ had higher acidity than those of untreated vines during storage in the two seasons, but had no obvious trend during the two seasons concerning total soluble solids (EDTA- Calcium at 1.5%) and total soluble solids / total acid ratio (GA₃).

These results are in line with those mentioned by Mohamed (1998), Young *et al.* (1998) and Mohamed and Hassan (2003). who reported that, TSS % of grape and total soluble solids / acid ratio increased while total acidity percentage decreased with prolonged storage.

Table 6. Effect of pre harvest spraying with Seaweed extract, EDTA- calcium, ascorbic acid and GA₃ on Hue Angle of Crimson Seedless grapes during storage.

St. Period / days	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												
0	41.1	34.8	32.6	30.8	34.3	36.4	37.3	31.6	35.1	38.9	46.0	36.3
14	42.7	36.0	32.1	35.7	35.5	37.6	33.4	32.8	35.0	38.1	45.8	36.8
28	38.4	32.7	31.8	31.0	33.7	33.4	32.9	31.0	34.6	36.0	45.6	34.6
42	38.3	28.2	31.4	30.1	31.2	28.9	32.2	30.6	33.1	32.8	43.2	32.7
56	38.0	27.7	28.8	29.0	32.8	32.5	28.9	24.5	28.2	30.8	42.7	31.3
70	37.9	21.3	28.1	29.7	29.7	28.5	28.4	23.9	22.9	29.9	41.3	29.2
84	33.6	18.3	25.4	29.5	24.5	22.4	26.5	22.7	22.5	26.7	36.2	26.2
98	32.5	15.0	11.4	28.1	20.0	22.5	24.7	21.3	15.2	20.1	30.6	21.9
Means	37.8	26.8	27.7	30.5	30.2	30.3	30.5	27.3	28.3	31.7	37.6	---
Second season												
0	35.6	25.5	24.8	24.7	27.5	27.8	29.8	30.7	32.3	34.7	38.3	30.2
14	34.8	25.7	24.9	24.1	26.8	26.8	28.4	29.3	32.2	34.0	35.4	29.3
28	34.6	24.8	23.3	23.7	26.7	25.5	26.0	27.4	31.4	32.2	33.8	28.1
42	31.9	24.1	23.2	22.5	25.8	23.8	25.9	25.2	26.2	28.1	31.1	26.2
56	25.4	22.7	22.6	21.8	25.7	23.9	21.7	25.4	25.7	24.4	29.5	24.5
70	27.8	19.6	21.0	20.4	24.2	22.3	23.6	21.7	22.4	24.7	27.5	23.2
84	23.7	19.2	19.4	17.3	16.6	21.9	21.7	16.9	23.0	22.2	23.0	20.4
98	23.7	15.5	16.4	16.2	13.2	20.6	19.0	10.9	15.1	18.1	21.8	17.3
Means	29.7	22.1	22.0	21.3	23.3	24.1	24.5	23.4	26.0	27.3	30.1	---

New LSD at 5 % level F.S.	Pre harvest treatments = 2.89	St.period = 2.46	Interaction = N.S.
New LSD at 5 % level S.S.	Pre harvest treatments = 1.48	St.period = 1.26	Interaction = 4.19

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II- STORABILITY

Table 7. Effect of pre harvest spraying with Seaweed extract, EDTA- calcium, ascorbic acid and GA₃ on TSS contents of Crimson Seedless grapes during storage.

St. Period / days	Treatments											Means
	Cont.	Seaweed extract			EDTA- calcium			Ascorbic acid			GA ₃	
		0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %		
First season												
0	16.7	16.9	17.3	17.5	17.2	17.5	16.8	17.3	17.5	17.7	16.5	17.17
14	17.1	17.6	19.4	19.0	18.6	18.0	16.9	17.6	17.8	18.5	17.1	17.96
28	17.7	18.1	20.4	19.6	19.6	18.7	17.4	18.2	18.3	18.6	17.6	18.56
42	18.1	18.8	21.0	19.5	19.2	19.1	17.6	18.3	18.4	18.7	19.4	18.92
56	18.4	19.1	21.6	20.5	20.4	19.3	17.7	18.4	18.5	18.7	19.5	19.28
70	18.7	19.8	21.2	20.7	20.5	19.7	17.8	19.7	18.6	19.2	19.6	19.59
84	18.3	19.9	21.9	20.8	20.6	19.5	17.9	18.9	19.3	19.9	19.8	19.71
98	19.6	20.1	21.6	21.2	20.4	19.8	18.0	19.0	19.4	20.1	19.9	19.97
Means	18.08	18.79	20.55	19.85	19.56	18.95	17.51	18.43	18.48	18.93	18.68	---
Second season												
0	17.1	17.7	18.0	18.1	17.6	17.7	17.3	17.2	17.3	17.6	17.0	17.51
14	17.5	18.0	18.5	18.9	18.3	18.3	17.8	17.7	17.6	17.8	17.6	18.00
28	17.8	17.9	19.0	19.8	19.3	18.7	18.6	17.9	18.8	17.9	18.2	18.54
42	18.4	18.6	20.0	20.2	19.4	19.3	18.8	18.8	19.7	18.4	18.4	19.10
56	18.9	19.8	19.9	20.7	19.6	19.5	19.0	19.4	19.3	19.0	19.2	19.49
70	18.6	19.5	21.1	20.8	19.9	19.7	19.2	19.7	19.8	18.6	19.3	19.66
84	19.4	19.6	20.9	21.2	19.8	19.9	19.5	20.0	19.9	19.1	20.1	19.95
98	17.5	20.1	20.1	21.7	20.8	19.7	20.3	19.5	21.1	19.5	20.4	20.07
Means	18.15	18.87	19.71	20.20	19.31	19.13	18.83	18.80	19.16	18.46	18.80	---

New LSD at 5 % level F.S.	Pre harvest treatments = 0.46	St.period = 0.34	Interaction = 1.29
New LSD at 5 % level S.S.	Pre harvest treatments = 0.27	St.period = 0.23	Interaction = 0.77

Table 8. Effect of pre harvest spraying with Seaweed extract, EDTA- calcium, ascorbic acid and GA₃ on total acidity of Crimson Seedless grapes during storage.

St. Period / days	Treatments											GA ₃	Means
	Cont.	Seaweed extract			EDTA- calcium			Ascorbic acid					
		0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %	0.5 %	1.0 %	1.5 %			
First season													
0	0.70	0.66	0.62	0.59	0.65	0.67	0.68	0.67	0.64	0.66	0.72	0.660	
14	0.67	0.66	0.63	0.61	0.64	0.68	0.68	0.66	0.63	0.62	0.70	0.653	
28	0.66	0.65	0.61	0.60	0.61	0.66	0.66	0.65	0.62	0.62	0.69	0.639	
42	0.62	0.66	0.58	0.59	0.60	0.64	0.65	0.64	0.62	0.61	0.66	0.625	
56	0.60	0.62	0.59	0.58	0.61	0.64	0.65	0.61	0.63	0.57	0.63	0.612	
70	0.57	0.60	0.55	0.57	0.59	0.62	0.64	0.64	0.62	0.56	0.58	0.595	
84	0.65	0.60	0.56	0.55	0.59	0.60	0.64	0.57	0.59	0.58	0.63	0.596	
98	0.68	0.59	0.51	0.53	0.55	0.62	0.67	0.62	0.61	0.58	0.65	0.601	
Means	0.644	0.630	0.581	0.578	0.605	0.641	0.659	0.633	0.620	0.600	0.658	...	
Second season													
0	0.68	0.65	0.62	0.61	0.65	0.64	0.67	0.68	0.67	0.66	0.70	0.657	
14	0.64	0.63	0.60	0.59	0.63	0.62	0.66	0.65	0.64	0.64	0.68	0.635	
28	0.60	0.62	0.63	0.57	0.61	0.60	0.65	0.64	0.65	0.60	0.68	0.623	
42	0.52	0.57	0.58	0.58	0.60	0.59	0.65	0.62	0.62	0.58	0.64	0.595	
56	0.55	0.59	0.61	0.54	0.60	0.57	0.61	0.61	0.61	0.62	0.64	0.595	
70	0.57	0.60	0.57	0.57	0.55	0.55	0.58	0.62	0.60	0.58	0.61	0.582	
84	0.64	0.65	0.60	0.56	0.53	0.54	0.61	0.60	0.59	0.55	0.75	0.602	
98	0.72	0.69	0.62	0.59	0.55	0.56	0.63	0.57	0.57	0.53	0.77	0.618	
Means	0.615	0.625	0.604	0.576	0.590	0.584	0.633	0.624	0.619	0.595	0.684	...	

New LSD at 5 % level F.S.	Pre harvest treatments = 0.018	S.period = 0.015	Interaction = N.S.
New LSD at 5 % level S.S.	Pre harvest treatments = 0.026	S.period = 0.022	Interaction = 0.072

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Table 9. Effect of pre harvest spraying with Seaweed extract, EDTA- calcium, ascorbic acid and GA₃ on TSS / total acidity ratio of Crimson Seedless grapes during storage.

St. Period / days	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												
0	23.9	25.6	27.9	29.7	26.5	26.1	24.7	25.8	27.3	26.8	22.9	26.11
14	25.5	26.7	30.8	31.1	29.1	26.5	24.9	26.7	28.3	29.8	24.4	27.61
28	26.8	27.8	33.4	32.7	32.1	28.3	26.4	28.0	29.5	30.0	25.5	29.15
42	29.2	28.5	36.2	33.1	32.0	29.8	27.1	28.6	29.7	30.7	29.4	30.38
56	30.7	30.8	36.6	35.3	33.4	30.2	27.2	30.2	29.4	32.8	31.0	31.60
70	32.8	33.0	38.5	36.3	34.7	31.8	27.8	30.8	30.0	34.3	33.8	33.08
84	28.2	33.2	39.1	37.8	34.9	32.5	28.0	33.2	32.7	34.3	31.4	33.20
98	28.8	34.1	42.4	40.0	37.1	31.9	26.9	30.6	31.8	34.7	30.6	33.53
Means	28.23	29.96	35.62	34.50	32.48	29.64	26.61	29.23	29.83	31.67	28.63	---
Second season												
0	25.1	27.2	29.0	29.7	27.1	27.7	25.8	25.3	25.8	26.7	24.3	26.70
14	27.3	28.5	30.9	32.1	29.0	29.6	27.0	27.3	27.5	27.8	25.9	28.44
28	29.7	28.8	30.2	34.8	31.6	31.2	28.6	28.0	28.9	29.8	26.8	29.86
42	35.4	32.6	34.5	34.9	32.3	32.8	29.0	30.4	31.7	31.7	28.8	32.18
56	34.4	33.5	32.7	38.4	32.6	34.3	31.2	31.9	31.6	30.6	30.0	32.83
70	32.6	32.5	37.1	36.5	36.1	35.9	33.1	31.8	33.0	32.0	31.7	33.85
84	30.3	30.1	34.9	37.9	37.3	36.9	32.0	33.4	33.7	34.7	26.8	33.45
98	24.3	29.1	32.5	36.8	37.8	35.2	32.3	34.3	37.0	36.7	26.5	32.95
Means	29.89	30.29	32.72	35.14	32.97	32.93	29.87	30.28	31.13	31.24	27.62	---

New LSD at 5 % level F.S.	Pre harvest treatments = 1.49	St.period = 1.27	Interaction = N.S.
New LSD at 5 % level S.S.	Pre harvest treatments = 1.68	St.period = 1.43	Interaction = 4.75

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تأثير المعاملة بكل من مستخلص الطحالب البحرية و
الكالسيوم المخلبي و حمض الاسكوربيك و حمض
الجبريليك على العنب "كريمسون سيدلس":-
ب - القدره التخزينيه.

محمود على احمد محمد^١ و عائشه صالح عبد الرحمن جاسر^٢
و عبد الغنى عبد الستار عبد الغنى^٢

١ - قسم بحوث تداول الفاكهة - معهد بحوث البساتين - مركز البحوث الزراعية.

٢ - قسم بحوث العنب - معهد بحوث البساتين - مركز البحوث الزراعية.

أجرى هذا البحث خلال موسمين متتاليين (٢٠٠٤ و ٢٠٠٥) ؛ حيث تم رش كرمات العنب صنف "كريمسون سيدلس" بعد حوالي أربعة أسابيع من اكتمال العقد بمستخلص الطحالب البحرية أو الكالسيوم المخلبي أو حمض الاسكوربيك بتركيزات ٠,٥% أو ١% أو ١,٥% او حمض الجبريليك بتركيز ٢٥ جزء في المليون بالإضافة إلى رش كرمات المقارنه بالماء فقط.

وعند وصول الثمار إلى درجة إكتمال النمو تم حصاد وفرز الثمار وتخزينها على درجة الصفر المئوى ورطوبة نسبية ٩٠ - ٩٥% ولمدة ١٢ اسبوع. تم أثناء التخزين دراسة الخواص الطبيعية والكيمائية للثمار على فترات دوريه كل أربع عشيرة يوماً.

أوضحت النتائج المتحصل عليها أن نسبة الفقد فى الوزن و العفن وكذلك نسبة الفط و الفقد الكلى و نسبة المواد الصلبة الذائبه و نسبة المواد الصلبة الذائبه الى الحموضه الكلية تزداد تدريجياً و معنوياً بينما تقل صلابة الحبات وكذلك نسبة العصير و نسبة الحموضه الكليه مع زيادة العمر التخزينى للثمار.

كما أوضحت النتائج المتحصل عليها أن رش كرمات العنب قبل الحصاد (بعد حوالي أربعة أسابيع من اكتمال العقد) سواء بمستخلص الطحالب البحرية أو الكالسيوم المخلبي او حمض الاسكوربيك أدى إلى تقليل حدوث كل من الفقد فى الوزن و العفن وكذلك نسبة الفط و الفقد الكلى وكذلك تقليل معدل ليونة الحبات فى العنب كريمسون سيدلس أثناء التخزين. هذا ووضحت النتائج ايضا ان التركيز الاعلى (١,٥%) من اى من هذه المركبات كان الاكثر فعالية من بين التركيزات المستخدمة فى تحقيق هذا الهدف .

مما تقدم يمكن القول ان رش كرمات العنب بعد حوالي أربعة أسابيع من اكتمال العقد سواء بمستخلص الطحالب البحرية او حمض الاسكوربيك بتركيز ١,٥% او الكالسيوم المخلبي بتركيز ١,٥% او حمض الجبريليك بتركيز ٢٥ جزء في المليون تحسن من القدرة التخزينية لثمارالعنب صنف كريمسون سيدلس وذلك عن طريق تقليل الفاقد (سواء كان مرضيا او فسيولوجيا) و تثبيط معدل تدهور الخواص الطبيعية و الكيمائيه للثمار أثناء التخزين .