Minufiya J. Agric. Res. Vol. 28 No. 1: 311 - 330 (2003)

PEACH FRUIT QUALITY AS AFFECTED BY PREHARVEST CALCIUM SPRAYS

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(Received : Dec., 17, 2002)

ABSTRACT: *An experiment was conducted to investigate the effect of preharvest calcium spray forms, i.e. (chloride and nitrate) on fruit quality of (Swelling and Met Ghamr) peach cultivars, at maturity and during storage at ambient room, during two successive seasons of 2001 and 2002. Both cultivars were growing each in separated private orchard at Aga, Dakahlia Governorate. The sprays of calcium either in chloride or nitrate were carried at rate of 0.05,0.10,0.15 and 0.20% at 30 days before harvesting, control treatment was sprayed with only water.*

The results showed that Calcium foliar sprays of both forms increased fruit quality parameters, i.e.(firmness, TSS, acidity, chlorophyll, pectin and calcium), while it decreased anthocyanin and gave irrigular trend of TSS/acid ratio and caroteins contents compared with unsprayed ones. Preharvest calcium spray forms reduced fruit decay and weight loss and increased acidity in both Swelling and Met Ghamr, while they increased TSS in Swelling fruits comparing with unsprayed ones during storage at ambient room. The preharvest Ca-nitrate spray at high concentrations (0.15-0.20%) increased firmness in the two cvs., TSS in Met Ghamr cv., while anthocyanin values was similar to the control in the two cvs., at harvest and improved TSS in Met Ghamr cv. and decreased acidity in Swelling cv. during storage at ambient room. As, the preharvest Ca- Chloride spray was increased TSS values and TSS/ acid ratio in Swelling cv. at harvest and during storage at ambient room. Both Ca- nitrate and chloride sprays at high rate increased pectin and calcium content in the two cvs. at harvest but, reduced decay and weight loss percentages during storage at ambient room, while at low rate both decreased acidity during storage at ambient room.

However, calcium spray forms at higher concentration (0.15-0.20%) improved fruit quality of Swelling and Met Ghamr peaches at harvest and keep them during storage at ambient room in better condition, hence it can be offers the opportunity of marketing a good quality peach in a period when the fruit are not available in local markets.

Key words: *prehrvest spray, calcium, peach, firmness, color, acidity, TSS, pectin, postharvest quality.*

INTRODUCTION

Peaches are perishable fruits which, at maturity, ripen and senescence rapidly. The softening of peaches after harvest has been shown to be

sensitive to its preharvest growth status and the calcium concentration in the flesh. Thus, peach fruits softening occurs either by movement of Ca^{2+} from the middle lamella or by the loss of Ca^{2+} attachment sites (knee and Bartley, 1981). Ca affects fruit softening because it is an essential part of cell wall structure and it also influences cell membrane integrity (Fallahi et al. 1997).

Attempts have been reported for improving fruit quality through cultural practices, such as fertilization or field spray of calcium. Hanson et al. (1993), suggested that, calcium content of fruit is directly related to the firmness and resistance not only to mechanical injury but also to disease and breakdown of fruits after harvest. Thus calcium is not only a macronutrient, but it also has major metabolic and developmental control in plants (Poovaiah, 1988). Preharvest calcium sprays are effective in improving overall quality of many perishable fruits, such as, peach (Brar et al. 1997); apricot (Tzoutzoukou and Bouranis, 1997); pear and apple (Warner, 1997); blue berry (Hanson, 1995); cherry (Mir et al. 1995); grape (lima et al. 2000); guava (Singh and Singh, 1999); Mango (Evangelista et al. 2000); and Strawberries (Camargo et al. 2000).

Quality factors such as, color, taste, firmness and composition are of major importance for both fresh market and processing uses. Therefore, the goal of this study was to evaluate the beneficial effects of prehravest calcium application on improve quality of peach fruits at harvest and during storage at ambient room.

MATERIALS AND METHODS

Plant material: Two peach *(Prunus persica L. Batsch)* cultivars Swelling and Met Ghamr were used. Swelling cv. have been widely spread in Egypt, characterized by free stone, fruit matured in mid season (3rd week of June) the chosen trees are five years old, budded to Nemagard rootstock. Met Ghamr cv. is the main peach cultivar grown in Egypt, characterized by cling stone, fruit matured in the end season (3rd week of July). The trees are six years old, budded on seedling Met Ghamr rootstock. Both varieties are grown in separated private orchard at Aga, Dakahlia Governorte. This experiment was carried during two successive seasons of 2001 and 2002. Trees of each variety were uniform in vigour, healthy and all subjected to the usual horticulture practices as in the other peach orchards in this area. Twenty seven trees of both were chosen and arranged in complete randomized block design. Each block was consisted of nine trees. One tree per block was assigned to receive one of the calcium treatments as follows:

1) Calcium chloride ($Ca\ Cl_2$) form at rates of 0.05, 0.10, 0.15, 0.20% with 0.1% triton B as a surfactant.
2) Calcium nitrate {$Ca\ (No_3)_2$}form at rates of 0.05, 0.10, 0.15, 0.20% with 0.1% triton B as a surfactant.
3) Control was sprayed with only water.

Spray was carried at 30 days before harvesting during phase III of fruit growth and after pit hardening(19 May for Swelling cv. and 17 June for Met Ghamr of the two seasons).

Fruits from all treatments including the control were harvested at the same time after103 days after full bloom for Swelling cv. at 18 June according to (Shaltout, 1995) and after 139 days of full bloom for Met Ghamr cv. at 17 July according to (Abd El-Naby, 1995).

Physico – chemical analysis: Two fruit samples of from each treatment in each cultivar were taken to study fruit physical and chemical characteristics at harvesting date and during storage at ambient room. In first sample, (fifteen fruits pre treatment) the following fruit parameters were determined :

(1) Firmness: By using manual pressure tester (Magness and Taylor) with 5/16 plunger, it was performed on two opposite sides to determine average firmness as pound/square inch.
(2) Total soluble solids in the juice was measured by a zeiss hand refractometer.
(3) Total acidity in the juice was determined as a percentage of malic acid according to (A.O.A.C.1995).
(4) Total soluble solids / total acidity ratio was calculated.
(5) Total anthocyanin was determined by Spectrocolourimeter as illustrated by (Hsia et al. 1965).
(6) Total chlorophyll and carotein were determined using Spectro-colourimeter as described by (Wettstein, 1957).
(7) Total pectin was estimated by the method of Gross (1984).
(8) Total calcium was measured on a dry – weight basis by atomic absorption Spectrophotometry as described by (Raese and Staiff, 1983).

The second sample [100 fruits uniforme in size, shape and color from each treatment were placed in four standard carton boxes (25 fruits each) and stored at ambient room 29-32 °c with 46-55% R.H. for Swelling and 30-34 °c with 54-62 % R.H. for Met Ghamr [32 ± 2 °c and 55 ± 7% R.H.].

Fruit samples at three days intervals were taken for determing loss in weight, decay percentage, total soluble solids and total acidity. The storage period was terminated when the control reached 50% or more weight loss.

Statistical analysis: the analysis of variance of the data obtained in both seasons were carried out according to Snedecor and Cochran (1982). Means were compared using Duncan's multiple range test (Duncan,1955) at the 5% level of probability.

RESULTS AND DISCUSSION

I- Influence of preharvest calcium sprays on fruit quality at harvest time:

1- **Firmness: a) Swelling peach** : the results presented in Table (1) show that the two Ca- forms sprays, significantly affected fruit firmness in both reasons as compared with untreated ones. Fruits treated with calcium had firmer pulp than untreated ones, with the exception of fruits treated with 0.05% Ca Cl_2 in the second season. Fruit firmness increased with increasing Ca-concentration of the two forms sprayed. Ca– nitrate had the highest fruit firmness especially at 0.20%.

b) **Met Ghamr peach:** As seen in Table (2) Ca applications effect on Met Ghamr firmness took the same trend as in Swelling peach, but it was much pronounced in fruits treated with high Ca- concentration (0.15-0.20%) especially, with Ca–nitrate sprays. The obtained results might be due to that calcium application plays an important role in the membrane by inducing rigidification at the membrane surface of fruit tissue (Legge et at. 1982 and Poovaiah, 1988). These results are in harmony with those reported by Crisosto et al. (2000) on peach; Tzoutzoukou and Bouranis (1997) on apricot; Dris and Niskanen, (1999); Wie et al. (2000) and Warner (1997) on apple; Cheolku et al. (2000) on pear; lima et al. (2000) on grape; Singh and Singh (1999) on guava and Evangelista et al. (2000) on mango.

2- **Total soluble solids (TSS) :a) Swelling peach:** It is clear from Table (1) that TSS was increased clearly in fruits received Ca-sprays compared with untreated fruits but it was significantly only in the second season. Preharvest Ca- chloride sprays had the highest fruit TSS especially with high concentrations (0.15,0.20%).

b) **Met Ghamr peach:** Results in Table (2)show that preharvest sprays with Ca Cl_2 at law conc. (0.05 and 0.10%) of Met Ghamr peach gave less TSS content in fruit as compared with untreated fruit, while, Ca- nitrate form at high rates raised significantly the TSS content compared with untreated fruits or / and fruits treated with Ca – chloride. This was more obvious in the second season. Thus TSS is associated with sensory sweetness and its are the most important indicator of quality and eatening acceptability of peach fruits. The results are in agreement with the results obtained by Brar et al. (1997) on peach ; Tuna (1999) on apple and Singh and Singh (1999) on guava.

3- **Total acidity: a) Swelling peach:** from Table (1) it can be concluded that acidity content in calcium treated fruits insignificantly increased as Ca-concentration rate increase. The significant calcium effect was only between Ca – chloride treated fruits at 0.20% and Ca- nitrate treated fruits at 0.05% in both seasons.

Table (1): Fruit quality characteristics of Swelling peach at maturity as affected by preharvest Calcium sprays

Calcium treatment \ Character		Firmness (Lb/inch²)		TSS %		Acidity %		TSS/ Acidity ratio		Anthocyanin O.D*.		Chlorophyll %		Carotens %		Pectin %		Calcium p.p.m.	
2001 Season																			
Calcium Chloride	0.05 %	11.83	b	11.1	a	0.122	ab	90.98	A	0.338	c	0.072	g	0.047	a	5.948	g	133.51	f
	0.10 %	12.23	ab	11.5	a	0.141	ab	81.56	A	0.323	c	0.164	d	0.014	c	6.843	f	135.89	f
	0.15 %	12.33	ab	11.5	a	0.143	ab	80.41	A	0.310	c	0.175	c	0.013	c	7.202	e	151.50	e
	0.20 %	12.50	ab	12.3	a	0.152	a	80.92	A	0.269	d	0.183	b	0.009	d	9.439	b	272.06	b
Calcium Nitrate	0.05 %	12.40	ab	10.1	a	0.116	b	87.06	A	0.454	a	0.135	f	0.018	b	7.501	d	159.20	d
	0.10 %	12.80	ab	11.0	a	0.120	ab	91.66	A	0.450	a	0.174	c	0.009	d	8.240	c	213.45	c
	0.15 %	12.83	ab	11.5	a	0.125	ab	92.00	A	0.432	a	0.177	c	0.003	e	8.258	c	216.75	c
	0.20 %	13.00	a	11.6	a	0.136	ab	85.29	A	0.415	b	0.224	a	0.001	f	10.622	a	280.07	a
Control (untreated)		10.06	c	10.8	a	0.132	ab	81.81	A	0.470	a	0.146	e	0.001	f	5.224	h	104.12	g
2002 Season																			
Calcium Chloride	0.05 %	10.13	f	10.70	d	0.121	bc	88.42	B	0.361	d	0.161	cd	0.051	a	6.514	ef	216.267	d
	0.10 %	11.20	e	11.50	b	0.125	abc	92.00	A	0.325	e	0.172	bc	0.012	b	6.653	de	288.587	c
	0.15 %	11.40	cd	12.00	a	0.134	abc	89.55	A	0.311	ef	0.176	bc	0.011	b	7.269	c	356.360	b
	0.20 %	11.50	bc	12.00	a	0.141	a	85.10	Bc	0.302	f	0.187	ab	0.009	b	7.420	b	413.143	a
Calcium Nitrate	0.05 %	11.30	de	10.50	d	0.114	c	92.10	A	0.465	a	0.143	b	0.017	b	6.551	ef	216.457	d
	0.10 %	11.30	de	10.50	d	0.127	abc	82.67	C	0.448	ab	0.172	bc	0.011	b	6.728	d	288.893	c
	0.15 %	11.60	b	11.00	c	0.132	abc	83.33	C	0.431	b	0.188	ab	0.009	b	7.300	bc	360.452	b
	0.20 %	11.80	a	11.50	b	0.140	ab	82.14	C	0.410	c	0.201	a	0.008	b	7.629	a	424.923	a
Control (Untreated)		10.10	f	10.00	e	0.132	abc	75.75	D	0.465	a	0.158	cd	0.003	b	6.447	f	118.100	e

O.D.* Optical Density at 500 mu

Me ans with the same letter are not significantly different.

Table (2): Fruit quality characteristics of Met Ghamr peach at maturity as affected by preharvest Calcium sprays

Calcium treatment \ Character		Firmness (Lb/inch²)		TSS %		Acidity %		TSS/ Acidity ratio		Anthocyanin O.D.*		Chlorophyll %		Caroteins %		Pectin %		Calcium p.p.m.	
2001 Season																			
Calcium Chloride	0.05 %	10.23	d	9.50	d	0.782	d	12.15	bc	0.618	b	0.158	d	0.049	a	6.356	c	150.85	f
	0.10 %	10.40	cd	9.86	cd	0.810	cd	12.00	c	0.517	c	0.170	cd	0.031	abc	6.361	c	170.57	e
	0.15 %	10.56	cd	10.46	bcd	0.671	b	12.01	c	0.451	e	0.179	c	0.015	bcd	6.447	c	193.14	d
	0.20 %	11.46	b	11.33	ab	0.864	bc	13.17	bc	0.387	g	0.205	b	0.014	cd	7.405	a	324.90	a
Calcium Nitrate	0.05 %	10.40	cd	10.93	abcd	0.782	d	13.97	ab	0.476	d	0.130	e	0.044	a	5.361	d	129.28	g
	0.10 %	10.60	cd	11.00	abc	0.879	b	12.51	bc	0.479	d	0.165	cd	0.034	ab	6.291	c	150.52	f
	0.15 %	11.06	bc	11.28	ab	0.890	ab	12.67	bc	0.455	e	0.170	cd	0.010	d	7.212	b	203.32	c
	0.20 %	12.73	a	12.06	a	0.938	a	12.86	bc	0.420	f	0.329	a	0.009	d	7.222	b	303.64	b
Control (untreated)		10.16	d	10.10	bcd	0.670	e	15.07	A	0.641	a	0.081	f	0.006	d	5.337	d	118.10	h
2002 Season																			
Calcium Chloride	0.05 %	11.1	e	9.5	e	0.653	d	14.54	Ef	0.513	b	0.141	d	0.048	a	6.261	c	156.90	e
	0.10 %	11.4	de	9.5	e	0.662	bcd	14.35	F	0.433	d	0.162	c	0.037	a	6.371	c	193.35	d
	0.15 %	11.9	bc	10.0	c	0.674	abc	14.83	De	0.418	d	0.180	bc	0.038	a	6.682	b	196.50	d
	0.20 %	12.4	a	10.5	b	0.691	a	15.19	Cd	0.350	e	0.190	ab	0.031	a	7.221	a	203.59	c
Calcium Nitrate	0.05 %	11.3	de	9.4	e	0.616	ef	15.25	C	0.482	c	0.163	c	0.013	b	5.667	d	130.23	g
	0.10 %	11.6	cd	9.7	d	0.632	e	15.34	C	0.475	c	0.170	c	0.010	b	6.231	c	152.17	f
	0.15 %	12.2	ab	10.7	a	0.657	cd	16.28	A	0.464	c	0.192	ab	0.009	b	7.232	a	301.96	b
	0.20 %	12.5	a	10.8	a	0.680	ab	15.88	B	0.420	d	0.200	a	0.008	b	7.381	a	345.67	a
Control (Untreated)		10.3	f	10.0	c	0.611	f	16.36	A	0.563	a	0.121	e	0.006	b	5.364	e	118.53	h

O.D.* Optical Density at 500 mu
Means with the same letter are not significantly different.

b) **Met Ghamr peach** : Met Ghamr fruits had highly acidity content as compared with Swelling fruits Tables(1,2), this may be related to the cultivar than treatments . However, calcium forms and concentrations treated fruits raised significantly acidity values than those untreated fruits in the two seasons. The 0.2% rate of both Ca- forms gave the highest values. This acidity affect the flavor, hence affect the fruit quality. These results are in agreement with those reported by Dris and Niskanen, (1999) on apple and Lima et al. (2000) on grape.

4- **TSS/ acid ratio: a) Swelling peach:** Table (1) indicates that although there is no significant differences between Ca- forms treated fruits and untreated fruits in TSS/ acid ratio in the first season, nevertheless, in the second season, all Ca– forms and concentrations of Ca –chloride recorded significantly the highest values.

b) **Met Ghamr peach:** Table (2) shows that untreated fruits had the highest TSS/acid ratio when compared with Ca treated fruits. This was true in both seasons of study. The calcium forms at different concentrations gave fluctuated results on TSS/ acid ratio without clear trend in this aspect. Also, it is quit clear that Met Ghamr peach had lowest TSS/ acid ratio as compared with Swelling peach this may be due to varietal differences as Met Ghamr fruits had high acidity content. In this respect, Poovaiah (1988) found that preharvest Ca treatments are effective in improving overall quality. Miao et al. (1991) sprayed peach fruits with 0.8% lime water, found that sugar/ acid ratio was increased, while Dris and Niskanen (1999) on apple, found that TSS/ acidity ratio decreased with preharvest Ca Cl_2 sprays.

5- **Pigments: 5-1- Anthocyanin : a) Swelling peach** : Results in Table (1) indicated that peel anthocyanin decreased with all Ca–forms and concentrations treated fruits as compared with untreated fruits. However, Ca nitrate treatments especially at 0.05 – 0.15% produced similar results, with few exceptions as, the control but, Ca- chloride at 0.20% conc. gave the lowest values, in the two seasons.

b) **Met Ghamr peach** : From Table (2) it is clear that untreated fruits had significantly the highest peel anthocyanin values when compared with all Ca-treated fruits. Ca – chloride treated fruits at 0.20% canc. had the lowest significant values. This was true in the two seasons. In addition that Met Ghamr fruits had the highest values of peel anthocyanin when compared with Swelling fruits Table (1), this is attributed to the varietal differences. This is in agreement with Fallahi et al. (1997) who indicated that fruit Ca correlated negatively to apple fruit skin color. Also, Schirra et al. (1997) who found that Ca Cl_2 spray delayed the appearance of external fruit color at harvest.

5.2.**Chlorophyll: a) Swelling peach:** It is shown in Table (1) that peel chlorophyll content increased as the concentration of falior spray increased. Calcium treated fruits at 0.05% and untreated fruits showed the least values than other Ca – treated fruits in the first and second seasons.

b) Met Ghamr peach: Table (2) indicate clearly that the results took the same trend as mentioned before. This was true in the two seasons.

5.3. **Caroteins : a) Swelling peach** : the results presented in Table (1) show that Ca- chloride treated fruits at 0.05% concentration had the highest

significantly carotein values when compared with other treated and untreated fruits in the two seasons.

b) **Met Ghamr peach** : Table (2) revealed that caroteins values decreased as Ca- concentration rate increased, and that Ca – chloride form had the highest caroteins in the two seasons, except 0.15 and 0.20% conc in the first season. In this connection, Raese and Drake (1995) noted that green skin of pear fruits was associated with higher Ca - concentration in fruit.

6- **Pectin: a) Swelling peach**: From Table (1) it is clear that, pectin content was increased remarkably as Ca-concentration increased. Fruits sprayed with Ca- nitrate at 0.20% had the highly significant pectin values followed by Ca- chloride at 0.20%, therefore, that Ca- spray at 0.20% concentration raised the pectin content in fruits followed by 0.15% conc., especial with Ca- nitrate form compared with untreated and other treated fruits. This was true in both seasons.

b) **Met Ghamr peach**: concerning pectin content in Met Ghamr fruits, it was can be noticed that pectin content increased significantly as Ca-concentration increased (Table, 2) for both forms in the two seasons. This pectin plays a central role in the physiological and textural changes occurring in ripening fruits (Huber, 1983). Also, the cementing effect on cell walls is due primarily to Ca- pectate of the middle lamella (Poovaiah et al. 1988). These findings are in agreement with results obtained by Camargo et al. (2000) on strawberries.

7- **Calcium: a) Swelling peach** : Results obtained concerning the amount of calcium were presented in Table (1). It revealed that calcium content had remarkable increase as Ca-concentration increased, linearly and significantly with increasing concentration. The pronounced effect was obtained from Ca-nitrate form, especially in the first season.

b) **Met Ghamr peach**: Fruit calcium content improved significantly by different Ca- treatments Table (2). The highest Ca- content was recorded by the high concentration of both calcium forms. The Ca- forms gave fluctuated results on fruit calcium content. At any rate, the Ca- concentration in the fruit tissue is well known to be an important determinant of quality. It can be concluded that relatively high Ca- concentrations in fruit showed a direct positive relationship with the pectin content and firmness and in slowing of ripening as well as slowing softening of the fruit. In this connection, Ca may regulate some metabolic processes in fruit maturity (Bangerth et al. 1972). Also, it has an important function in increasing the rigidity of cell wall and in promote cohesion of neighbouring cells (Demarty et al. 1984), besides, it protects the middle lamella from senescence breakdown (Poovaiah et al. 1988).

These results are in harmony with those reported by Conway et al. (1994) as they found foliar sprays can increase the Ca content of apple fruit from 150 to 250 $Mg.g^{-1}$. Also, calcium sprays are one way of increasing Ca concentration in peach (Evert et al. 1988); in apricot (Tzoutzoukou and Bouranis, 1997); in apple (Tuna, 1999 and Wei et al. 2000); in pear fruit (Raese

and Drake, 1995, Byung Woo et al. 2000 and Cheolku et al. 2000); and in table grape (Miceli et al. 1999).

II-Influence of preharvest calcium sprays on fruit quality during storage at ambient room :

1- **Decay: a) Swelling peach:** The results presented in Table (3) indicate that as storage period prolonged, decay percentage was significantly increased during the two studied seasons. No decayed fruits were observed before 6 days of storage at ambient room in the first season in all Ca – treatments only and 3 days in the second season in treated and untreated fruits. The decay percentages were higher in the untreated fruits than those of the preharvest calcium sprayed fruits in the end of the storage period with exceptions of calcium nitrate sprayed fruits at 0.05% in the first season only which was on a par with untreated fruits. Calcium chloride treatments at 0.20 and 0.15% in the two seasons and calcium nitrate treatments at 0.20% in the first season were more effective in reducing decay percentage than other treated and untreated fruits.

b) Met Ghamr peach: It is shown from Table (4) that decayed fruits were occurred after 3 days of storage in the treated and untreated fruits in the two seasons. Sprayed fruits with calcium chloride or nitrate at 0.20% had the least decay percentage comparing with other treated and untread fruits. This was true in the two seasons. Internal browning, water loss were the main symptoms in the observed of deteriorated fruits. The obtained results confirmed the results obtained by Fallahi et al. (1997) and Kader (2000). They found that Ca Cl_2 applied as a tree spray reduced the incidence and severity of rot. Also, Conway et al. (1994) reported that increasing the amount of Ca in plant stored organs by various methods is a means of enhancing natural disease. Also, Ca application has been reported to reduce storage decay (Brar et al. 1997 on peach and Schirra et al. 1997 on pear).

2- **Weight loss: a) Swelling peach:** It is clear from Table (5) that weight loss percentage was significantly increased as storage period prolonged during the two investigated seasons. Both calcium chloride and nitrate sprayed fruits at 0.20% followedly 0.15% rate were more effective in decreasing weight loss percentage than the other sprayed and unsprayed fruits. This was true in both experimental seasons.

b- **Met Ghamr peach:** General looking at Table (6), it is clearly noticed that Met Ghamr fruits take similar trend as Swelling fruits regarding the weight loss in both seasons. The loss in fruit weight is mainly due to water loss as a result of evaporation and transpiration, plus the amount of dry matter loss by respiration. Hence, calcium is responsible for reducing the evaporation of water through fruit surface and consequently gave the lowest loss in fruit weight. These results are in accordance with Brar et al. (1997) on peach; Schirra et al. (1997) and Byung Woo et al. (2000) on pear, they found that $CaCl_2$ spray reduce fruit weight loss. In addition, Gupta et al. (1984) reporeted that peach fruit treated with Ca $(No_3)_2$ or Ca Cl_2 and held at room temperature in 95% RH for up to 9 days showed the least weight loss in fruits treated with 1.5% Ca $(No_3)_2$.

Table (3) : Fruit decay percentage in Swelling peach during storage at ambient room as affect by preharvest Calcium sprays

Season		2001 season						2002 season					
Period (day) / Treatment		0	3	6	9	12	Mean	0	3	6	9	12	Mean
$CaCl_2$	0.05%	0.0	0.0	12.30	19.53	40.21	18.015 d	0.0	4.66	11.84	19.64	40.65	19.207 cd
	0.10%	0.0	0.0	11.51	20.13	34.43	16.597 e	0.0	5.45	11.50	18.34	40.05	18.842 d
	0.15%	0.0	0.0	12.37	22.97	28.67	16.007 ef	0.0	4.89	11.51	19.20	34.29	17.504 e
	0.20%	0.0	0.0	13.06	20.76	28.69	15.632 f	0.0	4.70	11.36	17.62	33.89	16.895 e
$Ca(No_3)_2$	0.05%	0.0	0.0	20.05	27.58	40.21	21.960 a	0.0	5.00	12.01	21.69	41.56	20.065 b
	0.10%	0.0	0.0	14.82	25.96	40.24	20.257 b	0.0	5.37	11.05	18.40	44.54	19.845 bc
	0.15%	0.0	0.0	11.49	20.21	45.36	19.259 c	0.0	4.94	11.98	20.62	20.20	19.441 cd
	0.20%	0.0	0.0	1.86	3.32	8.52	3.425 g	0.0	4.48	11.89	21.61	39.07	19.268 cd
Control (untreated)		0.0	4.77	20.25	26.50	40.16	22.920 a	0.0	9.01	17.33	22.17	45.50	23.50 ba
Mean		0.0	0.531 d	13.11 c	20.777 b	34.054 a	-	0.0	5.388 d	12.289 c	19.825 b	39.977 a	-

Means with the same letter are not significantly different.

Table (4) : Fruit decay percentage in Met Ghamr peach during storage at ambient room as affect by preharvest Calcium sprays:

Season		2001 season						2002 season					
Period (day) / Treatment		0	3	8	9	12	M	0	3	6	9	12	Mean
$CaCl_2$	0.05%	0.0	3.57	15.42	27.05	41.62	21.915 cd	0.0	6.41	15.38	28.16	36.21	21.545 a
	0.10%	0.0	3.46	13.07	27.59	37.92	20.510 d	0.0	5.63	11.52	25.19	37.40	19.938 b
	0.15%	0.0	3.64	14.26	28.62	35.44	20.496 d	0.0	5.55	10.58	23.88	35.21	18.808 c
	0.20%	0.0	3.40	10.30	23.25	36.89	18.462 e	0.0	5.49	10.56	23.11	35.23	18.602 c
$Ca(No_3)_2$	0.05%	0.0	3.60	15.56	33.64	42.14	23.738 ab	0.0	6.24	14.73	27.72	35.89	21.161 a
	0.10%	0.0	5.85	12.67	28.23	43.56	22.533 bc	0.0	5.69	13.76	27.83	35.98	20.819 ab
	0.15%	0.0	3.48	12.16	32.47	38.87	21.750 cd	0.0	5.16	11.03	25.37	41.31	20.721 ab
	0.20%	0.0	1.40	5.63	14.72	34.19	13.991 f	0.0	5.28	9.40	24.84	35.21	18.684 c
Control (untreated)		0.0	3.76	14.47	35.47	42.52	24.063 a	0.0	5.86	14.43	27.41	39.59	21.828 a
Mean		0.0	3.558 d	12.619 c	27.893 b	39.238 a	-	0.0	5.704 d	12.381 c	25.950 b	36.890 a	-

Means with the same letter are not significantly different.

Table (5) : Weight loss percentage in Swelling peach fruits during storage at ambient room as affect by preharvest Calcium sprays

Season		2001 season						2002 season					
Treatment \ Period (day)		0	3	6	9	12	Mean	0	3	6	9	12	Mean
$CaCl_2$	0.05%	0.0	8.94	16.4	26.11	50.42	25.473 d	0.0	8.21	15.92	26.21	49.26	27.907 bc
	0.10%	0.0	8.78	16.18	23.52	46.01	23.648 e	0.0	8.65	15.26	24.14	46.39	23.615 d
	0.15%	0.0	8.63	15.72	24.88	43.82	23.266 e	0.0	8.29	15.52	25.50	38.00	21.834 e
	0.20%	0.0	7.72	14.58	22.89	40.45	21.416 f	0.0	8.09	14.18	23.37	37.29	20.738 f
$Ca(No_3)_2$	0.05%	0.0	10.76	25.46	34.49	46.74	29.365 b	0.0	5.36	16.06	29.46	48.17	25.776 b
	0.10%	0.0	10.11	17.61	31.24	47.84	26.705 c	0.0	8.31	16.52	27.22	47.69	24.915 bc
	0.15%	0.0	7.98	14.19	22.66	48.17	23.256 e	0.0	7.60	15.76	26.37	47.09	24.208 cd
	0.20%	0.0	6.58	11.17	14.96	21.85	13.644 g	0.0	8.74	14.09	23.52	46.13	23.126 d
Control (untreated)		0.0	16.93	22.98	35.80	51.12	31.465 a	0.0	15.30	23.18	26.80	51.22	29.128 a
Mean		0.0	9.496 d	17.148 c	26.289 b	44.05 a	-	0.0	9.182 d	16.281 c	25.847 b	45.688 a	-

Means with the same letter are not significantly different.

Table (6) : Weight loss percentage in Met Ghamr peach fruits during storage at ambient room as affect by preharvest Calcium sprays:

Season		2001 season						2002 season					
Treatment \ Period (day)		0	3	6	9	12	Mean	0	3	6	9	12	Mean
$CaCl_2$	0.05%	0.0	7.40	17.39	32.30	50.19	26.820 c	0.0	9.44	18.52	35.36	53.38	29.179 ab
	0.10%	0.0	8.19	18.64	39.55	41.01	26.801 c	0.0	8.59	16.03	34.43	51.57	27.660 b
	0.15%	0.0	8.40	15.61	34.35	44.54	25.731 c d	0.0	8.40	14.86	31.69	44.77	24.935 c
	0.20%	0.0	8.23	14.47	30.03	42.56	23.827 d	0.0	8.04	14.61	30.24	42.58	23.873 c
$Ca(No_3)_2$	0.05%	0.0	10.79	21.78	42.41	49.94	31.235 a	0.0	10.30	19.54	36.40	49.45	28.931 a b
	0.10%	0.0	10.16	19.27	38.11	49.88	29.357 a b	0.0	7.28	16.78	34.25	55.27	28.400 ab
	0.15%	0.0	8.95	15.53	37.13	49.67	27.833 b c	0.0	9.23	17.42	36.51	49.09	28.070 b
	0.20%	0.0	7.64	12.30	36.23	48.19	26.093 c	0.0	7.42	13.69	33.33	46.88	25.335 c
Control (untreated)		0.0	8.54	19.20	48.01	51.33	31.770 a	0.0	11.13	21.83	37.83	50.49	30.323 a
Mean		0.0	8.704 d	17.140 c	37.550 b	47.485 a	-	0.0	8.876 d	17.036 c	34.454 b	49.281 a	-

Means with the same letter are not significantly different.

3- **Total soluble solids: a) Swelling peach**: From Table (7) it is quite clear that fruit TSS significantly increased as storage period prolonged during the two seasons. This could be due to the losses in water through the respiration and evaporation during storage and hence the losses in fruit weight. All Ca-treated fruits contained higher TSS comparing with untreated fruits. Calcium chloride sprayed fruits at 0.20% rate gave the highest values of TSS over other sprayed and unsprayed fruits. This was true in both seasons.

b) Met Ghamr peach: Fruit TSS gradually increased as storage period advanced after 3 days of storage at ambient room (Table, 8). In contrast, of Swelling peach, calcium nitrate sprayed fruits at 0.20% then 0.15% rate had significantly the highest TSS comparing with unsprayed fruits and some other sprayed fruits. On the other hond, Ca- chloride sprayed fruits at 0.05 and 0.10% rates gave the lowest significantly values comparing with unsprayed fruits. These results were true in the two seasons. Similar trend was reported by Raina et al. (1993) who found that optimum sensory properties were observed in peaches from trees received 2 sprays of 1% Ca $(No_3)_2$.

4- **Total acidity: a) Swelling peach**: Results in Table (9) clearly show that total acidity gradually decreased during storage at ambient room either in unsprayed or in Ca- sprayed fruits, there were constant decrease between each two periods (non significant) in the first season, while, in the second season, this decrease was constant till the first 6 days and the last 3 days of storage. Both calcium compounds sprayed fruits at 0.05% rate had the lowest acidity values in the two seasons, comparing with unsprayed and other sprayed fruits, as this was on the par with Ca-nitrate sprayed fruits at 0.10 and 0.15% rate in the first season.

b) Met Ghamr peach: Table (10) indicated that total acidity was significantly decreased as storage period prolonged in the two seasons. Unsprayed fruits had the least significantly acidity value as compared with the calcium sprayed fruits, In his respect, Kurnaz and Kaska (1993) found that weight loss, TSS content increased and acid content decreased continuously in peaches stored at room temperature throughout the storage period. Moreover, Ca application during the growing season improved apple fruit quality and storage life (Siddiqui and Bangerth, 1995).

Table (7) : Total soluble solids percentage in Swelling peach during storage at ambient room as affect by preharvest Calcium sprays

Season		2001						2002					
Treatment \ Period (day)		0	3	6	9	12	M	0	3	6	9	12	M
$CaCl_2$	0.05%	11.1	12.6	13.3	15.8	16.5	13.873 c	10.7	11.1	11.3	12.0	12.4	11.50 e
	0.10%	11.5	12.0	12.8	15.6	16.1	13.600 d	11.5	11.5	11.8	12.6	12.8	12.04 ab
	0.15%	11.5	12.8	14.4	16.9	17.0	14.520 b	12.0	11.0	11.4	11.8	12.1	11.66 cd
	0.20%	12.3	13.1	14.1	16.8	17.0	14.667 a	12.0	12.0	12.0	12.2	12.5	12.14 a
$Ca(No_3)_2$	0.05%	10.1	10.5	10.8	12.8	13.5	11.540 h	10.5	11.0	11.2	12.0	12.7	11.48 ed
	0.10%	11.0	11.8	12.8	14.9	15.5	13.200 e	10.5	11.5	11.5	11.8	12.5	11.56 d
	0.15%	11.5	11.9	12.2	12.8	12.5	12.140 g	11.0	11.6	11.8	12.3	13.0	11.94 b
	0.20%	11.6	12.1	13.1	13.9	14.0	12.940 f	11.5	11.5	11.5	12.1	12.0	11.72 c
Control (untreated)		10.8	10.8	11.0	12.0	12.0	11.320 l	10.0	11.2	11.6	12.1	12.2	11.42 e
Mean		11.266 e	11.956 d	12.722 c	14.600 b	14.900 a	-	11.077 e	11.377 d	11.566 c	12.100 b	12.467 a	-

Means with the same letter are not significantly different.

Table (8) : Total soluble solids percentage in Met Ghamr peach during storage at ambient room as affect by preharvest Calcium sprays:

Season		2001 season						2002 season					
Treatment \ Period (day)		0	3	6	9	12	Mean	0	3	6	9	12	Mean
$CaCl_2$	0.05%	9.5	9.6	10.0	10.6	10.5	10.040 f	9.5	9.8	10.1	10.6	11.0	10.200 fg
	0.10%	9.6	9.9	10.3	11.1	12.1	10.600 ef	9.5	9.9	10.2	10.6	11.1	10.260 fg
	0.15%	10.4	10.8	11.1	11.9	12.1	11.260 cd	10.0	10.1	10.5	10.9	11.4	10.581 de
	0.20%	11.3	11.5	11.8	12.1	12.3	11.801 bc	10.5	10.6	10.8	11.2	11.8	10.981 bc
$Ca(No_3)_2$	0.05%	10.9	11.1	11.6	11.9	12.2	11.540 bcd	9.4	9.6	9.8	10.4	10.6	9.980 g
	0.10%	11.0	11.3	11.6	12.0	12.4	11.660 b c	9.7	9.9	10.1	10.7	11.0	10.280 e f
	0.15%	11.2	11.5	11.9	12.2	12.6	11.880 b	10.7	10.8	11.0	11.4	11.8	11.140 ab
	0.20%	12.0	12.4	12.9	13.0	13.4	12.74 a	10.8	11.0	11.1	11.6	11.9	11.280 a
Control (untreated)		10.1	10.6	10.9	11.4	11.4	10.880 de	10.0	10.3	10.5	10.9	11.6	10.660 cd
Mean		10.666 c	10.967 bc	11.345 b	11.800 a	12.111 a	-	10.011 d	10.223 d	10.456 c	10.923 b	11.357 a	-

Means with the same letter are not significantly different.

Table (9) : Total acidity percentage in Swelling peach during storage at ambient room as affect by preharvest Calcium sprays

Season		2001 season						2002 season					
Treatment \ Period (day)		0	3	6	9	12	Mean	0	3	6	9	12	Mean
$CaCl_2$	0.05%	0.122	0.120	0.118	0.114	0.109	0.117 d	0.121	0.116	0.117	0.113	0.108	0115 de
	0.10%	0.141	0.136	0.127	0.120	0.114	0.128 c	0.125	0.127	0.120	0.116	0.109	0.119 cd
	0.15%	0.143	0.140	0.138	0.132	0.127	0.136 b	0.134	0.130	0.128	0.121	0.117	0.126 abc
	0.20%	0.152	0.150	0.147	0.143	0.138	0.146 a	0.141	0.139	0.138	0.127	0.122	0.133 a
$Ca(No_3)_2$	0.05%	0.116	0.114	0.111	0.107	0.104	0.110 d	0.114	0.112	0.110	0.108	0.106	0.110 e
	0.10%	0.120	0.119	0.115	0.111	0.107	0.114 d	0.127	0.123	0.120	0.115	0.111	0.119 cd
	0.15%	0.125	0.122	0.120	0.114	0.105	0.117 d	0.132	0.130	0.129	0.124	0.119	0.127 ab
	0.20%	0.136	0.133	0.131	0.127	0.122	0.130 bc	0.140	0.138	0.135	0.129	0.125	0.133 a
Control (untreated)		0.132	0.129	0.127	0.121	0.116	0.125 c	0.132	0.130	0.127	0.119	0.112	0.124 bc
Mean		0.132 a	0.129 ab	0.126 b c	0.121 cd	0.116 d	-	0.130 a	0.127 a	0.125 a	0.119 b	0.114 b	-

Means with the same letter are not significantly different.

Table (10) : Total acidity percentage in Met Ghamr peach during storage at ambient room as affect by preharvest Calcium sprays

Season		2001 season						2002 season					
Treatment \ Period (day)		0	3	6	9	12	Mean	0	3	6	9	12	Mean
$CaCl_2$	0.05%	0.782	0.703	0.631	0.589	0.371	0.615 e	0.653	0.609	0.590	0.561	0.498	0.582 c
	0.10%	0.810	0.791	0.769	0.691	0.565	0.729 bc	0.662	0.632	0.611	0.578	0.492	0.596 b
	0.15%	0.871	0.783	0.775	0.648	0.557	0.726 bcd	0.674	0.644	0.609	0.561	0.489	0.596 b
	0.20%	0.864	0.811	0.797	0.658	0.562	0.738 bc	0.691	0.661	0.622	0.580	0.520	0.615 a
$Ca(No_3)_2$	0.05%	0.782	0.710	0.602	0.533	0.438	0.513 e	0.616	0.593	0.565	0.513	0.478	0.553 e
	0.10%	0.879	0.790	0.704	0.645	0.511	0.705 d	0.632	0.600	0.581	0.523	0.461	0.559 e
	0.15%	0.890	0.800	0.788	0.667	0.570	0.743 b	0.657	0.617	0.598	0.533	0.458	0.573 d
	0.20%	0.938	0.822	0.877	0.730	0.654	0.804 e	0.680	0.638	0.610	0.566	0.460	0.591 b
Control (untreated)		0.670	0.651	0.576	0.558	0.470	0.585 f	0.611	0.592	0.558	0.491	0.457	0.542 f
Mean		0.831 a	0.762 b	0.727 c	0.635 d	0.522 e	-	0.653 a	0.621 b	0.594 c	0.545 d	0.479 e	-

Means with the same letter are not significantly different.

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تأثير الرش الورقي بالكالسيوم قبل الحصاد على جودة ثمار الخوخ

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الملخص العربي

أجريت هذه التجربة لدراسة تأثير بعض صور الكالسيوم (كلوريد ونترات) على جودة ثمار الخـــوخ (سويلنج-ميت غمر) عند الحصاد فى مرحلة اكتمال النمو و أثناء التخزين على درجة حرارة الغرفة خلال أعوام ٢٠٠١-٢٠٠٢ .كلا الصنفين منزرعين في بستان خاص مستقل في مركز أجا محافظة الدقهلية. تم الرش بصور الكالسيوم بتركيزات ٠,٠٥ - ٠,١٠ - ٠,١٥ - ٠,٢٠% قبل الحصاد بثلاثين يوم وقد أوضحت النتائج المتحصل عليها الاتى :-

أدى الرش الورقي بصورتي الكالسيوم إلى زيادة في بعض قياسات جودة الثمار (الصلابة، المـــواد الصـــلبة الذائـــبة ،الحموضـــة ، الكلوزوفـــيل، البكتيـــن والكالسيوم) فى حين أنقص الانثوســـيانين والكاروتيـــن فى كلا من ثمار صنفي السويلنج و ميت غمر عند الحصاد مقارنة بتلك التى لم ترش بالكالسيوم.

أدى الـــرش بصـــورتي الكالسيوم قبل الحصاد إلى تقليل نسبة العفن والفقد في الوزن في الـــثمار وزاد الحموضـــة فـــي كلا من الصنفين لكنه رفع نسبة المواد الصلبة الذائبة في ثمار السويلنج أثناء التخزين على درجة الحرارة المحيطة (درجة حرارة الغرفة) .

وجد أن رش نترات الكالسيوم قبل الحصاد فى تركيز عالي (٠,١٥-٠,٢٠%) رفع من صـــلابة الصنفين، المواد الصلبة الذائبة فى صنف الميت غمر، وأعطى قيم لصبغة الانثوسيانين (المسببة للون الأحمر) للصنفين مشابهة للون الثمار الغير معاملة عند الحصاد، كما رفع نسبة المواد الصلبة الذائبة فى صنف ميت غمر، انقص الحموضة في صنف السويلنج أثناء التخزين على درجة الحرارة المحيطة .

أيضـــا وجـــد أن رش كلوريد الكالسيوم قبل الحصاد بتركيز عالي أعطى أعلى قيم للمواد الصلبة الذائبة ولمعدل $\frac{\text{المواد الصلبة الذائبة}}{\text{الحموضة}}$ فـــي صـــنف الســـويلنج عـــند الحصاد وأثناء التخزين على درجة الحرارة المحيطة.

وجـــد أن رش كـــلا مـــن كلوريـــد ونـــترات الكالسيوم بتركيز عالي زاد محتوى البكتين والكالسيوم فى ثمار الصنفين عند الحصاد، وأنقص النسبة المئوية للعفن وللفقد في الوزن أثناء التخزيـــن علـــى درجة الحرارة المحيطة بينما رشهما فى معدل منخفض أنقص الحموضة أثناء التخزين على درجة حرارة الغرفة .

يمكـــن التوصية برش كلا من صورتي الكالسيوم بتركيز عالي (٠,١٥ % - ٠,٢٠ %) لأنـــه يحس جودة خوخ السويلنج وميت غمر عند الحصاد ويحفظها بحالة جيدة أثناء التخزين على درجة حرارة الغرفة، ومن ثم يعطى الفرصة لتسويق خوخ عالي الجودة في فترة تقل فيها الثمار بالسوق المحلى.