J. Agric. Sci. Mansoura Univ., 30 (6): 3397- 3412, 2005

YIELD, FRUIT CHARACTERISTICS AND KEEPING QUALITY OF MELON (*Cucumis melo* L.) IN RELATION TO K AND CA FOLIAR APPLICATION

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ABSTRACT

This study was carried out at "Rafah" district in North Sinai governorate during 2002/2003 and 2003/2004 seasons, to investigate the effect of preharvest foliar application with calcium and potassium on the yield, fruit characteristics and storageability on three cultivars of melon, Galia, Passport and Clandio and the results are summarized as follows :

- Passport cv gave higher vegetative growth (leaf number/plant, leaf area) than the other cultivars (Galia and Clandio). The same trend was recorded with average fruit weight. Both Galia and Passport cvs gave earlier yield than Clandio cv. Passport cv had bigger fruit longitudinal and equatorial diameters than those of Galia and Clandio. At the same time, Passport cv had the lowest flesh firmness and lower calcium content in fruit. Meanwhile, no significant differences between the three cultivars on TSS%, total sugars and titratable acidity, were noticed.
- Potassium and/or calcium foliar application led to or significant increase in plant height, number of leaves/plant and plant leaf area compared with the untreated control fruits. Such increase in vegetative growth, lead to increase the average fruit weight and both total and early yield.
- Foliar application treatment with potassium and/or calcium increased fruit longitudinal, equatorial diameter, flesh thickness and flesh firmness and improved the fruit characters via increasing total soluble solids, total sugar, titratable acidity and potassium, calcium concentration in the fruit.
- Regarding to storageability, Galia melon showed the lowest values of weight loss and decay incidence percentage, whereas the highest values were obtained for Passport cv. Moreover, Galia cv had higher flesh firmness, TSS, total sugar and titratable acidity compared with the other used cultivars.
- Calcium foliar spraying was the most effective treatment in minimizing the weight loss and decay percentage and had a significant effect on retaining a higher flesh firmness.
- Potassium foliar spraying resulted significantly in higher TSS and total sugar contents compared with untreated fruits control.
- Weight loss and decay percentage increased with the prolongation of the storage period but flesh firmness as well as TSS, total sugar and titratable acidity contents were decreased with increasing the period of storage.

It can be stated that, Galia melon plants, treated with K and/or Ca foliar application is recommended for improving fruit characteristics during prolonged handling.

INTRODUCTION

Calcium is an essential element involved in cell division, elongation and fruit growth. (Kirkby and Pilbeam, 1984). In addition, having a positive effect on fruit quality criteria such as storageability, vitamin C content and

firmness of melon fruit (Bernadac *et al.*, 1996). Spraying black berries plants by $CaCl_2$, reduced the rate of ripening during post-harvest holding, and the fruits of the first harvest was more firme, (Morris *et al.*, 1980). Meanwhile, disturbances in calcium nutrition results with the appearance of some characteristic symptoms in fruits of various species: bitter pit in apple, blossom-end rot in tomato, tip burn in strawberry or reduce *Cucurbita pepo* plant growth. Reduced fruit diameters, decreased significantly dry weight, and sugar accumulation in melon [(Bernadac *et al* 1996), Allan *et al* (1993); and Shear (1975)].

Taylor *et al* (1985) studied the effect of calcium on some vegetable Crops i.e, cabbage, cantaloupe, tomato, radish and swiss chard. All vegetative growth of vegetables were enhanced when the soil was supplied with additional Ca by 5 mmol/L. Cantaloupe plants grown with high Ca treatment bloomed 7-10 days earlier than those obtained from the control.

Bramlage *et al.*, (1985) reported that calcium chloride, calcium phosphate and calcium chelate at a rate of 79 to 84 $kg.ha^{-1}$ at weekly intervals during the growing season raised the Ca concentration of outer cortex by at least 46 ppm and reduced senescent break down after storage, and clearly concluded that $CaCl_2$ is the more effective source of Ca for foliar sprays on apple trees. Eaves *et al* (1972) illustrated that, calcium chloride ($CaCl_2$), calcium nitrate $Ca(NO_3)_2$ and water soluble wax increased berry size and decreased the rate of softening of red raspberry during storage, in addition, Raese and Drake (1995) increased higher yield and obtained larger fruit by spraying $CaCl_2$ as 34% calcium chloride compared with non spraying (control). They added that, the calcium concentration increased in cortex of pear fruits.

Johanson and Decoteau (1996) found that bio-mass (leaf, stem and dry weight) of pepper increased linearly and curvilinearly with increasing K rate.

Conceming potassium and calcium relationship, Zhu and Shu (1991) found that treating soil with K_2O at 12kg/0.067ha with or without $CaCl_2$ at the beginning of flowering gave the highest total yield of tomato than control by about 15.2%. The loss of fruits due to rotting in storage for fruits treated with K_2O and K_2O + $CaCl_2$ was 32 and 27% after 10 days of storage and 65 and 78% at 25 days, while, in control fruits it was 72% at 10 days and 83% at 25 days.

In watermelon experiments, yield was increased significantly by increasing the rate of potassium. (Sundstorm and Carter, 1983). There was a highly significant inverse relationship between tissue K and tissue Ca. Although there was a significant K × Ca interaction on yield and fruit quality.

In addition, Dennis Scott *et al* (1993) and Elmstron *et al* (1973) treated the soil with different rate of gypsum ($CaSO_4$) and concluded that, leaf Ca concentration increased in response to Ca rate in the soil. Seedless watermelon had lower leaf Ca and higher K concentrations than did Charleston Gray or Crimson Sweet. Both K and Ca uptake were found to be inverse.

Melon fruits have a relatively short storage life. Under current commercial handling techniques substantial loss of marketability commonly

occurs within 2 weeks of harvest (Ryall and Lipton, 1979; Hardenburg, 1986 and Miccolis and Saltveit, 1991).

Water loss usually results in appreciable weight loss (Miccolis and Saltveit, 1991; Sewon *et al.*, 1999) and lead to decrease in fruit firmness (Rodov *et al.*, 2002). Fruit softened after 2 to 3 weeks even when maintained in low temperatures (Aharoni *et al.*, 1993).

Further serious decay problem can be encountered when musk melon are removed from cold storage and kept at room temperature which is normally done at the retail market place (Aharoni and Copel, 1995 and Rodov *et al.*, 2002).

Storage conditions of 2-5°C and 85-95% relative humidity extends the marketable life of Galia melon (Hardenburg *et al.*, 1986), and was effective in maintaining TSS contents for a longer period (Fallik *et al.*, 2001), and at lower temperature that causes chilling injury.

The present study aimed at improving melon fruit quality and quantity through the foliar application of calcium and potassium nutrients. Also to figure out the fruits behavior during storage, to achieve high exportation record of fruit, as well as longer time in local markets, with the least loss in fruit quality and quantity.

MATERIALS AND METHODS

The experiment was performed at Rafah district in North Sinai during 2002/2003 and 2003/2004 seasons. Seeds of (Cucumis melo var. reticulatus cv Passport, Calandio and Galia F_1 hyprids) were directly sown in sandy soil on December 1st in both seasons. Melon seeds were sown on the middle of beds. Each bed was elevated about 10cm from the ground with one meter wide and 40 m long. The bed was covered with black plastic mulch 30 µm. in circular shape and with 5cm diameter made in the middle of plastic mulch with 50cm a part for seeds sowing. Polyethylene transparent film 50 µm was used immediately after sowing. The width of plastic sheet was 2.2 m and the length of tunnels was 40m. The plastic sheet was fixed on the arched wire (60 cm height). Fertigation and pest and disease control were carried out as commonly followed under low tunnels conditions according to Anonymous,1996.

A. Plant treatments and measurements.

The experiment at each season was designed in split plot with four replicates. The main plot contain three cultivars and the sub plots had four treatments as foliar application with potassium K_2O at a concentration of 1500 ppm / L, chelated calcium 1000 ppm / L ; and potassium K_2O 750 ppm plus chelated calcium 500 ppm / L compared with control sprayed with distilled water. The dimensions of each sub plot were 10 meters long and one meter wide, thus the area of each sub plot was 10 m^2. Spraying chemicals fertilizers took place at seven days intervals started from 1st February when the plants began to flower.

B. Studied plant and fruit characteristics.

A sample of three plants from each plot was randomly up rooted on April 30th to determine the following data:-

1. Plant height (m), leaves number/plant, leaf area/plant/m.
2. Yield and its components.
   Early yield was determined for the first three harvests and calculated per feddan, total yield was determined at the end of season as ton/feddan.
3. Average fruit weight (gm), fruit longitudinal caliper (cm), fruit equatorial caliper (cm) and calculation of fruit shape index, flesh thickness (cm) and fruit firmness Newton (N).
4. Chemical composition of fruits.

Percentage of total soluble solids content (TSS) by using a hand refractometer (A.O.A.C 1980), titratable acidity (as mg/100g fresh weight) by titration against 0.01 NaOH with phenolphethalin as an indicator (A.O.A.C. 1980), total sugar (gm/100gm dry weight) analysis was determined according to Smogyi (1952) and Nelson (1974), potassium and calcium (mg/100g) was measured by atomic absorption spectro photometry according to the methods of Chapman and Pra (1961).

C. Fruit storability and its characters.

Fruits were harvested at green yellowish stage on April 9th and April 12th in the first and second season, respectively.

Factorial experiment (3 cultivars × 4 preharvest foliar application treatments.. potassium and/or calcium or their combination in addition to control treatment × 3 storage period) in R.C.B.D. with four replications was used.

Fruits were stored at 5°C and 90-95 % relative humidity (RH) for 14 to 21 days followed by 3 days as a retail shelf life at 20°C and (≈ 65 % RH) to simulate sea transportation from Egypt to Europe and subsequent retail marketing. Six to eight fruits were packed in ≈ 5 kg weight carton boxes as one replicate before storage. Weight loss %, decay %, flesh firmness (N), soluble solid %, total sugars (gm /100gm dry weight) and titratable acidity (mg/100g fresh weight) contents were determined.

Data was statistically analysed according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1. Effect of calcium and potassium foliar application on the three cultivars of cantaloupe

1.1. The differences between cultivars behavior

Data in Table (1) indicate that Passport cultivar gave significantly higher vegetative growth parameters in terms of plant leaf number and leaf area than the other two cultivars, i.e. Galia and Clandio. The same trend was recorded as few average fruit weights (Table 2). Both Galia and Passport indicates significantly earlier yield than Clandio cultivar.

Table (3) showeds fruit characters of Galia, Clandio, and Passport. There are significant differences between thes cultivars. Passport fruit obtained taller longitudinal and wider equatorial diameters than those obtained from Galia and Clandio cultivars. Meanwhile, higher values of firmer fruits were recorded with Galia and Clandio cvs, respectively. At the same time, Passport fruits had the lowest flesh firmness. No significant differences were observed between cultivars for plant height and flesh thickness.

Table (1): Effect of calcium and potassium applications on three cantaloupe cultivars on vegetative growth parameters and their interactions in 2002 / 2003 and 2003 / 2004

Treatments		Plant height (m)		No. of leaves / plant		Leaf area / plant (m)	
Cultivar	Elements	1st season	2nd season	1st season	2nd season	1st season	2nd season
Galia		2.66	2.75	52.93	57.67	0.61	0.64
Clandio		2.66	2.74	58.06	60.48	0.61	0.66
Passport		2.61	2.66	62.93	66.27	0.69	0.72
LSD at 5%		N.S	N.S	3.45	4.21	0.03	0.03
	Potassium	2.72	2.79	62.03	65.57	0.68	0.72
	Calcium	2.69	2.73	58.14	60.93	0.64	0.67
	K + Ca	2.70	2.69	61.11	66.77	0.70	0.73
	Control	2.49	2.65	50.64	52.58	0.51	0.58
LSD at 5%		0.12	0.10	2.47	2.40	0.03	0.03
Galia	K	2.79	2.79	56.60	61.15	0.64	0.66
	Ca	2.80	2.81	54.20	59.95	0.61	0.62
	K + Ca	2.75	2.76	56.50	60.65	0.69	0.76
	Control	2.33	2.64	44.43	48.93	0.50	0.53
Clandio	K	2.67	2.83	62.28	64.98	0.66	0.73
	Ca	2.69	2.69	54.93	57.18	0.62	0.65
	K + Ca	2.81	2.79	59.85	65.50	0.66	0.70
	Control	2.51	2.84	55.18	54.25	0.50	0.57
Passport	K	2.72	2.77	67.20	70.75	0.76	0.77
	Ca	2.56	2.68	65.30	65.65	0.68	0.73
	K+ Ca	2.55	2.51	66.93	74.15	0.75	0.75
	Control	2.64	2.69	52.30	54.50	0.55	0.64
LSD at 5%		0.22	0.52	4.28	4.16	N.S	0.46

Table (2):Effect of calcium and potassium applications on three cantaloupe cultivars in average fruit weight and yield and their interactions in 2002 /2003 and 2003 / 2004

Treatments		Av. Fruit weight (gm)		Early yield (ton) / fed.		Total yield (ton) / fed.	
Cultivar	Elements	1st season	2nd season	1st season	2nd season	1st season	2nd season
Galia		878.12	833.90	4.11	4.08	13.01	13.69
Clandio		865.41	828.80	3.96	3.95	12.87	13.20
Passport		1101.01	994.90	4.03	4.03	12.67	13.42
LSD at 5%		20.19	25.16	0.11	0.06	N.S	0.19
	Potassium	978.55	935.18	4.16	4.23	13.32	13.85
	Calcium	933.92	866.77	3.95	3.92	12.59	13.17
	K + Ca	986.48	925.02	4.19	4.23	13.66	13.95
	Control	893.79	813.93	3.84	3.71	11.84	12.77
LSD at 5%		26.94	41.44	0.25	0.16	0.27	0.50
Galia	K	889.70	862.90	4.30	4.38	13.80	14.35
	Ca	872.40	812.30	4.01	4.06	12.44	13.38
	K + Ca	910.33	872.20	4.38	4.30	14.02	14.60
	Control	840.08	788.30	3.73	3.59	11.79	12.42
Clandio	K	880.23	875.30	4.07	4.15	13.15	13.55
	Ca	855.80	804.60	3.89	3.83	12.69	12.96
	K + Ca	887.20	837.40	4.09	4.11	13.55	13.62
	Control	838.30	790.10	3.80	3.71	12.11	12.65
Passport	K	1165.70	1067.50	4.10	4.16	13.02	13.64
	Ca	1173.60	983.50	3.95	3.87	12.65	13.16
	K+ Ca	1161.90	1065.20	4.10	4.28	13.42	13.64
	Control	1202.90	8634.50	3.98	3.82	11.81	13.25
LSD at 5%		46.66	N.S	N.S	N.S	0.47	0.50

Table (3): Effect of calcium and potassium applications on three cantaloupe cultivars on fruit characters and their interactions in 2002 / 2003 and 2003 / 2004

Treatments		Fruit longitudinal (cm)		Fruit equatorial (cm)		Flesh thickness (cm)		Flesh firmness (N)	
Cultivar	Elements	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Galia		11.39	11.12	11.75	11.25	3.637	3.53	18.35	16.71
Clandio		11.39	11.16	11.49	11.76	3.471	3.46	17.97	16.28
Passport		12.14	11.82	12.06	11.99	3.719	3.58	16.86	15.10
LSD at 5%		0.428	0.427	0.291	0.237	N.S	N.S	0.935	0.499
	Potassium	11.76	11.48	11.90	11.86	3.67	3.61	17.25	15.31
	Calcium	11.73	11.41	11.69	11.78	3.62	3.48	19.04	17.34
	K + Ca	11.99	11.76	12.13	11.91	3.81	3.56	18.50	16.98
	Control	11.19	10.81	11.34	11.12	3.34	3.39	16.14	14.51
LSD at 5%		0.361	0.296	0.352	0.28	0.138	0.135	0.582	0.285
Galia	K	11.42	11.12	11.74	11.53	3.59	3.63	17.98	15.98
	Ca	11.62	11.01	11.82	11.24	3.71	3.53	19.73	17.95
	K + Ca	11.65	11.55	12.13	11.53	3.93	3.65	19.30	17.75
	Control	10.91	10.81	11.32	10.71	3.33	3.31	16.39	15.18
Clandio	K	11.27	11.29	11.55	11.93	3.58	3.63	17.35	15.68
	Ca	11.58	11.29	11.43	11.81	3.36	3.33	19.55	17.53
	K + Ca	11.67	11.58	11.75	12.03	3.68	3.50	18.80	17.25
	Control	11.08	10.46	11.21	11.28	3.27	3.40	16.22	14.68
Passport	K	12.33	12.03	12.42	12.13	3.85	3.58	16.43	14.28
	Ca	11.99	11.93	11.82	12.28	3.79	3.58	17.83	16.53
	K+ Ca	12.65	12.15	12.51	12.18	3.82	3.70	17.40	15.93
	Control	11.59	11.17	11.49	11.38	3.42	3.48	15.80	13.68
LSD at 5%		N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Regarding the significant differences between cultivars on fruit chemical analysis data in (Table 4), show that Passport had the lower calcium content in their mesocarp compared with Galia and Clandio cultivars. Concerning potassium content in the fruit, Galia recorded higher potassium values in the fruit tissue than Passport and Clandio. Meanwhile, there were no significant differences between cultivars in TSS%, total sugars and titratable acidity contents.

1.2. The effect of foliar application on vegetative growth, fruit characteristics and compositions

The effectiveness of potassium (K_2O) at a concentrations of 1500ppm/L, chelated calcium 1000ppm/L; and potassium (K_2O) 750ppm plus chelated calcium 500ppm/L compared with spraying with distilled water as control on plant vegetative growth, fruit characters and composition are shown in Tables (1, 2, 3 and 4).

It is clear from Tables (1and 2) that, plants received additional foliar potassium and/or calcium, increased significantly plant height, number of leaves and plant leaf area compared with control. Increasing vegetative growth parameters leads to increase significantly the average fruit weight and both early and total yield.

Table (4): Effect of calcium and potassium applications on three cantaloupe cultivars on fruit characters and their interactions in 2002 / 2003 and 2003 / 2004

Treatments		TSS %		Total sugar gm/100gm d.w		Titratable acidity mg / 100 gm		Ca mg / 100 g		K mg / 100 g	
Cultivar	Elements	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Galia		15.22	14.68	11.44	10.96	1.10	1.00	0.084	0.07	291.46	277.86
Clandio		15.06	14.69	11.14	10.85	1.09	1.02	0.072	0.07	261.33	268.32
Passport		14.78	14.70	10.51	10.75	1.04	0.99	0.053	0.04	270.39	260.84
LSD at 5%		N.S	N.S	N.S	N.S	N.S	N.S	0.025	0.02	7.520	8.799
	Potassium	15.82	15.64	11.61	11.32	1.19	1.02	0.07	0.05	272.46	284.46
	Calcium	14.63	14.32	10.76	10.70	1.07	1.00	0.09	0.08	267.80	261.83
	K + Ca	15.37	14.81	11.32	11.13	1.14	1.02	0.08	0.07	289.78	278.40
	Control	14.27	13.99	10.44	10.27	1.00	0.97	0.05	0.04	267.52	251.36
LSD at 5%		0.27	0.416	0.572	0.339	0.059	0.024	0.01	0.001	13.27	9.25
Galia	K	15.93	15.53	12.03	11.46	1.04	1.04	0.09	0.07	300.80	297.40
	Ca	14.85	14.6	11.2	10.70	1.18	1.00	0.10	0.01	270.10	272.70
	K + Ca	15.58	14.78	11.69	11.25	1.19	1.02	0.09	0.08	297.90	282.00
	Control	14.53	13.8	10.84	10.45	1.01	0.96	0.06	0.05	276.20	259.40
Clandio	K	15.95	15.70	11.85	11.28	1.24	1.02	0.07	0.06	295.90	284.20
	Ca	14.78	14.25	10.68	10.7	1.00	1.02	0.09	0.08	268.20	263.50
	K + Ca	15.33	14.4	11.45	11.03	1.14	1.03	0.08	0.06	290.20	274.60
	Control	14.18	14.43	10.58	10.4	0.97	0.99	0.05	0.06	259.90	256.80
Passport	K	15.58	15.70	10.95	11.23	1.04	1.00	0.05	0.03	289.50	277.60
	Ca	14.25	14.1	10.4	10.70	1.02	0.99	0.07	0.06	260.10	249.30
	K+ Ca	15.2	15.25	10.78	11.13	1.09	1.01	0.06	0.05	281.20	278.60
	Control	14.1	13.75	9.9	9.95	1.01	0.95	0.03	0.03	250.70	237.90
LSD at 5%		N.S	N.S	N.S	N.S	0.103	N.S	0.19	0.015	35.84	35.079

With respect to the foliar treatments on cantaloupe fruits characters, i.e. longitudinal and equatorial diameters, flesh thickness and flesh firmness were increased significantly compared with control (Table 3). The same harmony was recorded in fruit chemical composition in (Table 4). A significant higher total soluble solids, total sugars and titratable acidity were found in fruits treated with calcium and/or potassium foliar treatments.

Also, fruit mesocarp reached higher calcium and potassium elements when plants were treated with foliar sprays containing calcium and/or potassium which lead to improve fruit quality via increasing total soluble solids and total sugar contents in the fruits.

1.3. Interaction between cultivars and foliar application on vegetative growth, fruit characters and fruit composition of cantaloupe

Data presented in Table (1) reveale the interaction between cultivars and foliar application on vegetative growth. The effect of interaction between Galia, Clandio and Passport with foliar treatments on plant height and the number of leaves was significant in both seasons.

Total yield ton/feddan was also influenced significantly by either cultivars or foliar treatments as shown in Table (2). The interaction between cultivars and foliar application on calcium and potassium contents in the fruit was observed in Table (4)

Data show that foliar spray application with 1500ppm/L (K_2O), 1000ppm/L Ca and 750ppm/L K_2O plus 500ppm/L Ca exerted the highest significant values of calcium and potassium in fruit mesocarp in both seasons.

It is obvious from the data tabulated in Tables (3) and (4) that the interaction between cultivars and foliar treatments on fruit diameters (longitudinal and equatorial), flesh (thickness and firmness), total soluble solids and total sugars contents, were not considerably governed by foliar treatments or cultivars in both growing seasons.

Effect of cultivars on physical and chemical properties of cantaloupe fruits during storage

With respect to weight loss, data in Table (5) showed that, no significant differences were detected in the first season. On the other hand, significant differences between cultivars was evident in the second season, where Galia melon had the lowest value (4.82%) whereas, Passport cv suffered higher weight loss (6.23%). These results were in agreement with those reported by Ezzat (2002).

Table (5) : Effect of cultivar on physical and chemical properties of cantaloupe fruits during storage in 2002-2003 and 2003-2004 seasons

Treatments	Weight loss (%)	Decay (%)	Flesh firmness (N)	T.S.S. (%)`	Total sugars (gm/100gm d.w)	Titratable acidity (mg/100 gm f.w)
	2002-2003					
Galia	5.538	6.584	16.33	13.60	10.18	1.005
Clandio	5.636	6.983	15.69	13.36	9.88	0.987
Passport	5.710	8.271	14.76	12.82	9.35	0.965
L.S.D. at 5%	N.S		0.263	0.193	0.164	0.018
	2003-2004					
Galia	4.824	4.252	14.98	13.43	9.85	0.944
Clandio	5.407	5.144	14.19	13.17	9.76	0.945
Passport	6.231	5.78	12.89	12.90	9.55	0.923
L.S.D. at 5%	0.239		0.187	0.214	0.131	0.0128

Data presented in Table (5) showed that decay incidence was affected by the cultivar in both seasons. The highest percentage of decayed fruits was found in Passport cultivar (8.27%) followed by Clandio cv (6.98%) and the lowest percentage was observed in Galia cv (6.58%) in the first season. The same trend was noticed in the second season.

The cultivars differed significantly in their flesh firmness, Galia cultivar, in the first season showed the higher values of flesh firmness 16.33 (Newton), and the lowest were in Passport cv 14.76 (Newton) (Table, 5). These results showed the same trend in the second season.

Flesh firmness is an important quality parameter of flesh muskmelon (Mizarach *et al.*, 1994). The results agreed with the findings of Fallik *et al.*,

(2001) and Ezzat (2002) who found noticeable differences among cultivars in fruit firmness.

According to the present results, there was significant differences in the chemical constituents of cultivars. Fruits of Galia melon contained the highest contents of TSS, total sugar and titratable acidity, whereas those of Passport cv had the lowest values of these contents (Table, 5).

Hubbard *et al.*, (1989) attributed genotypic differences in sucrose concentration to genetically determined differences in the activity of fruit sucrose phosphate synthase, the major sucrose synthesizing enzyme.

Miccolis and Saltveit (1991); Artés (1993); Ezzat (2002) found that TSS and sugars content differed significantly among melon cultivars.

Effect of preharvest calcium and potassium foliar application on physical and chemical properties of cantaloupe fruits during storage

Foliar application treatments had a significant effect on weight loss and decay percentage of melon fruits. The data in Table (6) clearly showed that calcium treatment was the most effective ones in minimizing the weight loss and decay percentage. Moreover, untreated fruits (control) gave the highest values of weight loss and decay percentage. These results were alike in the two seasons.

Table (6) : Effect of pre-harvest calcium and potassium foliar application on physical and chemical properties of cantaloupe fruits during storage in 2002-2003 and 2003-2004 seasons

Treatment	Weight loss (%)	Decay (%)	Flesh firmness (N)	T.S.S. (%)`	Total sugars (gm/100gm d.w)	Titratable acidity (mg/100 gm f.w)
	2002-2003					
Potassium	5.422	7.418	15.16	13.91	10.30	1.009
Calcium	5.210	6.686	16.80	12.98	9.62	0.981
K + Ca	5.548	6.757	16.28	13.42	9.99	1.033
Control	6.333	8.256	14.09	12.60	9.31	0.919
L.S.D. at 5%	0.297		0.304	0.223	0.1898	0.0209
	2003-2004					
Potassium	5.50	4.698	13.43	14.02	10.03	0.948
Calcium	5.24	4.445	15.27	12.75	9.64	0.935
K + Ca	5.26	5.024	14.85	13.54	9.89	0.948
Control	5.955	5.763	12.50	12.34	9.38	0.919
L.S.D. at 5%	0.276		0.216	0.247	0.151	0.0147

Foliar fertilization with calcium had a significant impact in favor of retaining a higher flesh firmness of melon fruit (Table, 6), while untreated fruits (control) showed the least values.

Calcium interacted directly with cell wall pectic substances, resulting in a cell wall stiffening. Calcium may also act by reducing the activity of cell wall degrading enzymes. Endo-polygalacturonase is the enzyme suggested to be primarily responsible for fruit softening (Gerasopoulos and

Richardson,1999). Polygalacturonase activity is reduced by addition of Ca to the substrate (Corden, 1965).

These data are consistent with those of Jeong *et al.*, (1998); Abed-El-Hady (2001) in which calcium treatment increased firmness in melon fruit.

Foliar spraying with potassium resulted significantly in higher TSS content (13.91%) compared with untreated fruits (control) (12.60%) in the first season, and similar results were obtained in the second season. Also, foliar spraying with potassium led to another significant increment in fruit total sugars content (10.3mg/100g f.w) compared with those of untreated fruits (9.3mg) in the first season. A similar trend took place in the second season.

Increasing the carbohydrate content due to the applied potassium can be contributed to the role of potassium in carbohydrate assimilation and accumulation in fruits as a final sink (Evans and Sorger, 1966). Such results were also obtained by Hanolo and Pulung (1994) on pea, and Soliman (2004) on eggplant.

Data in Table (6) showed that (potassium + calcium) foliar application resulted in the highest acidity (1.03mg/100g f.w) in fruits compared with the other treatments. In addition, the control plants gave fruits with the lowest level of this content (0.919mg) in the first season.

However, the values corresponding to the other three fertilizers were not significantly different from each other in the second season.

Effect of interaction (cultivar × foliar application treatment) on physical and chemical properties of cantaloupe fruits during storage.

With respect to weight loss, it is clear from data in Table (7) that the least values of weight loss of melon fruits were recorded with Galia plants sprayed with potassium fertilization (5.18%). On the contrary, the highest values were obtained from untreated Passport fruits (6.40%) in the first season. However, in the second season, the lowest value of weight loss was obtained in fruit of Galia melon plants sprayed with calcium fertilizers (4.58%).

Results in Table (7) indicated that decay percentage was influenced by the combined effect of (cultivar × foliar fertilization), whereas the lowest value of decay percentage was recorded in fruits obtained from Galia plants sprayed with calcium (5.96%) in the first season. On the other hand, the highest value was noticed in untreated Passport fruits (9.63%). Moreover, in the second season, Galia melon fertilized with (K+Ca) showed the lowest value (3.86%).

Concerning interaction effect (cultivar × foliar fertilization) on flesh firmness, appeared significant in the first season, Galia melon plants treated with calcium fertilization had the highest flesh firmness (17.82) N. On the other hand, the lowest value was obtained by fruit of untreated Passport cv. plants (13.67) N (Table, 7). The same results were found in the second season.

Regarding the effect of interaction (cultivar × foliar application) on TSS and total sugars content, data in Table (7) showed that significant differences were found in both seasons. Galia melon plants sprayed with potassium foliar application exhibited the highest TSS content (14.19%) and

total sugars (10.7mg/100gm dry weight) in the first season. However, untreated Passport fruits resulted in the lowest values of these contents (12.3%) TSS and (8.92mg/100gm d.wt.) total sugars. These results are true in the second season.

The interaction effect on titratable acidity, appeared significantly in both seasons. Fertilizing Clandio plants by potassium foliar application in the first season and Clandio cv fertilized by (K+Ca) in the second season gave the highest titratable acidity 1.08, 0.96mg/100g f.w), respectively. Moreover, untreated Passport cv had the lowest titratable acidity 0.93 and 0.89mg/100g f.w) in the first and second season, respectively (Table, 7).

Table (7) : Effect of interaction between cultivar and preharvest calcium and potassium foliar application on physical and chemical properties of cantaloupe fruits during storage in 2002-2003 and 2003-2004 seasons

Cultivar	Treatment	Weight loss (%)	Decay (%)	Flesh firmness (N)	T.S.S. (%)	Total sugars (gm/100gm d.w)	Titratable acidity (mg/100 gm f.w)
		2002-2003					
Galia	Potassium	5.18	7.02	15.75	14.19	10.70	0.962
	Calcium	5.21	5.96	17.82	13.32	10.01	1.066
	K + Ca	5.39	6.07	17.43	13.77	10.40	1.06
	Control	6.39	7.18	14.33	12.84	9.61	0.935
Clandio	Potassium	5.50	7.06	15.15	14.05	10.41	1.081
	Calcium	5.24	6.32	16.98	13.14	9.64	0.927
	K + Ca	5.60	6.53	16.28	13.58	10.08	1.05
	Control	6.21	8.03	14.26	12.67	9.41	0.891
Passport	Potassium	5.59	8.18	14.63	13.48	9.79	0.986
	Calcium	5.19	7.79	15.62	12.57	9.20	0.950
	K + Ca	5.66	7.56	15.15	13.03	9.48	0.993
	Control	6.40	9.63	13.67	12.3	8.92	0.931
L.S.D. at 5%		0.515		0.526	0.386	0.3287	0.036
		2003-2004					
Galia	Potassium	4.64	4.396	14.27	14.15	10.22	0.962
	Calcium	4.58	3.686	16.23	13.33	9.71	0.938
	K + Ca	4.76	3.859	15.83	13.56	9.82	0.943
	Control	5.31	4.884	13.51	12.67	9.65	0.932
Clandio	Potassium	5.50	4.345	13.60	14.15	9.92	0.938
	Calcium	5.22	4.878	15.57	12.48	9.58	0.953
	K + Ca	5.18	5.506	15.05	13.52	9.96	0.964
	Control	5.74	5.849	12.53	12.57	9.58	0.924
Passport	Potassium	6.35	5.352	12.43	13.77	9.96	0.943
	Calcium	5.93	5.491	13.99	12.46	9.62	0.912
	K + Ca	5.86	5.706	13.68	12.57	9.76	0.936
	Control	6.81	6.557	11.46	11.81	8.89	0.890
L.S.D. at 5%		0.478		0.374	0.427	0.261	0.0256

Effect of storage period and marketing simulation condition on fruit quality

With respect to weight loss, data in Table (8) indicated that there was a significant increase in weight loss percentage during the storage period. This increase in weight loss might be attributed to the loss in moisture

through transpiration and loss in dry matter through respiration, (Stanely, 1991).Similar conclusions have been reported by Ezzat (2002).

Data in table (8) indicated that decay percentage increased considerably with the prolongation of the storage period. Also, these results might be attributed to the increase in temperature under marketing condition which enhanced the pathogen activity.

The increase in the metabolic activity of fruit which increased at high temperature might account much for the increase in the liability of fruits to decay infection.

Similar results were reported by Abed-El-Hady (2001) and Ezzat (2002).

The same Table (8) indicated that firmness of cantaloupe fruits decreased gradually and significantly with the advanced storage period and reached its lowest value after 21 days of storage at 5°C plus 3 days at 20°C. These findings might be due to the conversion of protopectin to soluble pectins. (Ryall and Lipton, 1979).

These results are in harmony with those obtained by Abed-El-Hady (2001) and Ezzat (2002).

Total soluble solids, total sugars and acidity, contents decreased significantly with the prolongation of storage period (Table, 8).

These results might be due to the utilization of these compounds in respiration.

Table (8) : Effect of storage period on physical and chemical properties of cantaloupe fruits during storage in 2002-2003 and 2003-2004 seasons

Treatment	Weight loss (%)	Decay (%)	Flesh firmness (N)	T.S.S. (%)`	Total sugars (gm/100gm d.w)	Titratable acidity (mg/100 gm f.w)
	2002-2003					
At harvest	—	—	17.73	15.09	11.03	1.079
After 14 days at 5°C + 3 days at 20°C	4.103	4.373	15 61	12 89	9.585	0.976
After 21 days at 5°C + 3 days at 20°C	7.154	10.19	13.43	11.80	8.806	0.901
L.S.D. at 5%	0.210		0.263	0.1932	0.1644	0.0181
	2003-2004					
At harvest	—	—	16.03	14.69	10.85	1.006
After 14 days at 5°C + 3 days at 20°C	4.198	4.034	14.04	13.12	9.781	0.939
After 21 days at 5°C + 3 days at 20°C	6.777	6.081	11.99	11.70	8.536	0.866
L.S.D. at 5%	0.195		0.187	0.214	0.1305	0.0128

These results were recorded during storage in both seasons, and are in accordance with those obtained by Abed-El-Hady (2001) and Ezzat (2002).

CONCLUSION

Calcium and potassium nutrition may face problems in fixation or unavailability in Egyptian alkali soils. Both elements play a good role for maintaining cantaloupe with acceptable appearance such as fruit firmness especially when the cultivar had low shelf-life, i.e. Passport. Results obtained showed that calcium and potassium treatments can increase crop yield, average weight of fruits beside improving fruit quality represented as an increase in fruit chemical constituents (i.e. TSS and total sugars). The data revealed also that, fruits stored at 5°C for 14, and 21 days in shipment transfer and fruits kept at 20°C for three days maintained excellent overall quality when the cultivars were sprayed with calcium and potassium in the field.

REFERENCES

Abdel-Hady, S.A. (2001). Effect of pre and postharvest treatments on improving and maintaining cantaloupe postharvest quality. M.Sc. Thesis, Fac. Agric., Ain Shams Univ.

Aharoni, Y.; A. Copel and E. Fallik (1993). Storing Galia melons in a controlled atmosphere with ethylene absorbent. Hortscience 28, 725-726.

Aharoni, Y. and A. Copel (1995). The control of postharvest decay in Galia melons using preparations other than Imazalil. Trop. Sci. 35, 17-21.

Allan, A.C.; Y. Shacher-Hill and P.H. Rubery (1993). The effects of calcium deficiency on *Cucurbita pope* L. hypocotyl ceels. Hort. Abst. 1994 Vol. 64 No. 1.

Anonymous, (1996). Protected cultivation manual, UNDP-FAO-EGY/ 95 / 002.

AOAC (1980). Association of official agricultural chemist official methods of analysis of AOAC 12th Ed., Washington DC.

Artés, F.; A.J. Escriche; J.A. Martinez and J.G. Marin (1993). Quality factors in four varieties of melon (*Cucumis melo* L.). Jour. Of Food Quality 16 (91-100).

Bermadac, A.; I. Jean-Baptiste; G. Bertoni and P. Morad (1996). Changes in calcium contents during melon (*Cucumis melo* L.) fruit development. Scientia Horticultaree 66:181-189.

Bramlage, W.J.; D. Mack and S.A. Weis (1985). Comparisons of calcium chloride, calcium phosphate and calcium chelate as foliar sprays for "Mcintosh" apple trees. J.Amer. Soc. Hort. Sci. 110 (6):786-789.

Chapman, H.D. and P.F. Pra (1961). "Methods of analysis for soils, plants and waters". Div. of Agric. Sci. Univ. of Calif., pp. 309.

Corden, M.E. (1965). Influence of calcium nutrition on Fusarium wilt of tomato and polygalactouronase activity. Phytopathology 55 : 222-224.

Dennis Scott, W.; B. Mccraw Dean; E. James and M.W. Smith (1993). Application of calcium to soil and cultivar affect elemental concentration of watermelon leaf and rind tissue. J. Amer. Soc. Hort. 54, 118 (2):201-206.

Eaves, C.A.; C.L. Lockhart; K. Stark and D.L. Craig (1972). Influence of preharvest sprays of calcium salts and was on fruit quality of Red Raspberry. J. Amer. Soc. Hort. Sci., 97 (6): 706-707.

Elmstron, G.W.; J.G.A. Fiskell and F.G. Martin (1973). Watermelon yield and quality: Effect of fertilizer rate and placement. Proc. Fla. State. Hort. Soc. 86:196-200.

Evans, H.J. and G.J. Sorger (1966). Role of mineral elements with amphasis on the univalent cations. Ann Rev. Plant Physiol. 17 : 47-76.

Ezzat, M.A. (2002). Effect of cultivar and planting dates on yieldingability, fruit characteristics and storageability of some cantaloupe cultivars under lower Egypt conditions. J. Agric. Sci. Mansoura Univ., 27 (3) 1783-1799.

Fallik, E.; S. Alkali-Tuvia; B. Horev; A. Copel; V. Rodov; Y. Aharoni; D. Ulrich and H. Schulz (2001). Characterization of Galia melon aroma by GC and mass spectrometric sensor measurements after prolonged storage. Postharvest Biology and Technology 22, 85-91.

Gerasopoulos, D. and D.G. Richardson (1999). Storage temperature and fruit calcium alter the sequence of ripening events of 'd' Anjou pears. Hortscience 34 92) : 316-318.

Hanolo, W. and M.A. Pulung (1994). Effect of P and K fertilizers on growth and yield of pea. Acta Hort. 369: 335-339.

Hardenburg, R.E.; A.E. Watada and C.Y. Wang (1986). The commercial storage of fruit, vegetables and florist and nursery stock. U.S. Dep., Agric., Handbook, No. 66.

Hubbard, N.L.; S.C. Huber and D.M. Pharr (1989). Sucrose phosphate synthase and acid invertase as determinants of sucrose concentration in developing muskmelon (*Cucumis melo* L.) fruits. Plant Physiol. 89 : 1527-1534.

Jeong, C.S.; K.C. Yoo and Y. Yeoung (1998). Effect of foliar application of $CaCl_2$ on quality of netted muskmelon during postharvest storage. J. Kor. Soc. Hort. Sci. 39 (2) : 170-174.

Johnson, C.D. and D.R. Decoteau (1996). Nitrogen and potassium fertility affects "Jolapeno" pepper plant growth, pod yield and pungency. Hort. Science, 31 (7):1119-1123.

Kirkby, E.A. and Pilbeam (1984). Calcium as a plant nutrient. Plant cell Environ J. 7:397-405.

Miccolis, V. and M.E. Saltveit (1991). Morphological and physiological changes during fruit growth and maturation of seven melon cultivars. J. Amer. Soc. Hort. Sci., 116 (6) : 1025-1029.

Mizrach, A.; N. Galili; D.C. Teitel and G. Rosenhouse (1994). Ultrasonic evaluation of some ripening parameters of autumn and winter Galia melons. Scientia Horticulture, 56, 291-297.

Morris, J.R.; D.L. Cowthorn; G.S. Nelson and P.E. Cooper (1980). Effect of preharvest calcium sprays and postharvest holding on firmness and quality of machine-harvested black berries. Hortscience 15 (1) : 33-34.

Nelson, N. (1974). A photometric adaptation of the Somogyi methods for determination of glucose, Jour. Biology Chem. 159:375-380.

Raese, J.T and S.R. Drake (1995). Calcium sprays and timing affect fruit calcium concentrations, yield, fruit weight and cark spot of "Anjou" pears. Hortscience, Val. 30 (5) August 1995.

Rodov, V.; B. Horev; Y. Vinohur; A. Copel; Y. Aharoni and N. Aharoni (2002). Modified atmosphere packaging improves keeping quality of charantis-type melon. Hortscience 37 (6) 950-953.

Ryall, A.L. and W.J. Lipton (1979). Handling, transportation and storage of fruits and vegetables. Vol. 1, 2nd Ed. Vegetables and Melons.

Sewon, P.; K. Yong; C. Soung Han; SeJin; and P. Youn Moon (1999). Effect of shipping temperature on quality changes of cucumber, eggplant, melon and cherry tomato during simulated export and marketing. Korean Journal of Horticultural Science and Technology, Vol. 17, No. 2, pp. 118-122.

Shear, C.B. (1975). Calcium related disorders of fruits and vegetables. Hort. Science 10:361-365.

Snedecor, G.W. and W.G. Chochran (1980). "Statistical methods" 6th (ed) Iowa state University preu, AM. Iowa, USA.

Soliman, Kh. A. (2004). Response of eggplant fruits to pre-harvest foliar spraying with potassium; postharvest waxing and period of storage under ambient conditions. Alex. Sci. Exch, Vol. 25, No. 1, pp. 1-15.

Somogyi, M. (1952). Notes on sugar determination-jour. Biology Chem., 195:19-23.

Stanley, J.K. (1991). Postharvest, Physiology of Perishable Plant Products. Inc. Van Nostrand Reinhold. New York, U.S.A.

Sundstrom, F. J. and S.J. Carter (1983). Influence of K and Ca on quality and yield of watermelon. J. Amer. Soc. Hort. Sci. 108 (5): 879-881.

Taylor, R.M.; L.B. Fenn and G.L. Horst (1985). The influence of calcium on growth and selected vegetable species in the presence of ammonium nitrogen. Texas Agric. Experimental Station, Plant Nutrition, 8 (11), 1013-1023.

Zhu, Y.Y. and D.Z. Shu (1991). Effect of potassium and calcium fertilizers on the yield, quality and storability of tomato. Chinese J. of Soil Sci., (1991) 22 (3) 130-131.

المحصول وصفات الثمار وقدرتها التخزينية في الكنتالوب وعلاقة ذلك بالرش الورقي بالبوتاسيوم والكالسيوم

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أجريت هذه الدراسة بمركز رفح - بمحافظة شمال سيناء خلال موسم ٢٠٠٢/٢٠٠٣ ، ٢٠٠٣/٢٠٠٤ لدراسة تأثير الرش الورقي لكلاً من البوتاسيوم والكالسيوم علي المحصول وجودة الثمار والقدرة التخزينية لثلاثة أصناف من الكنتالوب وهي (جاليا - باسبورت - كلانديو) وقد أوضحت النتائج :

- أعطي الصنف باسبورت أعلي نسبة نمو خضري (عدد الأوراق / نبات ومساحة الورقة وأعلي متوسط لوزن الثمرة مقارنة مع الصنفين الآخرين جاليا وكلانديو).
- الصنفين جاليا وباسبورت كانا أبكر محصولاً مقارنة بالصنف كلانديو.
- كان الصنف باسبورت أكبر في طول وعرض الثمرة مقارنة بالصنفين جاليا وكلانديو ، وسجل أقل محتوي للثمار من الكالسيوم وكذلك صلابة اللحم.
- لم يكن هناك فروق معنوية بين الأصناف في محتواها من المواد الصلبة الذائبة الكلية والمحتوي من السكريات الكلية والحموضة المعايرة.
- أدي التسميد الورقي بالبوتاسيوم أو البوتاسيوم مع الكالسيوم إلي زيادة كلاً من إرتفاع النبات - وكذا عدد الأوراق/نبات ومساحة الورقة مقارنة بالمعاملة الكنترول. وقد أدي زيادة النمو الخضري إلي زيادة متوسط وزن الثمرة وكلاً من المحصول الكلي والمبكر للفدان.
- أدي التسميد الورقي بالبوتاسيوم أو الكالسيوم أو الإثنين معاً إلي زيادة كلاً من طول وقطر الثمرة - وكذا سمك اللحم وإلي زيادة صلابة الثمار وأيضاً إلي تحسين خواص الثمار من خلال زيادة محتواها في كلاً من المواد الصلبة الذائبة الكلية والسكريات الكلية وأيضاً الحموضة المعايرة ومحتوي الثمار من البوتاسيوم والكالسيوم.
- وقد أظهرت نتائج التخزين المبرد وفترة العرض أن أقل فقد في وزن الثمار وكذا نسبة التلف كانت في الصنف جاليا بينما أعلي قيم كانت مع الصنف باسبورت.
- ثمار الصنف جاليا كانت أكثر صلابة واحتوت علي أعلي نسبة من المواد الصلبة الذائبة الكلية والسكريات الكلية والحموضة المعايرة مقارنة بباقي الأصناف .
- التسميد الورقي بالكالسيوم كان له تأثير فعال في تقليل نسبة كلاً من الفقد في الوزن والتالف والإحتفاظ بالصلابة في الثمار.
- أدي التسميد الورقي بالبوتاسيوم إلي زيادة محتوي الثمار من المواد الصلبة الذائبة الكلية والسكريات الكلية عند مقارنتها بثمار المعاملة كنترول.
- زادت نسبة كلاً من الفقد في الوزن ونسبة التالف بإطالة فترة التخزين علي حين قلت صلابة الثمار وكذا المحتوي من المواد الصلبة الذائبة الكلية والسكريات والحموضة المعايرة.
- ونوصي بالتسميد الورقي بالبوتاسيوم أو الكالسيوم أو الإثنين معاً للحصول علي ثمار كنتالوب ذات صفات جيدة وإطالة القدرة التخزينية لها.