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Effect of Pre-harvest Treatments (Gibberellic Acid and Biofertilizers) and Postharvest Treatments on Fruit Characteristics of Egypt Lime (*Citrus aurantifolia*) During Cold Storage

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ABSTRACT

The study was conducted to investigate the effect of organic fertilization, biological fertilization and spraying gibberellic acid on the properties and behavior of the fruits of Egypt lime through some cold storage treatments during the 2003-2004 seasons. Trees were treated with one of the following treatments during growth season: A) organic fertilizer as control trees, B) Organic fertilizer with biofertilizer phosphorine, and C) Organic fertilizer with biofertilizer phosphorine after fruit set plus gibberellic acid (20 ppm)sprayed 2 weeks before harvest date. The fruits of each field treatments were treated with one of following treatments: 1) Packaging fruits in polyethylene bags perforated, 2) dipping fruits in GA_3 50 ppm,3) dipping fruits in Sida film 5%,4) dipping fruits in (GA_3 50 ppm, with Sida film 5%),5) wrapped in Silk paper,6) dipping the fruits in (GA_3 50 ppm) then wrapping ,7) dipping the fruits in a (SIDA film 5%) then wrapping and 8) dipping in (GA_3 50 ppm +Sida film 5%) then wrap.

The results showed that fruit treated with phosphorine +GA_3 during growth season induced the highest weight, volume, rag weight. Apply phosphorine plus spray GA_3 20 ppm during the growing season as well as dipping fruits in Sida film5% + GA_3 50 ppm were more effective in decreasing weight loss%, gave the lowest percentage of unmarketable fruits weight, resulted in the highest level of juice weight %, the highest level of TSS%, the lowest level of TA%, the highest value in vitamin C content in juice of stored fruit, keep good fruit quality and prolong cold storage period.

Key words:

INTRODUCTION

Citrus is the most important fruit crop in Egypt, as far as its acreage, production and exporting potential are concerned. The economic value put citrus fruit on the top of all other important fruit crops in Egypt. Egyptian area of lemons and lime is equal to 0.0211% of world area. On the other hand, Egyptian production of lemons and limes is equal to 1.20% of world production of lemons and limes as reported by the F A O (2004). Egyptian lime is considered as the favorite fruit crop in Egypt and it's considered as one of the important source of citric acid. They can grow under different environmental conditions and soil types. One of the important tools to increase its yield is the phosphorus fertilization. Egyptian soils having alkaline pH are low in their available P that approximately 90-95% of P occurring as unavailable form; it is thought that P biofertilizers are of the almost important for plant production and soil fertility as they improve the biological, physical and chemical properties of soils (Abd el- Rahman, 2002).

Growth regulators were used with film- forming or without wax emulsion to eliminate decay and to improve quality of citrus fruits during cold storage (Farag ,2001). El-Hammady *et al.*(2000)found that all preharvest treatments with GA_3 were effective in reducing weight loss% compared to control Balady mandarin fruits at 5 ^{0}C. Fruit wrapping decreased weight loss during storage period on Orablanco fruit (Citrus grandis L.xC. paradisimacr) (Rodov *et al.*, 2001).Therefore, the objectives of this study were comparing the effectiveness of some field treatments applied during growth seasons, i.e. farmyard manure, farmyard manure+phosphorine and farmyard manure+ phosphorine +GA_3. As well as some storage treatments wrapping, GA_3, Sida film with or without GA_3 in order to extend storage period and enhance physical and chemical properties of Egyptian Lime fruits at harvest and during cold storage.

MATERIALS AND METHODS

This study was carried out on Egyptian Lime grown at the Experimental Orchard, Faculty of Agriculture, Assuit University in 2003 and 2004 seasons. Trees were seedy and planted at 3.5x3.5 meters a part. Trees were treated with one of the following treatments during growth season: organic and bio-fertilizers were applied to the selected trees as follows:

1- Organic fertilizer (Farmyard manure) as control in the middle of December (50 kg /tree).

2- Organic fertilizer (Farmyard manure) + bio-fertilizer phosphorine (phosphate dissolving bacteria, *Bacillus megaterium*) (100 g/ tree) after fruit set.

3- Organic fertilizer (Farmyard manure)+ bio-fertilizer (phosphorine) after fruit set +GA_3 (20 ppm) sprayed 2 weeks before harvest date. The fruits were handpicked and carefully were brought soon to Postharvest Laboratory, Agriculture Research Station when color of fruit was yellowish green skin, and juice percentage fruit was approximately 37%-40% as an indicator of commercial fruit harvest standard. Mature fruit samples were taken for physical and chemical characteristics determination at harvest time (Weight, volume, rag weight %, juice weight, TSS %, TA %, TSS/TA ratio and Vitamin C). The other samples

were divided into 8 equal groups; each of these was treated with one of the following treatment:

a- Washing under tab water and then packing in perforated polyethylene bags
b- Dipping for 5 minutes in GA_3(50ppm) and then were packing.
c- Dipping for 5 minutes in Sida film 5% (wetting agent and surfactant compound, registered under No.(072) and then were packing
d- Dipping for 5 minutes in GA_3 (50ppm) with Sida film 5% and then were packed and stored
e- Washing and wrapping in silk paper then were packed perforated polyethylene bags
f- Dipping for 5 minutes in GA_3 (50ppm) and were wrapped and packed.
g- Dipping for 5 minutes in Sida film 5% and were wrapping and packing.
h- Dipping for 5 minutes in GA_3 (50ppm) with Sida film 5% and then wrapping and packing.

All the groups were stored at 7-10°C and 80-85% R.H and the following determination were carried out biweekly interval period through cold storage:

1- physical characteristics :
1-1- Fruit weight loss percentage
1-2- Fruit number unmarketable percentage
1-3- Juice weight percentage/fruit

2- Chemical fruits characteristics:
2-1 Total soluble solids percentage (TSS): was determined by a hand refractometer
2-2- Titratable acidity according to the A.O.A.C. (1985)
2-3- Total soluble solids/ acidity ratio (TSS/Acid ratio)
2-4- Ascobic acid (V.C.) content according to the A.O.A.C. (1985)

Statistical Analysis:

Means were compared by the L.S.D. value at 5% level (Snedecor and Cochran,1990).

RESULTS

1- Effect of pre-harvest treatments of organic fertilizer, phosphorine plus GA_3 on fruit physical characteristics at harvest time:

1-1- Weight and volume of mature limes:

As shown in Table (A) it is clear that both of phosphorine or phosphorine plus GA_3 (20 ppm) applied at 2 weeks pre-anticipated harvest date resulted in significant increase of fruit weight and volume in both seasons. This positive influence of phosphorine might be due to improving uptake of nutrients specially phosphate. The positive effect of GA_3 could be attributed to enhancement effects of GA_3 in cell division and enlargement at pre-mature stage. These results are in harmony with those found by Tawfiek and Gamal(2000) and Gamal and Ragab(2003) on Balady mandarin.

1-2- Percentage of rag weight and juice weight:

Appling phosphorine to organically fertilized lime trees resulted in significant decrease in rag weight %. On the other hand, spraying GA_3 (20ppm) 2 week at pre-anticipated harvest time induced significant increase in rag weight%. It could be observed that phosphorine caused an improve in juice weight %. While, spraying GA_3 induced reduction in juice weight % of mature fruits. These effects of GA_3 could be due to delaying maturity degree of lime and decreasing juice %. These results are in harmony with those found by Tawfiek and Gamal (2000) and Attia *et al.*(2002).

2- Effect of pre-harvest treatments of organic fertilizer, phosphorine plus GA3 on fruit chemical characteristics at harvest time:

2-1- Total soluble solids% (TSS %)

It could be noticed that treated fruits with phosphorine induced the highest level of TSS% in first season, while organic fertilizer gave the highest level of TSS% in second season (Table A). These results are in agreement with those reported by Tawfiek and Gamal (2000) and Gamal and Ragab(2003)on balady mandarin

2-2- Titratable Acidity% (TA %)

Data in Table (A) showed that fruits treated with phosphorine plus GA_3 during growth season induced the highest level of TA% in 2003 while organic fertilizer gave highest level in 2004 season, these results are in agreement with those found by Gamal and Ragab(2003).

2-3- TSS/TA ratio

As shown in Table (A) treated fruits with phosphorine induced the highest level of TSS/TS ratio in both season. the obtained results are in agreement with those of Ibrahim *et al.* (1994)they found that the application of GA_3 increased TSS/acid ratio on Washington Navel orange.

2-4- Vitamin C content in fruit juice

During the first season it was noticed that GA3 gave the highest level of vitamin C, while during the second season, it was found that organic fertilizer alone gave the highest level. These results are in agreement with those reported by Gamal and Ragab (2003) on Balady mandarin.

3- Effect of storage treatments on physical characteristics of Egyptian Lime fruits treated with phosphorine or phosphorine plus GA_3 applied during growth season:

3-1 Fruit weight loss percentage

Fruit weight loss % increased gradually as storage period advanced, data presented in Table (1) indicated that wrapping fruits gave the least percentage of loss in comparison with unwrapped fruits (control fruits) or unwrapped fruits treated with GA_3 or Sida film.

Table (A): Effect of pre-harvest treatments with organic fertilizer phosphorine and phosphorine plus GA_3 (20ppm) on physical and chemical characteristics of Egypt Lime fruits in 2003 and 2004 seasons

Season	Field treatments	Fruit weight (g)	Fruit volume (cm_3)	Reg weight%	Juice weight%	TSS%	Titrable acidity%	TSS/TA ratio	V.C in juice mg/100 ml
2003	Organic fertilizer	20.30^{C}	19.50^{C}	60.60^{B}	39.40^{B}	9.20^{B}	7.70^{B}	1.19^{B}	27.63^{B}
	Organic fertilizer + phosphorine	25.68^{B}	25.33^{B}	59.04^{C}	40.06^{A}	9.27^{A}	7.63^{C}	1.21^{A}	25.18^{C}
	Organic fertilizer + phosphorine + GA3 (20 ppm)	27.76^{A}	27.00^{A}	61.85^{A}	38.15^{C}	9.13^{C}	7.78^{A}	1.17^{B}	35.41^{A}
2004	Organic fertilizer	21.95^{C}	21.00^{C}	58.18^{B}	41.82^{B}	9.67^{A}	9.55^{A}	1.01^{B}	33.53^{A}
	Organic fertilizer + phosphorine	26.56^{B}	26.20^{B}	56.72^{C}	43.28^{A}	9.00^{C}	9.36^{B}	1.07^{A}	28.77^{C}
	Organic fertilizer + phosphorine + GA3 (20 ppm)	30.46^{A}	29.00^{A}	58.66^{A}	41.34^{C}	9.33^{B}	9.03^{C}	1.03^{B}	29.47^{B}

Mean separation by L.S.D at 0.0

Table (1): Average changes in weight loss% during cold storage of Egyptian Lime fruits treated with phosphorine and phosphorine+GA_3 (20ppm)applied through growth season as affected by storage treatments in 2003 and 2004 seasons

Storage treatment	Average of storage periods							
	2003				2004			
	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments
1- unwrapped fruits(control)	19.95	18.1	19.22	19.09 B	19.26	18.48	19	18.91 C
2-unwrapped+GA3	22.58	20.38	20.17	21.04 A	24.09	20.83	21.19	22.04 A
3-unwrapped+Sida film	18.53	18.83	18.6	18.65 C	19.23	19.8	19.24	19.42 B
4-unwrapped+GA3+Sida film	18.2	17.84	17.86	17.97 D	18.84	18.05	17.85	18.25 D
5-wrapped fruits	16.67	17.49	14.26	16.14 E	18.9	16.76	14.37	16.69 E
6-wrapped+GA3	14.27	12.93	14.26	13.82 F	14.67	12.8	14.22	13.86 F
7-wrapped+Sida film	14.01	14.59	10.46	13.02 G	15.84	13.92	10.67	13.48 G
8-wrapped+GA3+Sida film	13.67	10.13	11.57	11.79 H	13.85	10.82	11.77	12.15 H
Average of storage periods	17.24A	16.29 B	15.80 C	16.44	18.09 A	16.44 B	16.05 C	16.86

Mean separation by L.S.D at 0.05

It was found that wrapping fruits treated with GA_3 plus Sida film was more effective in decreasing weight loss % than treating with GA_3 or Sida film alone. Stored fruits treated with phosphorine plus GA_3 during growth season resulted in the lowest level of weight loss % (15.80, 16.05%) followed by phosphorine (16.29, 16.44%), while untreated control fruits gave the highest level of weight loss % (17.24, 18.09%). Furthermore, unwrapped fruits treated with GA_3(50ppm pre-storing) gave the highest level of weight loss% (20.04, 22.04%), while wrapped fruits treated with GA_3 (50ppm) plus Sida film (5%pre-storing)resulted in the lowest level of weight loss % (11.79,12.15%)under the condition of cold storage in two season, respectively.

These obtained results are in harmony with those found by Attia *et al.* (1996) on Banzahir and Houssini Lime, Ladaniya *et al.* (1997) on Nagpur Mandarin ,Subedi(1999)on Mandarin and Oranges, Sonkar and Ladaniya (1999)on Mandarin ,Tariq *et al.* (2002) on Banzahir Limes.

3-2- Unmarketable fruit number percentage:

It could be noticed that unmarketable fruit number increased gradually as storage period advanced. Unwrapped fruits and unwrapped fruits plus Sida film gave the highest percentage of unmarketable fruit number%. Table (2), wrapped fruits +Sida film 5%+GA3 (50ppm pre-storage) gave the lowest unmarketable fruit number (11.72, 14.86%). Fruits treated with phosphorine plus GA3 (20ppm) during growth season resulted in the lowest values of unmarketable fruit number (8.12, 8.60%), while treated fruits with phosphorine gave the highest level of unmarketable fruit number (26.85,26.20%) in two season, respectively. These results are in harmony with those found by El-Mughrabi(1999) on Baladi orange, El-Hammady *et al.* (2000) on Balady Mandarin, and El-Helaly (2002) on Banzahir Limes.

3-3- Fruit Juice weight%:

Fruit Juice weight percentage gradually decreased with prolonged storage duration. It could be noticed that fruit treated with phosphorine during growth season resulted in the highest level of juice weight %,(40.86, 42.99%), table (3). It was also found that wrapped fruit gave the highest value of juice weight %(40.71, 42.71%). Wrapped fruits treated with phosphorine +GA3 (50ppm pre-storing) plus Sida film resulted in the highest level of juice weight %(43.67, 46.33%) in the two studied seasons. These obtained results are coincided with those found by El-Mughrabi (1999) on Balady orange and Farag(2001) on Navel orange.

4- Effect of some storage treatments on chemical characteristics of Egyptian lime fruits treated with phosphorine or phosphorine plus GA_3 applied during growth season

4-1- Total Soluble Solids% (TSS %)

TSS% gradually increased with prolonging storage period. However, it was clear that storage treatments induced slight differences in TSS% in fruit juice under the conditions of cold storage Data presented in Table (4) indicated that wrapping fruits treated with GA_3 (50ppm pre-storing) plus Sida film resulted in the highest values of TSS% (10.49,10.41%) in two season, respectively. Moreover, fruits treated with phosphorine during growth season induced the highest level of TSS %(10.23%) in juice of pre-stored fruits during cold storage in 2003 season, while fruits treated with phosphorine plus GA_3 (20ppm) during growth season produced the highest level of TSS %(10.58%) in juice of stored fruits in 2004 season. These obtained findings are in harmony with those reported by Farag (2001) who reported that TSS% on Navel oranges treated with GA did not differ greatly than those of untreated ones. Meanwhile, El-Helaly (2002) on Banzahir Limes obtained that waxed fruits had lower values of TSS%.

4-2-Titratable acidity% (TA %) in fruit juice:

All storage treatments reduced TA% in Lime juice, and the reduction was associated with prolonging storage period duration. Table (5) observed that treated fruits with phosphorine plus GA_3 (20ppm) produced the lowest level of TA% (6.65, 8.20%) in juice of stored fruits during the two studies season. Moreover, it could be noticed that both of unwrapped control (6.90, 9.11%) or unwrapped fruits treated with Sida film resulted the highest level of TA %(7.36, 8.64%) in juice in two season respectively. While, unwrapped fruit treated with GA_3 (50ppm pre- storage) gave the lowest level in TA% (6.75%) in 2003. Also, wrapped fruits treated with GA_3 (50 ppm pre-storage) gave the lowest level of TA %(8.37%) in juice of stored fruit during season 2004. Those results are in partical agreement with those found by El-Mughrabi(1999) on Baladi orange and El-Helaly (2002) on Banzahir Limes fruits, they reported that waxed fruit treated with or without GA generally had the least percentage of citric acid than those of the other applied treatments.

4-3- Total soluble solids/ titratable acidity ratio (TSS/TA ratio) in fruit juice:

TSS/TA ratio increased gradually as storage period advanced. As shown in Table (6) data indicated that fruits treated with phosphorine plus GA_3 (20ppm) gave the highest value of TSS/TA ratio (1.51, 1.29%) in juice. Wrapped fruits treated with or without GA_3 + Sida film induced the highest level of TSS/TA (1.49, 1.25%) ratio, meanwhile, unwrapped fruits (control) gave the least value (1.42, 1.19%) in both seasons, respectively. These obtained results are in harmony with those findings reported by Farag (2001)

4-4- Vitamin C content in fruit juice:

Data presented in Table (7) indicated that phosphorine plus GA_3 (20ppm) induced slight differences in response to effect of some storage treatment during cold storage in the two studied season. It could be noticed that

Table (2): Average changes in unmarketable fruits number% during cold storage of Egyptian Lime fruit treated with phosphorine and phosphorine + GA_3 (20ppm)applied through growth season as affected by storage treatments in 2003 and 2004 seasons

Storage treatment	Average of storage periods							
	2003				2004			
	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments
1- unwrapped fruits(control)	16.42	34.33	27.32	26.02^{A}	19.78	36.83	27.32	27.98^{B}
2-unwrapped+GA3	11.88	32.84	29.91	24.88^{C}	14.67	34.78	30.76	26.74^{C}
3-unwrapped+Sida film	14.71	31.08	30.39	25.39^{B}	17.18	34.33	33.48	28.33^{A}
4-unwrapped+GA3+Sida film	11.46	30.36	31.77	24.53^{C}	13.44	31.73	32.8	25.99^{D}
5-wrapped fruits	13.17	25.62	10.71	16.68^{E}	16.08	22.94	11.74	16.92^{F}
6-wrapped+GA3	15.48	2305	11.86	16.80^{E}	17.07	19.2	12.98	16.42^{G}
7-wrapped+Sida film	22.03	25.98	11.13	19.71^{D}	27.16	22.94	11.63	21.24^{E}
8-wrapped+GA3+Sida film	15.48	11.56	8.12	11.72^{F}	19.55	16.44	8.6	14.86^{H}
Average of storage periods	15.15^{C}	26.85^{A}	20.15^{B}	20.72	18.37^{C}	26.20^{A}	21.16^{B}	21.91

Mean separation by L.S.D at 0.05

Table (3): Average changes in juice weight % during cold storage of Egyptian Lime fruits treated with phosphorine and phosphorine+GA_3 (20ppm) applied through growth season as affected by storage treatments in 2003 and 2004 seasons

Storage treatment	Average of storage periods							
	2003				2004			
	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments
1- unwrapped fruits(control)	36.3	37.98	38.16	37.48 D	40.73	41	40.09	40.61 C
2-unwrapped+GA3	37.32	39.19	38.24	38.25 B	42.88	41.1	39.51	41.16 B
3-unwrapped+Sida film	33.29	38.79	36.58	36.22 F	339.54	41.15	37.19	39.29 E
4-unwrapped+GA3+Sida film	35.52	38.25	35.32	36.36 F	41.97	40.67	35.88	39.51 D
5-wrapped fruits	40.81	45.52	35.79	40.71 A	44.85	44.58	38.71	42.71 A
6-wrapped+GA3	37.63	40.97	34.96	37.85 C	41.5	43.42	36.69	40.63 C
7-wrapped+Sida film	34.8	42.47	33.6	36.96 E	39.19	45.69	33.32	39.40 D
8-wrapped+GA3+Sida film	38.63	43.67	30.67	37.66 C	42.08	46.33	33.03	40.48 C
Average of storage periods	36.79 B	40.86 A	35.42 C	37.69	41.59 B	42.99 A	36.84 C	40.47

Mean separation by L.S.D at 0.05

Table (4): Average changes in TSS% during cold storage of Egyptian Lime fruits treated with phosphorine and phosphorine+GA_3 (20ppm) applied through growth season as affected by storage treatments in 2003 and 2004 seasons

Storage treatment	Average of storage periods							
	2003				2004			
	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments
1- unwrapped fruits(control)	9.84	9.72	9.91	9.82^{D}	10.57	10.03	10.6	10.40^{A}
2-unwrapped+GA3	9.95	10.4	9.76	10.04^{C}	10.4	10.03	10.5	10.31^{B}
3-unwrapped+Sida film	9.81	10.63	10.6	10.35^{B}	10.47	10	10.8	10.42^{A}
4-unwrapped+GA3+Sida film	9.96	10	9.73	9.89^{D}	10.67	10.2	10.57	10.48^{A}
5-wrapped fruits	10.03	9.98	10	9.97^{D}	10.37	10.17	10.37	10.30^{B}
6-wrapped+GA3	10.24	10.11	10.12	10.16^{C}	10.53	9.93	10.2	10.22^{C}
7-wrapped+Sida film	10.27	10.2	10.11	10.19^{C}	10.4	9.83	10.73	10.32^{B}
8-wrapped+GA3+Sida film	10.12	10.85	10.52	10.49^{A}	10.63	9.77	10.83	10.41^{A}
Average of storage periods	10.03^{B}	10.23^{A}	10.09^{B}	10.11	10.51^{A}	9.99^{B}	10.58^{A}	10.36

Mean separation by L.S.D at 0.05

Table (5): Average changes in TA% during cold storage of Egyptian Lime fruits treated with phosphorine and phosphorine+GA_3 (20ppm) applied through growth season as affected by storage treatments in 2003 and 2004 seasons

Storage treatment	Average of storage periods							
	2003				2004			
	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments
1- unwrapped fruits(control)	6.9	7.72	6.18	6.86^{B}	9.11	8.64	8.61	8.78^{A}
2-unwrapped+GA3	6.63	7.23	6.39	6.75^{C}	8.59	8.3	8.51	8.47^{C}
3-unwrapped+Sida film	7.01	7.01	7.36	7.13^{A}	8.49	8.59	8.64	8.57^{B}
4-unwrapped+GA3+Sida film	6.47	7.14	6.94	6.85^{B}	8.72	8.14	8.34	8.40^{D}
5-wrapped fruits	6.76	7.46	6.23	6.82^{B}	8.65	8.68	8.24	8.52^{B}
6-wrapped+GA3	6.74	7.32	6.51	6.85^{B}	8.66	8.84	7.59	8.37^{E}
7-wrapped+Sida film	6.92	7.01	6.65	6.86^{B}	8.64	8.63	7.95	8.41^{D}
8-wrapped+GA3+Sida film	6.55	7.15	6.74	6.81^{B}	8.87	8.73	7.7	8.43^{C}
Average of storage periods	6.75^{B}	7.25^{A}	6.65^{C}	6.88	8.72^{A}	8.68^{B}	8.20^{C}	8.53

Mean separation by L.S.D at 0.05

Table (6): Average changes in TSS/TA% during cold storage of Egyptian Lime fruits treated with phosphorine and phosphorine+GA_3 (20ppm) applied through growth season as affected by storage treatments in 2003 and 2004 seasons

Storage treatment	Average of storage periods							
	2003				2004			
	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments
1- unwrapped fruits(control)	1.43	1.26	1.57	1.42^{D}	1.16	1.19	1.23	1.19^{D}
2-unwrapped+GA3	1.5	1.44	1.48	1.47^{B}	1.21	1.24	1.25	1.23^{B}
3-unwrapped+Sida film	1.4	1.52	1.46	1.46^{B}	1.23	1.14	1.2	1.19^{C}
4-unwrapped+GA3+Sida film	1.54	1.4	1.43	1.45^{C}	1.22	1.29	1.27	1.26^{A}
5-wrapped fruits	1.48	1.33	1.51	1.44^{C}	1.2	1.2	1.28	1.22^{C}
6-wrapped+GA3	1.52	1.39	1.52	1.47^{B}	1.21	1.17	1.25	1.21^{C}
7-wrapped+Sida film	1.48	1.47	1.54	1.49^{A}	1.2	1.18	1.37	1.25^{A}
8-wrapped+GA3+Sida film	1.44	1.47	1.53	1.49^{A}	1.2	1.15	1.42	1.25^{A}
Average of storage periods	1.47^{B}	1.41^{C}	1.51^{A}	1.47	1.20^{B}	1.20^{B}	1.29^{A}	1.22

Mean separation by L.S.D at 0.05

Table (7): Average changes in vitamin C (mg Ascorbic acid/100ml juice)during cold storage of Egyptian Lime of fruits treated with phosphorine and phosphorine+GA3(20ppm)applied through growth season as affected by storage treatments in 2003 and 2004 seasons

Storage treatment	Average of storage periods							
	2003				2004			
	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments	Control	Phosphorine	Phosphorine + GA_3	Average of storage treatments
1- unwrapped fruits(control)	30.89	31.34	28.98	30.43^{B}	36.17	29.41	32.15	32.58^{B}
2-unwrapped+GA3	27.69	29.11	28.86	28.55^{D}	33.88	26.48	28.13	29.49^{E}
3-unwrapped+Sida film	26.15	29.93	38.08	30.39^{B}	32.33	25.26	30.96	29.52^{E}
4-unwrapped+GA3+Sida film	32.76	31.41	32.38	32.18^{A}	33.83	24.78	33.44	30.68^{D}
5-wrapped fruits	28.13	31.85	31.12	30.37^{B}	37.28	33.71	28.8	33.26^{A}
6-wrapped+GA3	28.82	32.35	29.96	30.38^{B}	33.63	30.34	30.87	31.61^{C}
7-wrapped+Sida film	30.6	27.18	30.54	29.44^{C}	31.35	27.69	27.03	28.69^{F}
8-wrapped+GA3+Sida film	28.61	32.06	27.89	29.52^{C}	32.37	28.69	27.84	29.63^{E}
Average of storage periods	29.21^{B}	30.66^{A}	30.60^{A}	30.16	33.85^{A}	28.29^{C}	29.90^{B}	30.68

Mean separation by L.S.D at 0.05

unwrapped fruits treated with GA_3 (50ppm pre-storage) plus Sida film gave the highest value in vitamin C content in juice of stored fruit (32.76 mg/ 100ml), followed by unwrapped content fruits (30.89 mg/ 100ml), while unwrapped fruits treated with Sida film produced the lowest value of V.C in season 2003. On the other hand, wrapped fruits gave the highest level of V.C (37.28 mg/ 100ml), followed by unwrapped content fruits, while wrapped fruits treated with Sida film induced the least value of V.C content (31.35 mg/100ml) in fruit juice stored during the second season.

These obtained findings of this study are in agreement with those reported by El- Maghrabi (1999) on Balady orange who found that wrapping had no effect on vitamin C. Moreover, Farag (2001) noticed that ,no significant differences was noticed in V.C content of navel oranges during storage .

CONCLUSION

Generally it could be concluded that Egyptian Lime fruits treated with phosphorine (after fruit set) plus GA_3 (20ppm 2 weeks before harvest date) during growth season resulted in the lowest values of weight loss%, the lowest values of unmarketable fruit number%, the lowest level of acidity %, the highest value of TSS/TA ratio in juice of stored fruits during the two studies seasons. Furthermore, wrapping treated fruits with GA_3 (50ppm) plus Sida film (5% wetting agent) was more effective in decreasing weight loss% than treating with GA_3 or Sida film alone. Also, wrapping fruits +Sida film + GA_3 (50ppm pre-storage) gave the lowest percentage of unmarketable fruits number, the highest value of juice weight percentage , the highest level of TSS/TA ratio in juice, keep good quality and prolong cold storage period .

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تأثير معاملات ما قبل الجمع (حمض الجبريليك والمخصبات الحيويه) وما بعد الحصاد على خصائص الليمون المصرى المالح خلال التخزين المبرد

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اجريت الدراسه لبحث تأثير التسميد العضوى والتسميد الحيوى والرش بحمض الجبريليك على خصائص وسلوك ثمار الليمون المالح المصرى خلال بعض معاملات التخزين خلال موسمى ٢٠٠٣-٢٠٠٤ فى مزرعه كليه الزراعة جامعة اسيوط حيث تم معامله الاشجار بثلاثه معاملات : تسميد عضوى. تسميد عضوى مع تسميد بالفوسفورين بعد العقد. تسميد عضوى مع تسميد بالفوسفورين والرش بحمض الجبريليك (٢٠ جزء فى المليون) قبل الميعاد المتوقع للجمع ٢-٣ اسابيع ثم معامله الثمار باحدى المعاملات:

تعبئه الثمار فى اكياس بولى اثيلين مثقب ,غمر الثمار فى محلول GA_3 تركيز ٥٠ جزء فى المليون ,غمر الثمار فى محلول Sida film 5% ,غمر الثمار فى محلول (GA_3 ٥٠ جزء، Sida film 5%)، لف الثمار فى ورق حرير، غمر الثمار فى محلول (GA_3 ٥٠ جزء) ثم لف الثمار، غمر الثمار فى محلول (Sida film 5%) ثم لف الثمار، غمر الثمار فى محلول (GA_3 ٥٠ جزء +Sida film 5%) ثم لف الثمار.

أوضحت النتائج انه للحصول على ثمار ذات جوده عاليه عند الجمع ولاطول فتره ممكنه (٦٠ يوم) مع صفات ثمريه جيدة تحت ظروف التخزين يفضل رش الاشجار بحمض الجبريليك ٢٠ جزء فى المليون مع التسميد بالسماد الحيوى الفوسفورين اثناء موسم النمو مع لف الثمار ومعاملتها Sida film 5 %+ GA_3 ٥٠ جزء فى المليون قبل التخزين على درجه ٧-١٠°م.