EFFECT OF SOME PRE –HARVEST TREATMENTS ON YIELD, SPLITTING PERCENTAGE AND STORABILITY OF MANFALOTY POMEGRANATES

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ABSTRACT

The present study was carried out during the two successive seasons of 2006 and 2007 in privet farm, El Bostan village, El Beheira Governorate on Manfaloty pomegranates "*Punica granatum."* to study the influence of some pre-harvest treatments yield, fruit quality, fruit splitting percentage, and cold storage durations of Manfaloty cv. Pomegranate fruits.

Results indicated that, spraying Manfaloty trees with GA_3 at 100 ppm twice after 2 and 8 weeks of full bloom greatly decreased or prevented fruit splitting percentage. In addition, pre harvest spray with either GA_3 at 100 ppm or boric acid at 0.2% significantly increased tree yield. Moreover, such sprays resulted in the greatest fruit weight, volume, seed weight and juice weight. On the other hand, SSC%, total sugars%, titratable acidity % and anthocyanin% in fruit juice did not affect by various pre harvest treatments. Spraying trees of Manfaloty with GA_3 at 100 ppm exhibited the longest fruit shelf life (5 - 6 weeks). In addition, pre harvest spray with boric acid followed by cold storage at 10° C and 90 % RH resulted in the longest shelf life after 20 weeks storage for Manfaloty pomegranates.

INTRODUCTION

In Egypt, pomegranate trees are widely planted especially in Assiut, Beheira, and El-Sharkia, around Alexandria and in newly reclaimed lands. This tree is extremely drought tolerant and thrives on a wide range of soils (Ravi, 1999).

Manfaloty is the most important pomegranate cultivar in Upper Egypt, cracking of fruits is one of the physiological disorders wherever pomegranate trees are grown. It is considered a limiting factor for continuous expansion of pomegranate in Egypt, where the growers loss most of their profit due to this problem. The cracked fruits substantially loss their marketing ability and easily susceptible to various types of pests and fungus attack. Such fruits couldn't be stored or exported. Although, the pomegranate peel appears to be thick, it has numerous minute openings that permit free movement of water vapor, making the fruit highly susceptible to water loss (Kader *et al*., 1984). Cracking can be minimized by choice of resistant varieties or sprays of minerals, hormones or other substances (Tony and John, 1994).

Singh *et al*. (1993) found that 7- to 8 year old pomegranate trees cvs. Kandhari and Beedana, at fruit set and 1 month later. Spraying 0.005 or 0.002 % boric acid, 1% KNo_3 or 1% $MgSo_4$ were the most effective in reducing fruit cracking and increasing yield.

Heshi *et al*. (2001) recorded that $CaCl_2$, Ca $(No_3)_2$ and KH_2Po_4 at 1 and 2 % concentrations, were sprayed on pomegranate trees cv. G-137 at 90 days after full Anthesis. Fruits were harvested at 135 DAFA and analyzed. Aril (68.93%) and juice percentage (54.57%) were markedly enhanced by 2% KH_2Po_4, while seed hardness was not affected by any treatment. Total soluble solids (16.36%) and ascorbic acid content (5.88 mg / 100g) were highest in the 2% Ca $(No_3)_2$ treatments, while the highest total (15.21%) and reducing sugars (11.94%) were recorded in the KH_2Po_4 treatment. Other parameters, i. e. acidity and anthocyanin content, were not significantly different among treatments.

In pomegranate trees, GA_3 at 50, 100 and 150 ppm decreased the fruit cracking percentage comparing to the control and increased fruit weight (Mohamed, 1993).

Ali (2006) found that when 15 years old Manfaloty pomegranate trees were sprayed twice/ year (two and eight weeks after full bloom) by GA at 30 and 60 ppm reduced fruit cracking percentage compared to the untreated trees.

Also, spraying GA_3 at 25, 50 and 75 ppm 20, 40 and 60 days after fruit set increased yield and fruit weight of pomegranate cv. Mridula (Pawar *et al*., 2005).

However, Ali, (2006) found that total acidity of Manfaloty pomegranate fruits significantly increased due to GA_3 applications either at 30 or 60 ppm.

Additionally, boron is also, required for retention of fruitlets, and possibly by influencing sink strength of the developing embryo through auxin mediated events (Nyomora, *et al*., 2000).

Singh *et al*. (2003) experimented pre harvest sprays of boron (0.1, 0.2, 0.3 and 0.4 %) and GA_3 (10, 20, 50, 100 ppm.) to control fruit cracking in pomegranate cv. Jalore seedless. They found that the least cracking was obtained with the application of boron at 0.2% which in turn produced the highest yield (10.3 Kg / tree in 2001 and 16.4 Kg / tree in 2002).

Ali, (2006) mentioned that 15 years old Manfaloty pomegranate trees were sprayed twice/ year (two and eight weeks after full bloom) by boric acid at 0.2 and 0.3%, resulted in a significantly higher vitamin C/ fruit.

ZhongJun and JingHui (2001) showed that acidity decreased gradually with fruit maturity, while ascorbic acid, reducing sugars and soluble solids contents increased. The harvest time occurred when the ground color of fruit rind changed from green to yellow and fruits had a glossy appearance or some red coloration in pomegranate cv. Qingpiruanzi.

The present investigation was outlined to study the effect of some pre harvest treatments such as Gibberellic acid, boric acid and potassium ortho diphosphate (KH_2PO_4) to improve the fruit quality, reduce the fruit splitting, prolonging the cold storage period and shelf life of Manfaloty cv. pomegranate fruits.

MATERIALS AND METHODS

Mature pomegranate fruits cv. Manfaloty was used in the present study during two successive seasons of 2006 and 2007. Fruits were obtained from a private orchard located at, El- Beheira Governorate, Egypt. Pomegranate trees were six years old; planted at 3 x 5 m. All trees had received adequate irrigation and fertilization amounts as well as other cultural practices recommended for pomegranate trees by the Egyptian Ministry of Agriculture (Ann. Rept. of Agric.2003).

The effect of the following pre-harvest treatments was evaluated on fruit splitting percentage, tree yield, fruit quality and storability of pomegranate fruits:-

1- Spraying with GA_3 at 100 ppm.

2- Spraying with potassium ortho di phosphate (KH_2PO_4) at 2%.

3- Spraying with boric acid at 0.2%.

4- Control (spraying with tap water)

Spraying was done twice: - The first time after 2 weeks from full bloom, and the second time after 6 weeks from the first time. Each treatment was applied to twelve trees (three replicate and 4 trees for each). Fruits were harvest on September7th in the first season and on September16th in the second one.

The following measurements were recorded:-

1-Tree yield:-

At the harvest date the tree yield was calculated using the following equation:-

Tree yield in kg = Mean fruit weight in kg x Total fruit number/ tree

2-Fruit splitting percentage:-

After the second spray of each treatment, the fruit splitting percentage was calculated at two weeks intervals till the harvest time by using the following equation :-

$$\text{Fruit splitting percentage (FSP)} = \frac{\text{Number of splitted fruits}}{\text{Total fruit number}} \times 100$$

3- Fruit physical characteristics:-

At the harvest time, the weight, length, diameter, fruit shape and volume of fruit as well as weight of rind, seeds and juice% rind and seed color were calculated.

4- Fruit chemical properties:-

4-1- Soluble Solids Content (SSC %):-

Abbe refractometer was used to determine the percentage of total soluble solids content in fruit juice.

4-2-Total sugars percentage:-

Total sugars percentage was determined by using the phenol sulphuric methods, Smith *et al*. (1956) and the concentration was calculated from a standard curve of glucose as g. per / 100 g. fresh weight.

4-3- Titratable Acidity %:-

Titratable acidity % was determined by titrating the juice against 0.1 N sodium hydroxide using phenolphthalein as an indicator. Results were expressed as percentage of malic acid in fresh white pulp weight. A.O.A.C. (1990).

4-4-SSC/ acid ratio %

By dividing the value of SSC on the value of titratable acidity for each replicate.

4-5- L-ascorbic acid content:-

L-ascorbic acid content was determined by titration against 2, 6 dichlorophenolendophenol, and using 2% oxalic acid solution as substrate. Ascorbic acid was calculated as milligram per 100 ml. of juice (Lucass, 1944).

4-6- Anthocyanins pigment percentage:-

Total anthocyanins percentage in fruit juice was determined as described by Wettstein, (1957), data was expressed as a percentage.

5- Fruit storability:-

Fruit boxes representing all the studied pre harvest treatments were kept at 5, 8 and 10±1º C and 90% RH, samples were taken at beginning of cold storage and every 4 weeks intervals to evaluate fruit quality and shelf life period after each cold storage interval.

Statistical analysis:-

The treatments were arranged as a factorial experiment in a randomized complete block design. All data were subjected to statistical analysis according to the procedures reported by Snedecor and Cochran (1982) and means were compared by Duncan's multiple range tests at the 5 % level of probability in the two seasons of experimentation (Duncan, 1955)

RESULTS AND DISCUSSION

Effect of some pre-harvest treatments on yield, physical and chemical properties of Manfaloty pomegranates: -

1. Tree yield in kg:-

Data in table (1) indicated that all the sprayed trees gave higher yield than the control in both seasons. The highest significant value was obtained by spraying boric acid in both seasons compared with other treatments and control.

Table (1): Effect of some pre-harvest treatments on yield (kg/tree), and splitting % of Manfaloty pomegranates during 2006 and 2007 seasons.

Treat. **	Yield/ tree (kg)	Splitting % Weeks after the second spray (July 1 st)				
		2 wk	4	6	8	10
			2006 season			
1	22.07A	0	0.01B	0.01B	0.01C	0.01C
2	22.85A	0	0.01B	0.01B	4.01B	5.01B
3	23.25A	0	0.01B	1.01B	3.01B	4.01B
4	**19.19B**	**0**	**1.01A**	**7.01A**	**15.01A**	**17.01A**
			2007 season			
1	21.52A	0	0.01B	0.01B	0.01C	0.01C
2	18.76B	0	0.01B	0.01B	5.01B	5.01B
3	22.80A	0	0.01B	1.01B	4.01B	5.01B
4	**17.66B**	**0**	**1.01A**	**8.01A**	**17.01A**	**17.01A**

Values followed by the same letter (s) in each column, row or interaction are not significantly different at 5 % level.
** Treatments: 1- GA_3 100 ppm - 2- KH_2Po_4 2% - 3- Boric acid 0.2% - 4- Control

The obtained results are in harmony with those reported by Ali (2006) who found that when Manfaloty pomegranate trees were sprayed twice/ year (two and eight weeks after full bloom) by boric acid at 0.2 and 0.3% significantly increased yield/ tree.

2. Effect on fruit splitting%: -

Table (1) showed that splitting percentage increased with extending fruit age of Manfaloty pomegranates, during 2006 and 2007 seasons except GA_3 spray treatment.

Trees sprayed with different compounds showed significantly lower fruit splitting % in both seasons. In general spray with GA_3 at 100 ppm resulted in the lowest significantly fruit splitting% in the two successive seasons 0.01%, opposite to the control ones. These results are in agreement with those obtained by Mohamed (2004) who reported that GA_3 at 50, 100 and 150 ppm decreased the fruit cracking percentage comparing to the control and increased fruit weight in pomegranate trees.

3. Fruit physical characteristics: -

Tables (2) show that both GA_3 at 100 ppm and boric acid at 0.2% spray considerably significantly increased fruit weight, fruit volume, and juice weight, than the control in both seasons.

On the contrary, KH_2PO_4 at 2 % significantly decreased seed weight and juice weight in the both seasons. Meanwhile, fruit length, diameter, shape and juice % did not respond to all the studied chemical compounds in both seasons.

These results could be confirmed with those reported by Ali (2006) who found that spray Manfaloty pomegranate trees with boric acid at 0.2 or 0.3% increased fruit weight, and noted that GA_3 and boric acid increased fruit diameter than control treatment.

Table (2): Effect of some pre-harvest treatments on some physical characteristics of Manfaloty pomegranates at harvesting during 2006 and 2007 seasons.

Treat. **	Fruit weight	Fruit Volume	Fruit length	Fruit diameter	Fruit shape	seed weight	juice weight	Juice	Rind weight
	(gm.)	(ml.)	(cm.)	(cm.)	L/D	(gm.)	(gm.)	%	(gm.)
					2006				
1	306.55 A	323.33 A	7.93 A	8.33 A	0.95 A	167.71 B	116.15 A	37.89 A	132.57 B
2	259.68 B	275.00 B	7.33 A	7.60 A	0.96 A	133.26 D	91.84 C	35.37 A	121.13 BC
3	327.50 A	333.33 A	7.70 A	8.37 A	0.92 A	254.00 A	122.98 A	37.55 A	217.70 A
4	272.71 B	283.33 B	7.27 A	7.83 A	0.93 A	152.66 C	103.13 B	37.82 A	113.19 C
					2007				
1	307.45 A	320.82 A	7.90 A	8.35 A	0.95 A	166.75 B	117.10 AB	38.09 A	131.90 B
2	260.60 B	276.10 B	7.35 A	7.65 A	0.96 A	132.55 C	92.30 C	35.42 A	120.14 B
3	325.75 A	331.34 A	7.72 A	8.30 A	0.93 A	255.00 A	123.10 A	37.79 A	216.80 A
4	271.77 B	281.35 B	7.30 A	7.90 A	0.92 A	153.70 BC	104.20 BC	38.34 A	111.90 B

Values followed by the same letter (s) in each column, row or interaction are not significantly different at 5 % level
**Treatments: 1- GA_3 100 ppm - 2- KH_2Po_4 2% - 3- Boric acid 0.2% - 4- Control

4. Fruit chemical characteristics: -

Table (3) illustrate that different studied treatments failed to affect significantly SSC%, total sugars %, titratable acidity % and anthocyanin % of Manfaloty pomegranate in both seasons. On the other hand, GA_3 spray at 100 ppm considerably increased both ascorbic acid content and SSC/acid ratio in the both studied seasons.

These results are differ than those recorded by Ali, (2006) who found that pomegranate trees which were sprayed by GA significantly increased fruit juice acidity.

Moreover, Al-Hmedawi (2003) found that Salimi pomegranate trees which were sprayed by GA at 100 and 150 mg/ liter on 30 June in two growing seasons, showed an increase in vitamin C content in the juice during ripening.

Table (3): Effect of some pre- harvest treatments on some chemical characteristics on Manfaloty pomegranates during 2006 and 2007 seasons

Treat. **	SSC (%)	Total sugars (%)	Titratable acidity (%)	SSC/ acid ratio	Ascorbic acid (mg/100 ml.)	Anthocyanin (%)
			2006			
1	14.90 A	12.67 A	0.704 A	21.16 A	20.21 A	0.266 A
2	14.80 A	12.58 A	0.779 A	19.00 C	17.08 AB	0.392 A
3	14.80 A	12.58 A	0.768 A	19.27 BC	15.63 B	0.289 A
4	**15.60 A**	**13.26 A**	**0.768** A	**20.31 AB**	**14.38 B**	**0.291 A**
			2007			
1	15.60 A	13.26 A	0.683 A	22.84 A	20.00 A	0.197 A
2	15.90 A	13.52 A	0.758 A	20.98 B	18.00 AB	0.311 A
3	16.00 A	13.60 A	0.747 A	21.42 B	18.00 AB	0.438 A
4	**16.10 A**	**13.69 A**	**0.747** A	**21.55 B**	**16.00 B**	**0.215 A**

Values followed by the same letter (s) in each column, row or interaction are not significantly different at 5 % level
**Treatments: 1- GA_3 100 ppm - 2- KH_2Po_4 2% - 3- Boric acid 0.2% - 4- Control

II. Effect of some pre-harvest treatments on fruit storability of Manfaloty pomegranates:

1. Discarded fruit percentage: -

Table (4) revealed that cold storage of Manfaloty pomegranates at 5±1ºC and RH 90% was terminated after 16 weeks where the percentage of discarded fruits exceeded 50% in both seasons.

Regarding the specific effect of the pre harvest treatments, one can notice that GA_3 at 100 ppm significantly decreased % of the discarded fruit in all storage periods in both seasons, regardless of the degree of cold storage.

In most cases, cold storage at 8 ° C was better than storage at lower degree (5° C) or higher one (10° C) regardless of the used pre harvest treatments in both seasons.

As for the effect of the interaction between the two studied factors, it is obvious that trees were sprayed with GA_3 at 100 ppm gained fruits when stored at 8 or 10 ° C and 90% RH showed significantly lowest percentage of discarded fruits in both seasons.

2. Fruit weight loss percentage: -

Table (5) exhibited that fruit weight loss in general increased steadily as cold storage period prolonged in both seasons. For instance, such increase in control fruits was 4.19 % after 4 weeks and reached 12.95 % at the end of storage (20 weeks) in the first season.

Table (4): Effect of some pre- harvest treatments on discarded fruit % of Manfaloty pomegranates stored at 5°, 8° and 10 ± 1°C and 90% RH, during 2006 and 2007 seasons

Treat. **	Storage periods in weeks											
	12				16				20			
	Temperature degrees storage											
	5°C	8°C	10°C	Mean	5°C	8°C	10°C	Mean	5°C	8°C	10°C	Mean
	2006											
1	16.6 e	16.6 e	8.3 f	**13.8 C**	33.3 e	35.0 e	33.3 e	**33.9 D**	-	40.0 c	50.0 b	**45.0 C**
2	28.2 b	25.0 cd	25.0 cd	**26.1 A**	50.0 a	40.0 d	40.0 d	**43.3 B**	-	46.7 b	55.0 a	**50.8 AB**
3	27.0 bc	23.0 d	25.0d	**25.0 A**	35.0 e	40.0 d	40.0 d	**38.3 C**	-	41.7 c	55.0 a	**48.3 B**
4	33.3 a	16.7 e	16.7 e	**22.2 B**	50.0 a	47.0 b	45.0 c	**47.3 A**	-	55.0 a	50.0 b	**52.5 A**
Mean	**26.3 A**	**20.3 B**	**18.8C**		**42.1 A**	**40.5 B**	**39.6 C**		-	**45.8 B**	**52.5 A**	
	2007											
1	25.0 b	16.7 c	16.6 c	**19.4 D**	33.3 f	20.0 i	33.3 f	**28.9 D**	-	45.0 c	50.0 b	**47.5 B**
2	33.3 a	16.7 c	16.6 c	**22.19 C**	50.0 b	25.0 h	40.0 d	**38.3 B**	-	40.0 e	55.0 a	**47.5 B**
3	27.0 b	25.0 b	25.0 b	**25.7 B**	35.0 e	30.0 g	33.3 f	**32.8 C**	-	50.0 b	50.0 b	**50.0 A**
4	25.0 b	25.0 b	33.3 a	**27.8 A**	58.3 a	33.3 f	41.6 c	**44.4 A**	-	41.7 d	50.0 b	**45.8 C**
Mean	**27.6 A**	**20.8 C**	**22.9 B**		**44.2 A**	**27.1 C**	**37.05 D**		-	**44.2 D**	**51.3 A**	

Values followed by the same letter (s) in each column, row or interaction are not significantly different at 5 % level

* Storage period at 5°C Was stopped after 16 weeks where percentage of discarded fruits reached 50 %

**Treatments: 1- GA_3 100 ppm - 2- KH_2Po_4 2% - 3- Boric acid 0.2% - 4- Control

Table (5): Effect of some pre-harvest treatments, different cold storage degrees and their interaction on fruit weight loss percentage of Manfaloty pomegranate fruits, during 2006 and 2007 seasons.

Treat. **	Storage periods in weeks																			
	4				8				12				16				20			
	Temperature degrees storage																			
	5 °C	8° C	10 °C	Mean	5 °C	8° C	10 °C	Mean	5 °C	8° C	10 °C	Mean	5 °C	8° C	10 °C	Mean	5 °C	8° C	10 °C	Mean
										2006										
1	3.91	4.22	4.35	**4.16**	6.25	7.36	7.79	**7.13**	8.02	9.28	12.80	**9.24**	9.83	11.86	12.80	**11.50**	-	13.87	15.04	**14.4**
	a	a	a	**A**	cd	ad	a-d	**AB**	bc	abc	abc	**AB**	d	a-d	abc	**AB**		abc	ab	**6B**
2	3.68	4.79	5.04	**4.50**	6.13	8.59	8.92	**7.88**	7.97	11.07	11.86	**10.30**	9.91	14.00	14.67	**12.86**	-	16.35	17.00	**16.68**
	a	a	a	**A**	cd	ab	a	**A**	bc	ab	a	**A**	d	ab	a	**A**		a	a	**A**
3	3.50	3.92	4.28	**3.90**	5.97	6.49	7.33	**6.60**	7.54	8.28	9.22	**8.35**	8.95	10.53	11.76	**10.41**	-	12.37	14.17	**13.27**
	a	a	a	**A**	d	bcd	a-d	**B**	c	bc	abc	**B**	d	cd	bcd	**B**		bc	abc	**B**
4	3.79	3.98	4.79	**4.19**	6.05	6.23	8.19	**6.82**	7.90	8.02	10.92	**8.95**	9.72	9.89	13.36	**10.99**	-	11.35	14.55	**12.95**
	a	a	a	**A**	cd	cd	abc	**AB**	bc	bc	ab	**AB**	d	d	abc	**B**		c	ab	**B**
Mean	**3.72**	**4.23**	**4.62**		**6.10**	**7.17**	**8.06**		**7.86**	**9.16**	**10.61**		**9.60**	**11.57**	**13.15**		-	**13.49**	**15.19**	
	B	**AB**	**A**		**B**	**A**	**A**		**B**	**B**	**A**		**C**	**B**	**A**			**B-**	**A-**	
										2007										
1	4.86	5.68	5.74	**5.43**	8.44	9.81	12.34	**10.20**	14.12	14.65	17.28	15.**35**	18.14	18.36	21.26	**19.25**	-	21.07	21.53	**21.30**
	abc	abc	ab	**A**	de	bcd	ab	**A**	cde	b-e	ab	**A**	cd	c	a	**A**		a	a	**A**
2	4.52	5.40	5.79	**5.24**	8.10	9.76	11.64	**9.83**	13.92	14.64	16.31	**14.96**	18.73	18.82	21.40	**19.65**	-	22.34	22.38	**22.36**
	abc	abc	ab	**A**	de	bcd	abc	**A**	de	b-e	a-d	**A**	bc	bc	a	**A**		a	a	**A**
3	3.00	5.35	6.48	**4.94**	7.30	9.23	12.55	**9.69**	11.80	13.93	17.07	**14.27**	16.40	18.13	21.43	**18.65**	-	19.87	20.65	**20.26**
	c	abc	a	**A**	de	cde	a	**A**	e	de	abc	**A**	d	cd	a	**A**		a	a	**A**
4	3.17	5.42	6.09	**4.89**	6.7	9.42	13.04	**9.74**	12.17	14.58	18.24	**15.00**	16.44	19.23	20.44	**18.70**	-	19.88	22.80	**21.34**
	bc	abc	a	**A**	6e	cde	a	**A**	e	b-e	a	**A**	d	bc	ab	**A**		a	a	**A**
Mean	**3.89**	**5.46**	**6.03**		**7.65**	**9.56**	**12.39**		**13.00**	**14.45**	**17.23**		**17.43**	**18.64**	**21.13**		-	**20.79**	**21.84**	
	B	**A**	**A**		**C**	**B**	**A**		**C**	**B**	**A**		**C**	**B**	**A**			**A-**	**A-**	

Values followed by the same letter (s) in each period are not significantly different at 5 % level.

- Storage period at **5 °C** was stopped after 16 weeks where percentage of discarded fruits reached 50 %

**Treatments: 1- GA_3 100 ppm - 2- KH_2Po_4 2% - 3- Boric acid 0.2% - 4- Control

However, the lowest signficant values of fruit weight loss were obtained with storage at 5 or8 º C compared with storage at 10 º C in both seasons.

Considering the interaction between the two studied factors (pre harvest treatments & storage temperatures) it is obvious that spraying trees with boric acid at 0.2 % followed by cold storage at 5 º C and 90% RH resulted in the lowest fruit weight loss in both seasons in all storage periods.

In this regard, Mohamed (1993) reported that Manfaloty pomegranate fruit treated with GA_3 gave the least value of weight loss during storage period. He added that those storage temperature as well as duration periods were found to be of clear effect on weight loss. The higher storage temperature or the longer shelf life had the greater loss in fruit weight in Manfaloty pomegranate.

3. Effect of treatments on fruit chemical properties: -

3.1. Soluble solids content percentage (SSC %):

Table (6) showed that the specific effect of both the pre-harvest treatments and cold storage temperatures was insignificant in the both seasons of study for the 6 studied storage periods (0.8488&12&16&20 weeks) except the spray with KH_2PO_4 and boric acid after 4 weeks storage where such treatments considerably decreased SSC% than the control regardless of storage temperatures.

Consequently, the interaction between the two studied factors was insignificant in all storage periods of the two considered seasons.

In addition, one can notice that changes in SSC % during different storage periods were somewhat little where they ranged between 15.40 after 4 weeks storage and 14.50 after 20 weeks storage. Such reduction in SSC% may be due to their consumption among respiration process as storage period proceed.

Different findings were reported by Al-Hmedawi (2003) who reported that when 8 year old pomegranate cv. Salimi trees were sprayed by GA at 100 and 150 mg/ liter GA showed significant increase in total soluble solids content.

3.2. Total sugars percentage: -

Tables (7) illustrate that treatments alone and their interaction failed to affect considerably total sugars % in fruit juice in all the storage periods of both seasons.

Table (6): Effect of some pre-harvest treatments, different cold storage degrees and their interaction on SSC % in fruits juice of Manfaloty pomegranate fruits, during 2006 and 2007 seasons.

Treat. **	Storage periods in weeks																			
	0	4				8				12				16				20			
	Temperature degrees storage.																				
		5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean
2006																					
1	14.90A	15.30a	15.40a	15.50a	**15.40AB**	15.40a	15.80a	15.80a	**15.67A**	15.70a	15.70a	16.00a	**15.80A**	15.10a	15.30a	15.50a	**15.30A**	-	14.60a	14.80a	**14.70A**
2	14.80A	14.80a	15.00a	15.50a	**15.10B**	15.20a	15.40a	15.60a	**15.40A**	15.40a	15.60a	15. 80a	**15.60A**	15.20a	15.20a	15.40a	**15.27A**	-	14.50a	14.70a	**14.60A**
3	14.80A	14.90a	15.10a	15.30a	**15.10B**	15.00a	15.30a	15.50a	**15.27A**	15.30a	15.50a	15.70a	**15.50A**	15.00a	15.00a	15.20a	**15.07A**	-	14.40a	14.60a	**14.50A**
4	15.60A	15.70a	15.80a	15.90a	**15.80 A**	15.80a	16.00a	16.40a	**16.07A**	16.00a	1590a	15.60a	**15.83A**	15.20a	14.90a	14.70a	**14.93A**	-	14.40a	14.10a	**14.25A**
Mean	**15.03A**	**15.18A**	**15.33A**	**15.55A**		**15.35A**	**15.63A**	**15.83A**		**15.60A**	**15.68A**	**15.78A**		**15.13A**	**15.10A**	**15.20A**		-	**14.48A**	**14.55A**	
2007																					
1	15.60A	16.00a	16.20a	16.40a	**16.20A**	16.20a	16.40a	16.60a	**16.40A**	16.00a	16.20a	16.30a	**16.17A**	15.70a	15.90a	16.00a	**15.87A**	-	15.50a	15.70a	**15.60A**
2	15.90A	16.20a	16.40a	16.60a	**16.40A**	16.30a	16.50a	16.70a	**16.50A**	16.10a	16.30a	16.40a	**16.27A**	15.70a	15.90a	16.10a	**15.90A**	-	15.60a	15.80a	**15.70A**
3	16.00A	16.20a	16.40a	16.60a	**16.40A**	16.50a	16.70a	16.90a	**16.70A**	16.10a	16.30a	16.40a	**16.27A**	15.90a	16.20a	16.30a	**16.13A**	-	15.90a	16.00a	**15.95A**
4	16.10A	16.40a	16.30a	16.40a	**16.37A**	16.60a	16.80a	16.90a	**16.77A**	16.20a	16.60a	16.70a	**16.50A**	15.80a	16.30a	16.50a	**16.20A**	-	16.10a	16.40a	**16.25A**
Mean		**16.20A**	**16.33A**	**16.50A**		**16.40A**	**16.60A**	**16.78A**		**16.10A**	**16.35A**	**16.45A**		**15.78A**	**16.08A**	**16.23A**		-	**15.78A**	**15.98A**	

Values followed by the same letter (s) in each period are not significantly different at 5 % level.

* Storage period at **5** °C was stopped after 16 weeks where percentage of discarded fruits reached 50 %

**Treatments: 1- GA_3 100 ppm - 2- KH_2Po_4 2% - 3- Boric acid 0.2% - 4- Control

Table (7): Effect of some pre-harvest treatments, different cold storage degrees and their interaction on total sugars % in fruit juice of Manfaloty pomegranate fruits stored at 5°, 8° and 10± 1°C and 90% RH, during 2006 and 2007 seasons.

Treat. **	Storage periods in weeks: 0				4				8				12				16				20			
	Temperature degrees storage:	5°C	8°C	10°C	Mean	5°C	8°C	10°C	Mean	5°C	8°C	10°C	Mean	5°C	8°C	10°C	Mean	5°C	8°C	10°C	Mean
2006																					
1	12.67A	13.01a	13.09a	13.18a	**13.09A**	13.09a	13.43a	13.43a	**13.32A**	13.35a	13.35a	13.60a	**13.43A**	12.84a	13.01a	13.18a	**13.01A**	-	12.41a	12.58a	**12.50A**
2	12.58A	12.58a	12.75a	13.18a	**12.84 A**	12.92a	13.09a	13.26a	**13.09A**	13.09a	13.26a	13.43a	**13.26A**	12.92a	12.92a	13.09a	**12.98A**	-	12.33a	12.50a	**12.41A**
3	12.58A	12.67a	12.84a	13.01a	**12.84 A**	12.75a	13.01a	13.18a	**12.98A**	13.01a	13.18a	13.35a	**13.18A**	12.75a	12.75a	12.92a	**12.81A**	-	12.24a	12.41a	**12.33A**
4	13.26A	13.35a	13.43a	13.52a	**13.43A**	13.43a	13.60a	13.94a	**13.66A**	13.60a	13.52a	13.26a	**13.46A**	12.92a	12.67a	12.50a	**12.69A**	-	12.24a	11.99a	**12.11A**
Mean	**12.77A**	**12.90 A**	**13.03 A**	**13.22 A**		**13.05A**	**13.28A**	**13.45A**		**13.26A**	**13.32A**	**13.41A**		**12.86A**	**12.84A**	**12.92A**		-	12.30A	12.37A	
2007																					
1	13.26A	13.60a	13.77a	13.94a	**13.77A**	13.77a	13.94a	14.11a	**13.94A**	13.60a	13.77a	13.86a	**13.74A**	13.35a	13.52a	13.60a	**13.49A**	-	13.18a	13.35a	**13.26A**
2	13.52A	13.77a	13.94a	14.11a	**13.94A**	13.86a	14.03a	14.20a	**14.03A**	13.69a	13.86a	13.94a	**13.83A**	13.35a	13.52a	13.69a	**13.52A**	-	13.26a	13.43a	**13.35A**
3	13.60A	13. 77a	13.94a	14.11a	**13.94A**	14.03a	14.20a	14.37a	**14.20A**	13.69a	13.86a	13.94a	**13.83A**	13.52a	13.77a	13.86a	**13.71A**	-	13.52a	13.60a	**13.56A**
4	13.69A	13.94a	13.86a	13.94a	**13.91A**	14.11a	14.28a	14.37a	**14.25A**	13.77a	14.11a	14.20a	**14.03A**	13.43a	13.86a	14.03a	**13.77A**	-	13.69a	13.94a	**13.81A**
Mean	**13.52A**	**13.77A**	**13.88A**	**14.03A**		**13.94A**	**14.11A**	**14.26A**		**13.69A**	**13.90A**	**13.98A**		**13.41A**	**13.66A**	**13.79A**		-	13.41A	13.58A	

Values followed by the same letter (s) in each period are not significantly different at 5 % level.

* Storage period at **5** °C was stopped after 16 weeks where percentage of discarded fruits reached 50 %

****Treatments: 1- GA_3 100 ppm - 2- KH_2Po_4 2% - 3- Boric acid 0.2% - 4- Control**

Meanwhile, total sugars % ranged between 13.89 after 4 weeks cold storage and 12.33 at the last storage period (20 week) regardless of the considered pre harvest treatments and cold storage temperatures in both season. Such reduction in total sugars content may be due mainly to their consumption in respiration process during cold storage periods.

3.3. Titratable acidity percentage in fruit juice:-

Table (8) indicated that different treatments failed to affect significantly the titratable acidity % of Manfaloty pomegranate fruits up to 12 week in cold storage in the two seasons regardless of the storage temperatures.

On the other hand, spraying trees with KH_2PO_4 at 2% proved to reduce acidity % of fruit juice in the last two periods of cold storage in both seasons.

Also, cold storage temperatures had no significant effect on acidity % after 16 weeks storage in the two studied seasons. Whereas, cold storage at 5º C for 8 and 12 weeks significantly reduced acidity % in both season than the higher degrees. In addition, storage at 8 ºC was better than at 10ºC when the storage period extended to 20 weeks. This is clearly shown regardless of the used pre harvest treatment.

The interaction between the two factors was insignificant up to 12 weeks storage in both seasons. On the other hand, fruits received KH_2PO_4 application and stored at 5 º C or8 º C and 90% RH for 20 weeks respectively showed significantly lower acidity %. In addition, the same pre harvest treatment followed by storage at 8 º C achieved the lowest acidity % after 20 weeks cold storage in the two seasons.

Titratable acidity % of fruit juice seemed to increase gradually among different storage periods up to 16 weeks, there after, it decreased. This is clearly shown in the two studied seasons. Such increment in acidity % was coincided with the steadily reduction in SSC and total sugars % at 8 º C.

3.4. SSC/ acid ratio in fruit juice:-

Table (9) indicated that different studied treatments failed to show significant differences in SSC/ acid ratio after 8 & 12 and 16 week cold storage in both seasons regardless of storage temperature. On the other hand, potassium phosphate spray significantly increased SSC/ acid ratio after 20 weeks cold storage in the 1st season only. Conversely, the three studied pre harvest sprays reduced considerably

Table (8): Effect of some pre-harvest treatments, different cold storage degrees and their interaction on titratable acidity in fruit juice of Manfaloty pomegranate fruits, during 2006 and 2007 seasons.

	Storage periods in weeks																			
	0	4				8				12				16				20		
Treat**.	Temperature degrees storage																			
		5 °C	8° C	10 °C	Mean	5 °C	8° C	10 °C	Mean	5 °C	8° C	10 °C	Mean	5 °C	8° C	10 °C	Mean	5 °C	8° C	10 °C	Mean
											2006										
1	0.704A	0.684a	0.592a	0.676a	**0.651A**	0.704a	0.680a	0.821a	**0.735A**	0.824a	0.863a	0.876a	**0.854A**	0.880b	0.952ab	0.992ab	**0.941AB**	-	0.800bc	0.924ab	**0.862A**
2	0.779A	0.704a	0.640a	0.592a	**0.645A**	0.832a	0.712a	0.825a	**0.790A**	0.888a	0.956a	0.900a	**0.915A**	0.868b	0.928ab	0.896b	**0.897B**	-	0.712c	0.992a	**B**
3	0.768A	0.640a	0.623a	0.555a	**0.600A**	0.736a	0.784a	0.848a	**0.789A**	0.833a	0.909a	0.975a	**0.906A**	0.896b	0.924ab	0.992ab	**0.937AB**	-	0.844abc	0.920ab	**0.852B**
4	0.768A	0.516a	0.651a	0.535a	**0.567A**	0.672a	0.808a	0.784a	**0.755A**	0.892a	0.848a	0.955a	**0.898A**	1.056a	0.956ab	0.908b	**0.973A**	-	0.940ab	0.992a	**0.882A**
Mean	**0.755A**	0.636A	**0.627A**	**0.590A**		**0.736B**	**0.746 AB**	**0.820A**		**0.859B**	**0.894 AB**	**0.927A**		**0.925A**	**0.940A**	**0.947A**		-	0.824B	0.957A	**B**
																					0.966A
											2007										
1	0.683A	0.663a	0.571a	0.655a	**0.630A**	0.683a	0.659a	0.800a	**0.714A**	0.803a	0.842a	0.855a	**0.833A**	0.859cd	0.931bc	0.971ab	**0.920AB**	-	0.779bc	0.903ab	**0.841B**
2	0.758A	0.683a	0.619a	0.571a	**0.624A**	0.811a	0.691a	0.804a	**0.769A**	0.867a	0.935a	0.879a	**0.894A**	0.847cd	0.907bc	0.875bc	**0.876B**	-	0.691c	0.971a	**0.831B**
3	0.747A	0.619a	0.602a	0.534a	**0.585A**	0.715a	0.763a	0.827a	**0.768A**	0.812a	0.888a	0.954a	**0.885A**	0.875bc	0.903bc	0.971ab	**0.916AB**	-	0.823abc	0.899ab	**0.861AB**
4	0.747A	0.495a	0.630a	0.514a	**0.546A**	0.651a	0.787a	0.763a	**0.734A**	0.871a	0.827a	0.934a	**0.877A**	1.035a	0.935abc	0.887bc	**0.952A**	-	0.919ab	0.971a	**0.945A**
Mean	**0.734A**	**0.615A**	**0.606A**	**0.569A**		**0.715B**	**0.725B**	**0.799A**		**0.838A**	**0.873A**	**0.906A**		**0.904A**	**0.919A**	**0.926A**		-	**0.803B**	**0.936A**	

Values followed by the same letter (s) in each period are not significantly different at 5 % level.

* Storage period at **5** °C was stopped after 16 weeks where percentage of discarded fruits reached 50 %

****Treatments: 1- GA_3 100 ppm - 2- KH_2Po_4 2% - 3- Boric acid 0.2% - 4- Control**

Table (9): Effect of some pre-harvest treatment, different cold storage tempe. and their interaction, on SSC/ acid ratio in juice of Manfaloty pomegranate fruits, during 2006 and 2007 seasons.

Treat**.	Storage periods in weeks: 0	4				8				12				16				20			
		Temperature degrees storage: 5 °C	8° C	10 °C	Mean	5 °C	8° C	10 °C	Mean	5 °C	8° C	10 °C	Mean	5 °C	8° C	10 °C	Mean	5 ° C	8° C	10 °C	Mean
										2006											
1	21.16 a	22.37 de	26.01 bcd	22.93 cde	**23.67 B**	21.88 abc	23.24 ab	19.24 abc	**21.32 A**	19.05 a	18.19 a	18.26 a	**18.49 A**	17.16 a	16.07 a	15.63 a	**16.25 A**	-	18.25 ab	16.02 bc	**17.14 AB**
2	19.00 c	21.02 e	23.44 cde	26.18 bc	**23.40 B**	18.27 c	21.63 abc	18.91 bc	**19.50 A**	17.34 a	16.32 a	17.56 a	**17.06 A**	17.51 a	16.38 a	17.19 a	**17.01 A**	-	20.37 a	14.82 bc	**17.59 A**
3	19.27 be	23.28 cde	24.24 b-e	27.57 ab	**24.92 B**	20.38 abc	19.52 abc	18.28 c	**19.34 A**	18.37 a	17.05 a	16.10 a	**17.11 A**	16.74 a	16.23 a	15.32 a	**16.07 A**	-	17.06 abc	15.87 bc	**16.47 AB**
4	20.31 ab	30.43 a	24.27 b-e	29.72 a	**27.85 A**	23.51 a	19.80 abc	20.92 abc	**21.29 A**	17.94 a	18.75 a	16.34 a	**17.63 A**	14.39 a	15.59 a	16.19 a	**15.34 A**	-	15.32 bc	14.21 c	**14.76 B**
Mean	**19.91 C**	**23.86 B**	**14.46 B**	**26.38 A**		**20.86 A**	**20.95 A**	**19.31 A**		**18.16 A**	**17.53 A**	**17.03 A**		**16.35 A**	**16.06 A**	**16.05 A**		-	**17.75 A**	**15.23 B**	
										2007											
1	22.84 A	24.13 ef	28.37 b-e	25.04 def	**25.85 B**	23.72 a	24.89 a	20.75 a	**23.12 A**	19.93 a	19.24 a	19.06 a	**19.41 A**	18.28 a	17.08 a	16.48 a	**17.28 A**	-	19.90 ab	17.39 b	**18.64 A**
2	20.98 B	23.72 f	26.49 def	29.07 a-d	**26.43 B**	20.10 a	23.88 a	20.77 a	**21.58 A**	18.57 a	17.43 a	18.66 a	**18.22 A**	18.54 a	17.53 a	18.40 a	**18.16 A**	-	22.58 a	16.27 b	**19.42 A**
3	21.42 B	26.17 def	27.24 c-f	31.09 abc	**28.17 AB**	23.08 a	21.89 a	20.44 a	**21.80 A**	19.83 a	18.36 a	17.19 a	**18.46 A**	18.17 a	17.94 a	16.79 a	**17.63 A**	-	19.32 ab	17.80 ab	**18.56 A**
4	21.55 B	33.13 a	25.87 def	31.91 ab	**30.30 A**	25.50 a	21.35 a	22.15 a	**23.00 A**	18.60 a	20.07 a	17.88 a	**18.85 A**	15.27 a	17.43 a	18.60 a	**17.10 A**	-	17.52 b	16.89 b	**17.20 A**
Mean	**21.7**	**26.79 B**	**27.00 B**	**29.28 A**		**23.10 A**	**23.00 A**	**21.03 A**		**19.23 A**	**18.78 A**	**18.20 A**		**17.56 A**	**17.50 A**	**17.57 A**		-	**19.83 A**	**17.09 B**	

Values followed by the same letter (s) in each period are not significantly different at 5 % level.

* Storage period at **5 °C** was stopped after 16 weeks where percentage of discarded fruits reached 50 %

****Treatments: 1- GA_3 100 ppm - 2- KH_2Po_4 2% - 3- Boric acid 0.2% - 4- Control**

SSC/ acid ratio in fruit juice after 4 week cold storage in both seasons as compared with the control. Also, storage temperature degree had no considerable effect on SSC/ acid ratio in the 2nd, 3 rd and 4th storage period in both seasons regardless of pre harvest treatment. On the other hand, storage at 10 º C for 4 week or at 8º C for 20 week proved to increase considerably SSC/ acid ratio in fruit juice in both seasons.

The interaction between the two studied factors was insignificant after 12 and 16 week cold storage in the 1st season as well as after 8 & 12 and 16 weeks cold storage in the 2nd season. On the contrary, KH_2PO_4 spray followed by storage at 8ºC and 90% RH for 20 week showed the significantly greatest ratio in the 1 st season.

Regarding the changes in SSC/ acid ratio during cold storage period, it is apparent that it was (26.38& 29.28) after 4 week storage and steadily decreased up to 16 week (16.35 & 17.57) , thereafter it raised (17.75& 19.83, respectively) after 20 week period.

Such reduction in SSC/ acid ratio mainly due to the consumption of sugars and raise of acids during prolonged periods of cold storage as a result of respiration process.

Also, cold storage temperature, failed to affect considerably SSC / acid ratio after 8 week and up to 20 week of cold storage, regardless of pre harvest treatments in both seasons. On the other hand, fruit storage at 10º C and 90% RH for 4 week, significantly reduced SSC / acid ratio in both seasons.

In this respect, Hanafy *et al*. (2008) noted that TSS/ acid ratio increased significantly during storage period at the three different storage temperatures (2, 8 and 2+8º C). Navel orange fruits stored at 2º C had the lowest percentage of TSS/ acid ratio followed by 2+8º C and then 8º C.

3.5. Total anthocyanin percentage in fruit juice: -

Table (10) clearly indicates that spraying trees with potassium phosphate or boric acid significantly increased anthocyanin % in fruit juice than other treatments. This is clearly shown in all the studied storage periods of both seasons regardless of storage temperature.

Storage temperature had no considerable effect in the first storage period of the 1st season as well as the 1st, 2nd, 4th and 5th periods of the second season, regardless of the used pre harvest treatment. On the other hand, fruit storage at 8ºC and 90 % RH

Table (10): Effect of some pre-harvest treatments, different cold storage degrees and their interaction on anthocyanin % in fruit juice of Manfaloty pomegranate fruits, during 2006 and 2007 seasons.

Treat**.	Storage periods in weeks: 0				4				8				12				16				20			
	Temperature degrees storage	5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean
2006																					
1	0.266a	0.309b	0.454ab	0.376ab	**0.380B**	0.428cd	0.481bcd	0.409cd	**0.439B**	0.451c	0.539c	0.489c	**0.493B**	0.554cde	0.735ab	0.530cde	**0.606B**	-	0.829abc	0.624d	**0.727B**
2	0.392a	0.440ab	0.611a	0.506ab	**0.519A**	0.458bcd	0.612ab	0.549abc	**0.540A**	0.468c	0.829a	0.693ab0	**0.663A**	0.686abc	0.842a	0.757ab	**0.762A**	-	0.942ab	0.890ab	**0.916A**
3	0.289a	0.424ab	0.487ab	0.435ab	**0.449AB**	0.467bcd	0.669a	0.469bcd	**0.535A**	0.549bc	0.773a	.551bc	**0.624A**	0.665bc	0.838a	0.615bcd	**0.706A**	-	0.973a	0.761bcd	**0.867A**
4	0.291a	0.366ab	0.394ab	0.315b	**0.358B**	0.378d	0.442cd	0.365d	**0.395B**	0.467c	0.506bc	0.434c	**0.469B**	0.484de	0.677bc	0.436e	**0.532B**	-	0.682cd	0.567d	**0.625B**
Mean	**0.31A**	**0.385A**	**0.487A**	**0.408A**		**0.433B**	**0.551A**	**0.448B**		**0.484B**	**0.662A**	**0.542AB**		**0.597B**	**0.773A**	**0.585B**		-	**0.857A**	**0.711B**	
2007																					
1	0.197A	0.293cde	0.326b-e	0.240e	**0.286B**	0.312d	0.349cd	0.367cd	**0.343C**	0.417de	0.518cde	0.508cde	**0.481BC**	0.511de	0.561cde	0.517de	**0.530C**	-	0.614 c	0.558c	**0.586B**
2	0.311A	0.319b-c	0.493ab	0.419a-d	**0.410A**	0.427bcd	0.499abc	0.469a-d	**0.465B**	0.511cde	0.609abc	0.590bcd	**0.570B**	0.620b-e	0.694a-d	0.680a-e	**0.665B**	-	0.872a	0.887a	**0.880A**
3	0.438A	0.500a	0.465abc	0.545a	**0.503A**	0.614a	0.578ab	0.606a	**0.599A**	0.717ab	0.772a	0.614abc	**0.701A**	0.770ab	0.817a	0.752abc	**0.780A**	-	0.899a	0.837ab	**0.868A**
4	0.215A	0.299cde	0.260de	0.315b-e	**0.291B**	0.315d	0.493a-d	0.353cd	**0.387**	0.389e	0.526cde	0.434cde	**0.450C**	0.491e	0.566cde	0.611b-e	**0.556C**	-	0.648c	0.668bc	**0.658B**
Mean	0.29A	0.353A	0.386A	0.380A		0.417A	**0.480A**	**0.449A**	**BC**	**0.509B**	**0.606A**	**0.537 AB**		**0.598A**	**0.660A**	**0.640A**		-	**0.758A**	**0.738A**	

Values followed by the same letter (s) in each period are not significantly different at 5 % level.

* Storage period at **5** °C was stopped after 16 weeks where percentage of discarded fruits reached 50 %

****Treatments: 1- GA_3 100 ppm - 2- KH_2Po_4 2% - 3- Boric acid 0.2% - 4- Control**

significantly raised anthocyanin % in fruit juice after 8 & 12 & 16 and 20 week in the first season and after 12 week only in the second one.

The interaction between the two studied factors was significant in both seasons where the pre harvest spray with either KH_2PO_4 or boric acid followed by cold storage at 8 ºC considerably increased anthocyanin percentage in fruit juice in the five studied storage periods in both seasons.

In general, anthocyanin percentage in fruit juice seemed to increase gradually as cold storage period proceed in both seasons.

In this regard, Meshrake (1999) found that when Anna apple sprayed by potassium green (35% K_2O) at 0.15%, the highest anthocyanin % was recorded with K treatment. In addition, anthocyanin percentage was increased with storage periods; the highest content of anthocyanin was recorded after 75 days of storage while control treatment gave the lower anthocyanin percentage.

3.6. Fruit shelf life period (in weeks):-

Table (11) indicates that control Manfaloty fruits showed generally the shortest shelf life all over the tested periods, whereas trees sprayed with GA_3 at 100 ppm gained fruits with the longest shelf life which attained 2.3 weeks after 20 weeks of cold storage regardless of cold storage degree.

As for the effect of different studied temperatures degrees, one can notice that there were no significant differences after 4 and 12 weeks of cold storage, regardless of the studied pre harvest treatments in the 1st season. Cold storage at 8ºC was better than both at 5 or 10 ºC after 16 weeks storage. But there were no significant differences between 8ºC and 10 ºC after storage for 8 or 20 weeks, regardless of the pre harvest treatment.

Concerning the interaction between the two studied factors it is obvious that fruit harvested from trees sprayed with GA_3 at 100 ppm and cold stored at 10 ºC achieved the longest shelf live after different periods of cold storage except the 16 week period. On the other hand, control fruits showed the shortest shelf life especially when they were cold stored at 5 ºC or 10 ºC and they failed to complete the storage at 5 ºC longer than 16 weeks

As for the second season, it is clear that shelf life was longer in all treatments than the control except the least storage period and the highest value of shelf life was recorded by fruits treated with GA_3 at

Table (11): Effect of some pre-harvest treatments, different cold storage degrees and their interaction on shelf life in weeks of Manfaloty pomegranate fruits, during 2006 and 2007 seasons.

Treat. **	Storage periods in weeks																			
	0	4				8				12				16				20			
	Temperature degrees storage																				
		5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean	5 °C	8 °C	10 °C	Mean
2006																					
1	6.0 a	4.0 c	4.0 c	5.0 a	**4.3 A**	4.0 b	4.0 b	5.0 a	**4.3 A**	4.0 a	3.5 a	4.0 a	**3.8A**	2.5 bc	3.5a	3.0b	**3.0A**	-	2.0a	2.5 a	**2.3 A**
2	5.5 ab	4.5 b	4.0 c	4.0 c	**4.2 AB**	4.0 b	4.0 b	4.0 b	**4.0 A**	4.0 a	3.5 a	3.5 a	**3.7A**	3.0 b	3.0b	3.0b	**3.0A**	-	2.0a	2.0 a	**2.0 A**
3	5.0 b	4.0 c	4.0 c	4.0 c	**4.0 BC**	4.0 b	4.0 b	4.0 b	**4.0 A**	4.0 a	4.0 a	3.5 a	**3.8A**	3.0 b	3.5a	3.0b	**3.1A**	-	2.5a	2.0 a	**2.3 A**
4	4.0 c	4.0 c	4.0 c	3.5 d	**3.8 C**	3.0 c	3.5 bc	3.5 bc	**3.3 B**	3.0 a	3.0 a	3.0 a	**3.0A**	2.0 c	2.5bc	2.5bc	**2.3B**	-	1.0b	2.0 a	**1.5 B**
Mean	**5.1A´**	**4.1 A´**	**4.0 A´**	**4.1 A´**		**3.8 B´**	**3.9 AB´**	**4.1 A´**		**3.8 A´**	**3.5 A´**	**3.5 A´**		**2.5C´**	**3.1A´**	**2.9B´**		-	**1.9A´**	**2.1 A´**	
2007																					
1	5.0 a	4.0 c	4.0 c	5.0 a	**4.3 A**	4.0 b	4.0 b	4.5 a	**4.2 A**	4.0 a	4.0 a	4.0 a	**4.0 A**	3.0 b	3.0 b	4.0 a	**3.3 B**	-	2.0 b	2.0 b	**2.0 B**
2	4.5 a	4.0 c	4.0 c	4.0 c	**4.0 C**	4.0 b	4.0 b	4.0 b	**4.0 B**	3.0 b	3.0 b	4.0 a	**3.3 C**	2.5 c	3.0 b	4.0 a	**3.2 C**	-	2.0 b	2.0 b	**2.0 B**
3	5.0 a	4.0 c	4.5a	4.0 c	**4.2 B**	4.0 b	4.0 b	4.0 b	**4.0 B**	3.0 b	4.0 a	4.0 a	**3.7 B**	2.5 c	4.0 a	4.0 a	**3.5 A**	-	2.0 b	3.0 a	**2.5 A**
4	4.0 a	4.0 c	4.0 c	4.0 c	**4.0C**	3.5 c	3.5c	4.0 b	**3.7 C**	2.5 c	3.0 b	3.0 b	**2.8 D**	2.0 d	2.0 d	2.5 c	**2.2 D**	-	2.0 b	2.0 b	**2.0 B**
Mean	**406A´**	**4.0 C´**	**4.1 B**	**4.3A´**		**3.9 B´**	**3.9 B´**	**4.1 A´**		**3.1 C´**	**3.5 B´**	**3.8 A´**		**2.5 C´**	**3.0B**	**3.6 A**		-	**2.0 A´**	**2.3 A´**	

Values followed by the same letter (s) in each period are not significantly different at 5 % level.

* Storage period at **5 C´** was stopped after 16 weeks where percentage of discarded fruits reached 50 %

****Treatments: 1- GA_3 100 ppm - 2- KH_2Po_4 2% - 3- Boric acid 0.2% - 4- Control**

100 ppm in the first 3 storage periods and boric acid in other periods. While the lowest value of shelf life was recorded by the untreated fruits after 20 weeks of storage (2.0 week).

Regarding the effect of storage temperature, significant differences were observed between the used storage temperatures. Where, fruits stored at 10±1ºC recorded the highest value of shelf life compared with fruits stored at 5±1ºC or 8±1ºC in all the studied storage periods.

Concerning the interaction between the two studied factors, it is clear that pre harvest spray with GA_3 followed by cold storage at 10ºC achieved the significantly longest shelf life after storage up to 16 weeks whereas, boric acid spray + cold storage at 10ºC gave the same result after 20 weeks of cold storage.

The aim of this study was to evaluate the influence of various pre-harvest and post-harvest treatments on the storability of pomegranates.

The fruits were treated with GA_3 100ppm, boric acid at 0.2% and potassium ortho diphosphat (KH_2PO_4) at 2% in the pre harvest experiment, and treated with wax and hot water in the post harvest experiment. Both treated and untreated fruits (control) were stored at 5±1°C or 8±1°C or 10±1°C and 90% RH. Samples of fruits of all treatments were taken at one month intervals for a whole storage period of 20 weeks (5 month). Samples of fruits of all treatments were taken at one month intervals for a whole storage period of 20 weeks (5 month).

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تأثير بعض معاملات ما قبل الجمع على المحصول ونسبة التشقق و القدرة التخزينية لثمار الرمان المنفلوطى

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أجريت هذه الدراسة خلال موسمي 2006 ، 2007 على ثمار الرمان صنف المنفلوطى (*Punica granatum* L.) بمزرعة خاصة بقرية البستان – محافظة البحيرة – جمهورية مصر العربية

لدراسة تأثير بعض معاملات ما قبل الجمع على بعض صفات الجودة للثمار عند الجمع و أثناء التخزين بهدف تحسين صفات ثمار الرمان وتقليل الفاقد منها أثناء وجودها على الأشجار وبعد الجمع حيث قسمت الأشجار إلى أربعة مجاميع عشوائية (كل مجموعة تحتوى على ثلاث مكررات) ورشت كل مجموعة مرتين (الأولى بعد أسبوعين من الإزهار الكامل والثانية بعد 6 أسابيع من موعد الرش الأول) وذلك بأحد المركبات التالية:- الرش بمحلول حمض الجبرليك بتركيز 100 جزء في المليون.

الرش بمحلول فوسفات البوتاسيوم بتركيز 2%.

الرش بمحلول من حمض البوريك بتركيز 0.2% .

المقارنة تم رش الأشجار بماء الصنبور

جمعت الثمار عند اكتمال النمو (ثمار كل معاملة على حده) و نقلت مباشرة إلى معمل بحوث تداول الفاكهة حيث أجريت عليها عمليات الفرز النهائي والتعبئة في عبوات التخزين (عبوات من الكرتون سعتها 6 كجم) والتخزين على درجات حرارة 5 أو 8 أو10 ±1 °م ورطوبة نسبية90 % .

أخذت عينات عشوائية من ثمار كل معاملة وقت الجمع ثم كل 4 أسابيع و حتى 20اسبوع لدراسة التغيرات الطبيعية والكيميائية التي تحدث للثمار أثناء التخزين المبرد وخلال فترة العرض.

ويمكن تلخيص أهم نتائج هذه الدراسة كما يلي :-

1- جميع المعاملات المستخدمة أعطت نسبة تشقق اقل من المقارنة وتعتبر اقل نسبة تشقق تحصل عليها من معاملة الأشجار بحمض الجبرليك بتركيز 100 جزء في المليون.كما ادى رش أشجار الرمان المنفلوطى بحمض الجبرليك بتركيز 100 جزء في المليون أو حمض البوريك بتركيز 0.2% الى زيادة معنوية في كمية المحصول في موسمي الدراسة.

2- ادت المعاملة بفوسفات البوتاسيوم أو حمض الجبرليك إلى زيادة درجة اللون الأحمر في حبات الرمان المنفلوطى في الموسم الأول فقط.

3- المعاملة بحمض الجبرليك أو حمض البوريك أدت إلى زيادة وزن و حجم الثمار و كذلك وزن البذور - وزن العصير والقشرة عن باقي المعاملات تحت الدراسة بينما لم تؤثر أي معاملة على طول أو قطر أو شكل الثمار أو النسبة المئوية للعصير في الصنف المنفلوطى

4- لم تسجل أي فروق معنوية بين المعاملات تحت الدراسة في تأثيرها على نسبة المواد الصلبة الذائبة أو السكريات الكلية أو الحموضة أو الأنثوسيانين عند الجمع في حين إن المعاملة بحمض الجبرليك (100 جزء في المليون) أدت إلى زيادة محتوى الثمار من حمض الاسكوربيك و نسبة المواد الصلبة الذائبة إلى الحموضة

أدت معاملة أشجار الرمان المنفلوطى بحمض الجبرليك (100 جزء في المليون) إلى زيادة فترة عرض الثمار(shelf life) عن باقي المعاملات(5 – 6 أسابيع)

5- أدى رش الأشجار قبل الجمع بالبوريك أسد 0.2% متبوعا بالتخزين البارد على 10 °م و90% رطوبة نسبية الى زيادة فترة تخزين للثمار حتى 20 أسبوع.