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Studies of some pre harvest treatments on growth and fruit quality of guava fruits

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Abstract: *This investigation was done during two successive seasons (2009/2010 and 2010/2011) on 10 years old (Psidium guajva, L) seedy guava trees at Mariout Research Station of the Desert Research Center. This investigation aimed to compare fruit growth curve of summer and winter guava fruit also study the effect of some treatments: 1- control (sprayed with water only). 2- Calcium chloride at 1%. 3- Calcium nitrate at 0.6%. 4- Paclobutrazol at 150 ppm. These treatments were sprayed twice (the first spray was applied 80-85 days after full bloom at August in spring summer (SS) guava and first week of December in Autumn winter (AW) guava, the second spray was done ten days after the first spray in both) to study the impact fruit quality in guava.*

Guava from the (SS) season grew faster (total= 122 days) than the (AW) fruit that required 186 days. Weight, volume and diameter constituents were higher of fruit in (SS) fruit than in the (AW) fruit, while total soluble solids and acidity were higher in (AW) than in the (SS) fruit.

The obtained results showed that, spraying with calcium nitrate at 0.6% with spring summer date gave the lowest values of titratable acidity and the highest values of total sugars.

Moreover, spraying with calcium nitrate at 0.6% with autumn winter date gave the lowest values of weight loss, the highest values of fruit firmness of flesh, the lowest values of decay percentage, the highest values of total soluble solids and the lowest values of incidence of rot% in both seasons at shelf life storage about 10 days.

We can be recommended by spraying calcium nitrate at 0.6% 80-85 days after full bloom in both dates to get the best results of fruit quality.

Keywords: *fruit quality- growth curve- guava- pre harvest- shelf life- spray.*

I. Introduction

Guava (Psidium guava, L) is one of the most popular fruit crops in Egypt. This may be due to the high nutritive value of fruits, good source of vitamin C, minerals and pleasant aroma. Guava cultivated area in Egypt amounted **40841** feddans produced about **349626** tons of fruits according to the lastest statistics of Ministry of Agriculture, Egypt (2012). It is normally consumed fresh as a dessert fruit, or processed into puree, juice, concentrate, jam, jelly, nectar or syrup (**Jagtiani et al. 1988**). Due to hardy nature of plant it can withstand adverse climatic conditions and grows under a wide range of soil types from sandy loam to clay loam (**Dhaliwal and Singla 2002**). There is an increasing demand of fruits for fresh as well as processing purpose in domestic and international markets. Therefore, it needs immediate marketing and utilization after harvesting. During storage, physicochemical and biochemical changes affect the final texture and quality of fruits. The effect of elucidating the maintenance of fruit quality has been based on the modifications taking place in the cell wall (**Brummell et al. 2004**).

Guava is round or oval and is eaten as a fresh fruit at two stages: mature green, where the taste is like a sweet apple having white flesh; or fully ripe. At the fully ripe stage, the flesh can be white to bright red with light yellow skin. Harvest stage depends on variety and the stage at which fruit are to be eaten. If eaten green, fruit should be harvested at the mature, firm stage without any signs of ripening. Fruit to be consumed soft and ripe are harvested when they show some sign of color change from green to yellow, as well as initial softening. **Weaver (1972)** studied the fruit growth pattern of the guava cultivars Patillo, Paluma and Red selection of Florida he found that resulting on sigmoidal curves characterizing three growth phases, for all cultivars. Also, **Gonzalez (1985)** reported a double sigmoid growth curve for guava with the first stage extending for 60 days after anthesis. The second stage took 49 days and the third 79 days. Spring summer (SS) and autumn winter (AW) guava showed a double sigmoid curve with three characteristic stages. In stage I, there was a rapid increase weight, volume, and diameter, stage II was characterized by slow changes in weight, volume, and diameter and in stage III the fruit attained final size **(Edmundo Mercado et al 1998).**

Calcium, as a constituent of the cell wall, plays an important role in forming cross-bridges, which influence cell wall strength and regarded as the last barrier before cell separation (**Fry 2004**).

Pre-harvest calcium spray is one of the most important practices of new strategies applied in the integrated fruit production systems, improving fruit characteristics and minimizing fungicides sprays towards the end of the harvest period, since they improve fruit resistance to brown rot (**Conway et al. 1994**). Calcium spray during fruit development provides a safe mode of supplementing endogenous calcium to fresh fruits

(Gerasopoulos et al. 1996; Tzoutzoukou and Bouranis 1997; Raese and Drake 2000). (Gamal 2012) studied the effect of some pre-harvest treatments using calcium chloride (1.5 %), calcium EDTA (1.5 %), calcium nitrate (2%) and zinc sulphate (0.4%) on some fruit quality of Canino apricot fruits under cold storage conditions. All treatments were done one month before maturity stage. The results showed that fruit weight loss (%), decay (%), T.S.S. (%), T.S.S./acid ratio, total sugars of fruits were increased with prolonging the period of cold storage, while fruit firmness as well as total acidity were decreased by prolonging it. Calcium nitrate at 2% was the best treatment for improving fruit quality under cold storage conditions comparing with other treatments.

Paclobutrazol (**Lever et al., 1982**), a plant growth regulator (PGR) from Imperial Chemical Industries. There are few reports of paclobutrazol influencing the post-harvest behavior of apples, but orchard application has delayed ripening by about 3 days (**Luo 1987)**, they reported that the ripening of 'Golden Delicious' and 'Bramley's Seedling' fruits was retarded by applications of paclobutrazol made early in the season. **El-khoreiby et al, (1990),** found that a single foliar spray of 250 mg paclobutrazol/liter was applied to 7-year-old ‘Oregon Spur Delicious‘(OSD) or ’Smoothie Golden Delicious‘ (SGD) apple trees (Malus domestica Borkh.) at 12 growth stages between tight cluster and petal fall plus 28 days. A linear increase in fruit length: diameter ratio and a linear decrease in percent soluble solids content were observed on OSD as sprays were applied later in the season. For both cultivars, best control of shoot growth and minimal change in fruit characteristics occurred when paclobutrazol was applied after bloom. Chemical name used; B -[(4-chlorophenyl)methyl]- a –(1,1-dimethylethyl)- 1H-1,2,4-triazole-1-ethanol (paclobutrazol). **Whiley and Saranah (1992),** found that bloom foliar sprays of paclobutrazol (PB) at 2.5, 1.25 and 0.62 g a. i./L on avocado (Persea americana Mill, cv. Hass) trees reduced spring flush shoot length and redistributed dry matter among the components of fruiting shoots. There was an increase in the allocation of dry matter to fruit on treated trees with a corresponding reduction in the allocation to the stem and leaves. The spray treatments of 2.5 and 1.25 g a. i. /L PB at bloom increased the mean fruit size at harvest by 16 and 11%, respectively. Fruit yield was not significantly affected by PB applications on an annual basis. However, the PB spray treatments of 1.25 and 0.62 g a. i. /L significantly increased the two year cumulative yield by about 63% in a second experiment.

II. Material and Methods

This study was conducted through two successive seasons 2009/2010-2010/2011 on 10 years old seedy guava (Psidium guajava L.) trees planted at 5x5 meters and subjected to the same agricultural practices apart at Mariout Research Station of the Desert Research Center– Alexandria. Twenty four trees, uniform in growth and in good physical condition were selected and grouped under four treatments; each treatment had six replicates and a tree for each.

Physical properties at mature stage:

1- The stability of the size and shape of the fruit.
2- The change in fruit dimensions becomes too little.
3- Reduced firmness flesh of the fruit.
4- The color of the fruit begins to shift from dark green to light yellow color.

Chemical properties at mature stage:

1- Increasing the proportion of total soluble solids.
2- Increase the pigments responsible for the fruit color and appearance of the color characteristic of the variety and less pigments chlorophyll.

Experiment I:

This experiment aimed to compare fruit growth curve of both summer and winter guava fruits. For this goal a healthy uniform tree was chosen and at each of main four directions four shoots at each direction were labeled. Twenty fruits at the same physiological stage and nearly have the same shape and dimensions were labeled at each direction. Weekly from full bloom to maturity the flowering measurements were recorded: fruit weight, fruit volume, fruit diameter, total soluble solids and titratable acidity from these collected data growth curve of fruit was carried out.

Experiment II:

Trees under investigation were subjected to the following four treatments:

1- Control (sprayed with water only).
2- Calcium chloride at 1%.
3- Calcium nitrate at 0.6%.
4- Paclobutrazol at 150 ppm.

Dates of spraying:

The first spray was applied 80-85 days after full bloom during August in spring summer (SS) guava and first week of December in Autumn winter (AW) guava of (2009/2010 and 2010/2011). The second spray was done ten days after the first spray in both. The sprays were conducted until total saturation of foliage. The experimental trees were also sprayed with 0.1% Bavistin to protect the fruits against storage rots. Fruits samples were harvested at light yellow color stage to study the effect of these treatments on the storage of fruits under ambient conditions at 25-30˚C for spring summer guava and 20-25˚C for autumn winter guava to the laboratory in desert research center so that measurements taken every two day until we get to 50% fruits damaged and then analyzed for:

1- Fruit weight loss percentage.

2-Fruit firmness of flesh was measured on two paired sides of fruits with the help of "Penetrometer" (Model FT 327, QA Supplies, Norfolk, VA, USA).

3-Decay percentage and chemical composition, for chemical analyses the pericarp with seeds removed was homogenized in a Warring blender.

4-TSS%: Total soluble solids in juice were measured using Abb. Refractometer (Bausch and Lomb. Japan).

5-Titratable acidity was determined by an **A.O.A.C. (1990).**

6-Total sugars content percentage: the total sugar percentage were determined colorimetrically by using a picric acid **Tomas and Dutcher (1924)** and expressed as g/100g fresh weight.

7- Incidence of rot%.

$$\text{Fruit weight loss percentage} = \frac{\text{Weight loss}}{\text{Total weight}} \times 100$$

$$\text{Decay percentage} = \frac{\text{Number of decayed fruit}}{\text{Total number of fruit}} \times 100$$

Contained 6 replicates which presented as a tree for each. The experiment had four treatments, each treatment. All collected data were subjected to statistical analysis according to the procedure reported by **Snedecor and Cochran (1980).**

III. Results and discussion

Experiment I:

Generally from data shown in fig. (1, 2, 3 and 4) it could be concluded that, the fruits of the spring-summer fruits required 122 days from bloom to harvest time while the fruit of the autumn-winter fruits needed 186 days to reach maturity. Both showed a double sigmoid curve with three characteristic stages. In stage I, there was a rapid increase weight, volume, and diameter, stage II was characterized by slow changes in weight, volume, and diameter and in stage III the fruit attained final size. This pattern of growth has been reported for other guava cultivars which recorded by **Srivastava and Narasimhan, (1967)**, **Chang and Tee, (1976), Akamine and Goo, (1979), Ong and Ding, (1980),** they described a moderate increase in weight, volume, and diameter during 50 days after anthesis, followed by a rapid increase in weight, volume, and diameter from 50 to 95 days, and finally a period of slow growth. **Salunkhe and Desai, (1984),** also observed a sigmoidal growth curve of cv. "Safeda" but with the unusual behavior that initial increase in weight, volume, and diameter was rapid.

The first growth stage (31 days) (Fig.1, 2) was similar in the spring- summer and the autumn-winter fruit (Fig.3, 4) stage II required 64 days in autumn-winter fruit whereas only 50 days were required for spring-summer fruit. The last stage was completed in 41 and 76 days for spring-summer and autumn-winter fruit, respectively. Fruit mass changes through growing season showed a similar trend to that observed for weight, volume, and diameter. **Gonzalez (1985)** reported a double sigmoid growth curve for guava with the first stage extending for 60 days after anthesis. The second stage took 49 days and the third 79 days.

This growth curve was very similar to our results of fruit growth in the autumn-winter production. The longer growth period of autumn-winter fruits is probably a response to cooler temperatures. **Rathore (1976)** also found that the growth periods of four Indian cultivars were inversely related to prevailing temperatures.

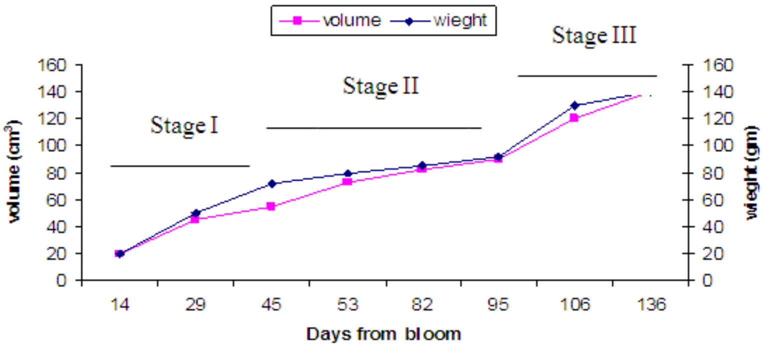

Fig.1. Changes in weight and volume of spring summer guava fruit through growing season.

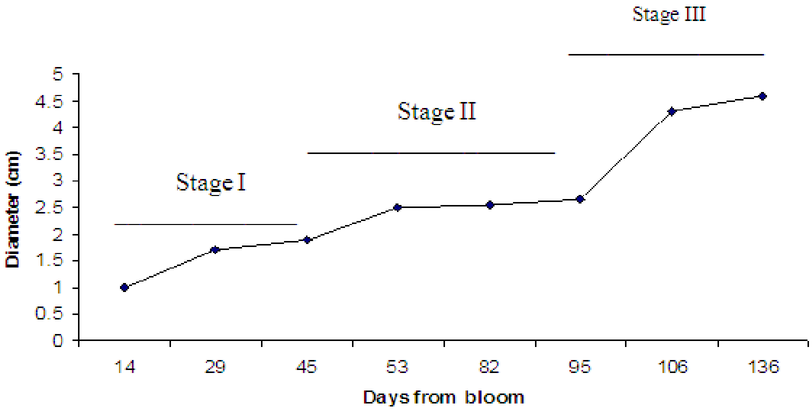

Fig.2. Changes in diameter of spring summer guava fruit through growing season.

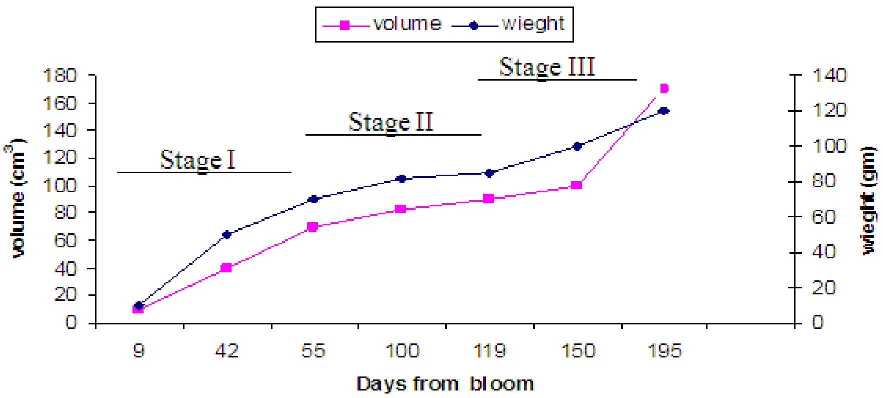

Fig.3. Changes in weight and volume of autumn winter guava fruit through growing season.

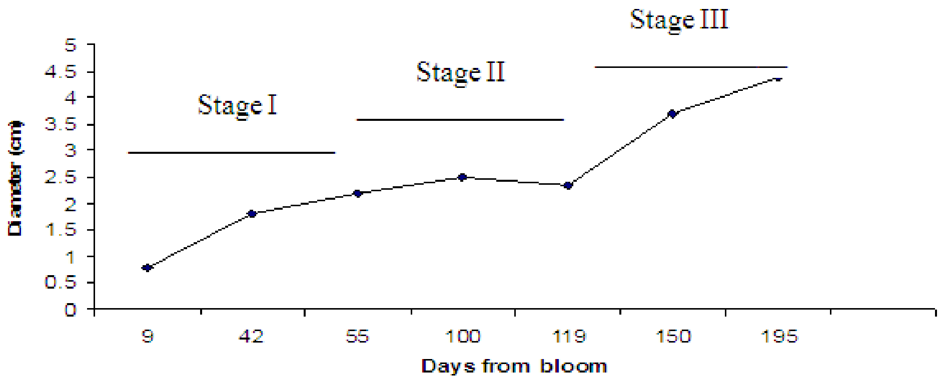

Fig.4. Changes in diameter of autumn winter guava fruit through growing season.

Titratable acidity values were low during stage I and II and increased during stage III (Fig.5). This behavior was also reported by **Kumar and Hoda (1974) and Dhillon et al. (1987)** for fruit developing during the rainy and winter seasons.Our results also showed that the autumn-winter samples had a higher acidity than spring-summer.

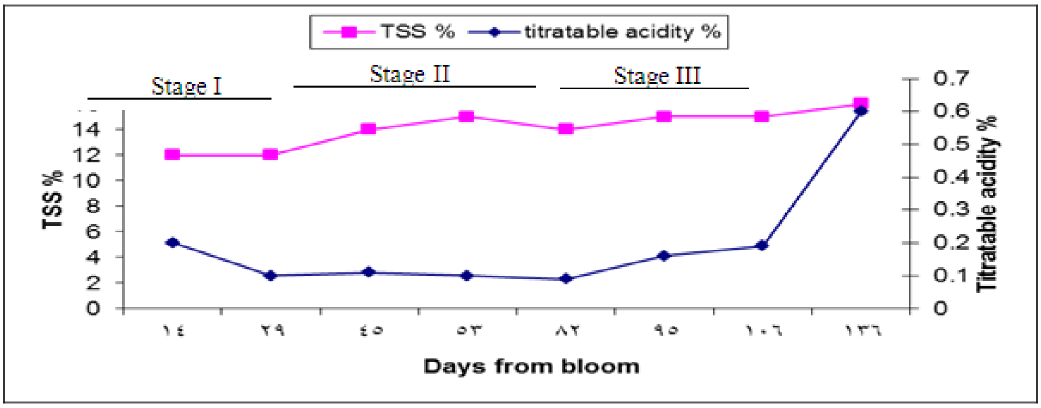

Fig.5. Changes in TSS and titratable acidity of spring summer guava fruit through growing season**.**

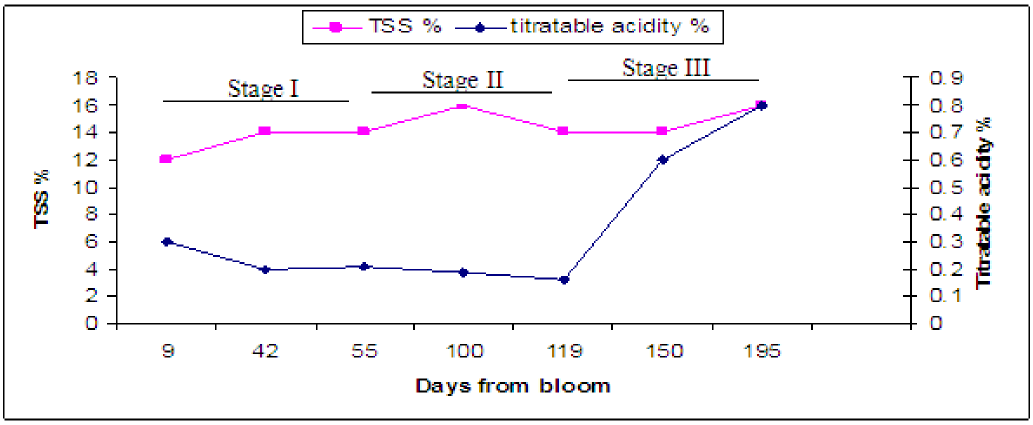

Fig.6. Changes in TSS and titratable acidity of autumn winter guava fruit through growing season**.**

TSS increased during stage I and stage II then decreased at the end of stage II, then increased during stage III (Fig.5., Fig.6.).

Guava showed a climacteric respiratory as was previously reported Brown and Will (1983). The time to reach the climacteric, however, was related to growth season. Edmundo Mercado et al (1998) found that fruit produced in spring summer (SS) had climacteric peaks of carbon dioxide and ethylene production 5 days after harvest. Autumn winter (AW) fruit had their climacteric peaks 8 and 7 days post- harvest. So this again indicates that the development of (AW) fruit is slower than that of (SS) fruit and showed be related to the temperature regime during the period. The increased accumulation of chemical constituents during the (AW) season is an effect of lower temperature. Low temperatures not only retard the excessive loss of substrates due to respiratory activity but also increase the translocation of photosynthesis from leaves to the fruits Rathore (1976)

Weaver (1972) has defined guava fruit growth in three growing phases. The first one is a fast growing phase of the ovary and its components, except the endosperm and embryo. The growth of endosperm and embryo is observed in the second phase, together with the endocarp lignification and a small increase of the ovary wall. The third is the mesocarp growing phase, complete fruit formation and maturation.

Experiment II:
Effect of some pre harvest treatments and yield time on guava fruit physical properties,
Table (1) Effect of some pre harvest treatments, yield time and their interaction on weight loss percentage of guava fruits (2009/2010 and 2010/2011 seasons).

Weight loss%: Data presented in table (1) cleared the effect of some pre harvest treatments, yield time and their interaction on guava weight loss at individual different shelf life periods.

Data presented in Table (1) cleared that the minimal fruit weight loss percentage was obtained by control treatment in both seasons, while the maximum weight loss %was recorded by Ca(NO3)2 at 0.6% treatments as well as PP333 150 ppm treatments at all shelf life periods in both seasons.

Regarding yield time, autumn winter (AW) fruits showed lower significant value than spring summer (SS) one. The interaction between the two studied factors, control with AW fruit recorded lowest significant weight loss percentage through most of shelf live periods in first season and all shelf live periods of second season.

Table (1) Effect of some pre harvest treatments, yield time and their interaction on weight loss% of guava fruits at different periods of shelf live (2009/2010 and 2010/2011 seasons).

									Shelf life period days						1ST.season			
Treatments.	0			2			4			6			8			10		
	SS	AW	Mean	SS	AW	Mean	SS	AW	Mean	SS	AW	Mean	SS	AW	Mean	SS	AW	Mean
Control	13.03j	18.02e	12.43D'	12.31j	11.23h	11.77D'	12.22j	10.64h	11.42D'	12.10e	10.03f	11.07D'	11.34d	8.56f	9.95D'	11.04d	7.13f	9.09D'
Cacl2 1%	20.60c	18.02e	19.31B'	20.52d	16.11e	18.31B'	20.12b	12.85f	16.48B'	19.52b	10.60j	15.05B'	19.42b	8.79e	14.10B'	18.23b	7.22f	12.73B'
$Ca(NO3)_2$ 0.6%	24.71a	22.44b	23.58A'	24.52a	20.60b	22.56A'	24.25a	17.33d	20.79A'	23.77a	14.36d	19.06A'	22.41a	11.53d	16.97A'	22.12a	9.23e	15.67A'
Pp333 150ppm	19.50d	15.93f	17.71C'	19.43c	14.16f	16.79C'	18.72c	13.76e	16.24C'	18.16c	9.62h	13.89C'	17.31c	7.67j	12.49C'	17.22c	6.59j	11.91C'
Mean	19.46A	17.06B		19.19A	15.52B		18.82A	13.65B		18.38A	11.15B		17.62A	9.14B		17.16A	7.55B	
									2nd season									
Control	10.53d	6.44j	8.48D'	11.26e	8.74h	10.00D'	11.69e	9.34j	10.52D'	12.22f	10.74j	11.48D	12.50j	11.33h	11.91D	13.18f	11.91j	12.54D
Cacl2 1%	18.12b	7.29f	12.71B'	19.75b	8.87j	14.32B'	20.77b	10.74f	15.51B'	21.02b	16.61d	18.82B	21.60b	17.12e	19.36B	21.90c	19.65d	20.77B
$Ca(NO3)_2$ 0.6%	21.26a	9.43e	15.35A'	22.87a	11.77d	17.32A'	23.27a	15.55d	19.41A'	24.14a	18.56c	21.35A	24.31a	20.72c	22.52A	24.94a	22.85b	23.89A
Pp333 150ppm	17.22c	7.31e	12.27C'	17.55c	8.93f	13.24C'	18.02c	10.76f	14.39C'	18.32c	14.83e	16.57C	19.55d	16.66f	18.11C	19.73d	17.95e	18.84C
Mean	16.78A	7.62B		17.86A	9.58B		18.31A	11.59B		18.93A	15.18B		19.49A	16.46B		19.94A	18.09B	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level. SS = Spring summer yield AW = Autumn winter yield.

Table (2) Effect of some pre harvest treatments, yield time, and their interaction on fruit flesh firmness Kg / cm² of guava fruits (2009/2010 and 2010/2011 seasons).

Firmness of flesh (Kg/ cm²): Data in table (2) cleared that fruit firmness decreased in control and PP333 in all shelf life periods (2, 4, 6, 8 and 10) day.

At the beginning date: concerning pre harvest treatments, Ca(NO3)2 at 0.6% had highest significant values in both seasons. Regarding yield time, autumn winter (AW) fruits showed higher significant value than spring summer (SS) one. The interaction between the two studied factors, Ca(NO3)2 with (AW) yield recorded highest significant values at all shelf live periods in both seasons. Calcium nitrate has been found to be effective in increasing the firmness of fruits by delaying senescence, preserving cellular organization and retarding respiration rate **(Faust and Shear 1972)**. These results are harmony with those found by (**Conway and Sams, 1983),** they found that the positive effect of calcium on maintaining fruit firmness may be due to the calcium binding to free carboxyl groups of polyglacturonate polymer, stabilizing and strengthening the cell wall**..** These results are in agreement with those of (**Selvan and Bal 2005)** in guava and (**Martinsson et al. 2006)** in strawberry.

Table (2) Effect of some pre harvest treatments, yield time and their interaction on fruit firmness of flesh Kg/ cm2 of guava fruits at different periods of shelf live (2009/2010 and 2010/2011 seasons).

									Shelf life period days						1ST.season			
Treatments.	0			2			4			6			8			10		
	SS	AW	Mean	SS	AW	Mean	SS	AW	Mean	SS	AW	Mean	SS	AW	Mean	SS	AW	Mean
Control	11.84h	13.03j	12.43D'	11.23j	12.31f	11.77D'	10.64f	12.21e	11.42D'	10.03j	12.10e	11.06D'	8.56e	11.33d	9.95D'	7.13f	11.04d	9.09D'
Cacl2 1%	18.02e	20.60c	19.31B'	16.11d	20.51b	18.31B'	12.85e	10.11j	16.48A'	10.60f	19.51b	15.05B'	8.79e	19.42b	14.10B'	7.22f	18.23b	12.73B'
$Ca(NO3)_2$ 0.6%	22.44b	24.71a	23.58A'	20.60b	24.52a	22.56A'	17.33c	24.25a	20.79B'	14.36d	23.77a	19.06A'	11.53d	22.41a	16.97A'	9.23e	22.13a	15.67A'
Pp333 150ppm	15.93f	19.50d	17.71C'	14.16e	19.42c	16.79C'	13.75d	18.72b	16.24C'	9.62h	18.15c	13.89C'	7.67f	17.31c	12.49C'	6.59j	17.22c	11.91C'
Mean	17.06B	19.46A		15.52B	19.19A		13.64B	18.82A		11.15B	18.38A		9.14B	*17.62A*		7.54B	17.15A	
									2nd season									
Control	11.91j	13.71f	12.54D'	11.33j	12.50h	11.91D'	10.74f	12.22e	11.48D'	9.34h	11.66e	10.50D'	8.34e	11.26d	10.0D'	6.44j	10.53d	8.48D'
Cacl2 1%	19.65d	21.90c	20.77B'	17.11e	21.60b	19.36B'	14.94d	21.02b	17.98B'	10.73j	20.27b	15.50B'	8.87e	19.75b	14.31B'	7.29f	18.12b	12.70B'
$Ca(NO3)_2$ 0.6%	22.85b	24.94a	23.89A'	20.72c	24.31a	22.51A'	18.56c	24.14a	21.35A'	15.54d	23.26a	19.40A'	11.77d	22.86a	17.32A'	9.43e	21.26a	15.34A'
Pp333 150ppm	17.95e	19.73d	18.84C'	16.66j	19.56d	18.11C'	14.82d	18.31c	16.57C'	10.75f	18.02c	14.39C'	8.93e	17.54c	13.23C'	7.31f	17.22c	12.26C'
Mean	19.93A	18.09B		16.45B	19.49A		14.77B	18.92A		11.59A	18.30A		9.57B	17.85A		7.62B	16.78A	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level. SS = Spring summer yield AW = Autumn winter yield.

Decay%: Data in table (3) showed that the pre harvest treatment with Ca(NO3)2 at 0.6% recorded lowest significant fruit decayed percentage at all shelf life periods. Regarding yield time, autumn winter (AW) fruits showed lower significant value than spring summer (SS) one. The interaction between the two studied factors, Ca(NO3)2 with (AW) yield recorded lowest significant value at all shelf live periods in both seasons.

These results are agreement with those found by (**Abdel- Wahab and El-Shinawy 2004),** decay percentage of Crimson seedless grape variety was increased considerably with prolonged storage period in all treatments.

Table (3) Effect of some pre harvest treatments, yield time and their interaction on fruit decay% of guava fruits at different periods of shelf live (2009/2010 and 2010/2011 seasons).

Shelf life period days 1ST.season																		
Treatments.	**0**			**2**			**4**			**6**			**8**			**10**		
	SS	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**
Control	0a	0a	**0A'**	19.70a	0d	**9.85A'**	27.71a	0e	**13.85A'**	36.17a	0e	**18.08A'**	42.25a	0e	**21.12A'**	51.38a	0d	**25.69A'**
Cacl2 1%	0a	0a	**0A'**	14.32b	0d	**7.16B'**	20.45c	0e	**10.22C'**	28.38c	0e	**14.19C'**	35.47c	0e	**17.73C'**	47.33b	0d	**23.66C'**
Ca(NO3)$_2$ 0.6%	0a	0a	**0A'**	9.41c	0d	**4.70C'**	17.70d	0e	**8.85D'**	24.74d	0e	**12.37D'**	32.26d	0e	**16.13D'**	45.81c	0d	**22.90D'**
Pp333 150ppm	0a	0a	**0A'**	14.75b	0d	**7.37B'**	23.28b	0e	**11.64B'**	31.95b	0e	**15.97B'**	37.13b	0e	**18.56B'**	48.77b	0d	**24.38B'**
Mean	**0A**	**0A**		**14.54A**	**0B**		**22.28A**	**0B**		**30.31A**	**0B**		**36.78A**	**0B**		**48.32A**	**0B**	
2nd season																		
Control	0a	0a	**0A'**	19.46a	0e	**9.73A'**	27.32a	0e	**13.66A'**	33.47a	0e	**16.73A'**	41.37a	0	**20.68A'**	52.45a	0e	**26.22A'**
Cacl2 1%	0a	0a	**0A'**	13.19c	0e	**6.59C'**	18.42c	0e	**9.21C'**	26.21c	0e	**13.10C'**	32.22c	0	**16.11C'**	47.66c	0e	**23.83C'**
Ca(NO3)$_2$ 0.6%	0a	0a	**0A'**	10.17d	0e	**5.08D'**	15.07d	0e	**7.53D'**	23.93d	0e	**11.96D'**	30.83d	0	**15.41D'**	44.62d	0e	**22.31D'**
Pp333 150ppm	0a	0a	**0A'**	15.19b	0e	**7.59B'**	21.17b	0e	**10.58B'**	28.66b	0e	**14.33B'**	35.84b	0	**17.92B'**	49.32b	0e	**24.66B'**
Mean	**0A**	**0A**		**14.50A**	**0B**		**20.49A**	**0B**		**28.07A**	**0B**		**35.06A**	**0B**		**48.51A**	**0B**	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level. SS = Spring summer yield AW = Autumn winter yield.

Effect of some pre harvest treatments and yield time on guava fruit chemical characteristicsTotal Soluble solids (TSS%): Data in table (4) cleared that higher significant total soluble solids (TSS%) of fruits values were recorded by in Ca(NO3)2 at 0.6% at all shelf live periods in both seasons. Regarding yield time, autumn winter (AW) fruits showed higher significant value than spring summer (SS) one at all shelf periods in both seasons. The interaction between the two studied factors, Ca(NO3)2 with (AW) yield recorded highest significant values at all shelf live periods in both seasons.

Table (4) Effect of some pre harvest treatments, yield time and their interaction on TSS% of guava fruits at different periods of shelf live (2009/2010 and 2010/2011 seasons).

Shelf life period days 1ST.season																		
Treatments……..	**0**			**2**			**4**			**6**			**8**			**10**		
	SS	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**
Control	10.22c	10.49c	**10.36D'**	10.26c	10.86c	**10.56D'**	10.31c	10.97c	**10.64D'**	10.16d	11.14c	**10.65D'**	10.46d	11.34c	**10.90D'**	10.23d	11.65c	**10.94D'**
Cacl2 1%	10.66c	11.41b	**11.04B'**	10.70c	11.60b	**11.15B'**	10.72c	11.81b	**11.27B'**	11.57c	12.15b	**11.86B'**	11.85c	12.46b	**12.16B'**	11.72c	12.72b	**12.22B'**
Ca(NO3)$_2$ 0.6%	11.43b	12.40a	**11.92A'**	11.61b	12.73a	**12.17A'**	11.72b	12.95a	**12.33A'**	12.55b	13.12a	**12.84A'**	12.48b	13.37a	**12.92A'**	12.49b	13.65a	**13.07A'**
Pp333 150ppm	10.44c	11.22b	**10.83C'**	10.50c	11.52b	**11.01C'**	10.55c	11.63b	**11.09C'**	11.38c	12.10b	**11.74C'**	11.69c	12.25b	**11.97C'**	11.58c	12.44b	**11.98C'**
Mean	**10.69B**	**11.38A**		**10.77B**	**11.67A**		**10.82B**	**11.84A**		**11.41B**	**12.12A**		**11.62B**	**12.35A**		**11.49B**	**12.61A**	
2nd season																		
Control	10.37c	10.43c	**10.40D'**	10.35c	10.63c	**10.49D'**	**10.28j**	**10.81e**	**10.54D'**	10.15c	11.12b	**10.64D'**	10.39d	11.21c	**10.80D'**	11.11c	11.46c	**11.29D'**
Cacl2 1%	10.67c	11.34b	**11.01B'**	10.73c	11.45b	**11.09B'**	**10.51f**	**11.52c**	**11.01B'**	11.52b	12.12a	**11.82B'**	11.81c	12.35b	**12.08B'**	11.34c	12.57b	**11.96B'**
Ca(NO3)$_2$ 0.6%	11.54b	12.37a	**11.95A'**	11.40b	12.60a	**12.00A'**	**11.64b**	**12.72a**	**12.18A'**	12.33a	12.99a	**12.66A'**	12.70b	13.28a	**12.99A'**	12.25b	13.60a	**12.92A'**
Pp333 150ppm	10.51c	11.18b	**10.84C'**	10.54c	11.30b	**10.92C'**	**10.43f**	**11.33d**	**10.88C'**	11.38b	12.01a	**11.69C'**	11.68c	12.30b	**11.99C'**	11.17c	12.28b	**11.72C'**
Mean	**10.77B**	**11.33A**		**10.75B**	**11.49A**		**10.71B**	**11.59A**		**11.34B**	**12.06A**		**11.64B**	**12.28A**		**11.47B**	**12.48A**	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level. SS = Spring summer yield AW = Autumn winter yield.

Total acidity%: Data in table (5) cleared that control had highest significant acidity percentage at most shelf live periods in both seasons (table 5). Concerning yield time, AW fruits showed higher significant values than SS one at all shelf live periods in both seasons. The interaction between the two studied factors, control with (AW) treatment recorded highest significant values at most shelf live periods in both seasons.

These results are agreement with those found by (Rhodes, et al 1968), the decrease in total acidity during ripening and storage may be attributed to the increase in malic and pyruvate decarboxylation reaction during the climacteric period.

Table (5) Effect of some pre harvest treatments, yield time and their interaction on total acidity% of guava fruits at different periods of shelf live (2009/2010 and 2010/2011 seasons).

Shelf life period days 1ST.season																		
Trt.	**0**			**2**			**4**			**6**			**8**			**10**		
	SS	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**
Control	0.178d	0.197a	**0.187A'**	0.190c	0.200a	**0.195A'**	0.193c	0.227a	**0.210A'**	0.224d	0.238a	**0.231A'**	0.186c	0.191a	**0.188A'**	0.173c	0.181a	**0.177A'**
Cacl2 1%	0.171f	0.192c	**0.181C'**	0.180e	0.197b	**0.188C'**	0.183e	0.223b	**0.203D'**	0.201f	0.231c	**0.216C'**	0.184d	0.186c	**0.185C'**	0.167e	0.173c	**0.170C'**
$Ca(NO_3)_2$ 0.6%	0.176e	0.194b	**0.185B'**	0.188d	0.199a	**0.193B'**	0.190d	0.224b	**0.207C'**	0.221e	0.235b	**0.228B'**	0.182e	0.187c	**0.184C'**	0.170d	0.178b	**0.174B'**
Pp333 150ppm	0.177d	0.195b	**0.186B'**	0.189cd	0.199a	**0.194AB'**	0.191d	0.226a	**0.208B'**	0.223d	0.237a	**0.230A'**	0.184d	0.189b`	**0.186B'**	0.172c	0.180a	**0.176A'**
Mean	**0.175B**	**0.194A**		**0.186B**	**0.198A**		**0.189B**	**0.225A**		**0.217B**	**0.235A**		**0.184B**	**0.188A**		**0.170B**	**0.178A**	
2nd season																		
Control	0.177d	0.196a	**0.186A'**	0.187e	0.201a	**0.194A'**	0.191e	0.220b	**0.205A'**	0.214e	0.228a	**0.221A'**	0.185b	0.190a	**0.187A'**	0.171d	0.180a	**0.175A'**
Cacl2 1%	0.170j	0.190c	**0.180D'**	0.178j	0.195d	**0.186D'**	0.180f	0.215d	**0.197A'**	0.198h	0.221d	**0.209D'**	0.182d	0.182d	**0.182C'**	0.162f	0.172d	**0.167D'**
$Ca(NO_3)_2$ 0.6%	0.173f	0.192b	**0.182C'**	0.184f	0.197c	**0.190C'**	0.189e	0.217c	**0.203A'**	0.202j	0.223c	**0.212C'**	0.182d	0.183c	**0.182BC'**	0.167e	0.175c	**0.171C'**
Pp333 150ppm	0.175e	0.193b	**0.184B'**	0.186e	0.199b	**0.192B'**	0.423a	0.218c	**0.320A'**	0.211f	0.225b	**0.218B'**	0.183c	0.184b	**0.183B'**	0.178b	0.178b	**0.173B'**
Mean	**0.173B**	**0.192A**		**0.183B**	**0.198A**		**0.245A**	**0.217A**		**0.206B**	**0.224A**		**0.183B**	**0.184A**		**0.167B**	**0.176A**	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level. SS = Spring summer yield AW = Autumn winter yield.

Total sugars%: Data in table (6) showed that the maximum total sugars percentage of fruits were gained from fruits treated with Ca(NO3)2 at 0.6%.
Regarding yield time, spring summer (SS) fruits showed higher significant value than autumn winter (AW) one. The interaction between the two studied factors, Ca(NO3)2 at 0.6% treatments with (SS) yield recorded highest significant values at all shelf life periods in both seasons.

Table (6) Effect of some pre harvest treatments, yield time and their interaction on total sugars% of guava fruits at different periods of shelf live (2009/2010 and 2010/2011 seasons).

Shelf life period days 1ST.season																		
Treatments.	**0**			**2**			**4**			**6**			**8**			**10**		
	SS	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**
Control	6.48f	5.48h	**5.98D'**	6.71f	5.77h	**6.24D'**	7.36d	6.45f	**6.90D'**	7.62j	6.61h	**7.11D'**	9.21e	8.01h	**8.61D'**	9.52c	8.64f	**9.08C'**
Cacl2 1%	7.30b	6.25j	**6.77B'**	7.74b	6.82f	**7.28B'**	8.37b	7.33d	**7.85B'**	9.11c	8.46e	**8.78C'**	9.55c	8.74f	**9.14B'**	9.85b	9.25e	**9.55B'**
Ca(NO3)2 0.6%	8.51a	7.14c	**7.82A'**	8.82a	7.52c	**8.17A'**	9.68a	8.19c	**8.93A'**	9.97a	8.76d	**9.36A'**	10.33a	9.33d	**9.83A'**	9.43d	9.87b	**9.65A'**
Pp333 150ppm	7.01d	6.33e	**6.67C'**	7.31d	6.60j	**6.95C'**	8.29b	7.18e	**7.73C'**	9.66b	8.15f	**8.90B'**	9.84b	8.36j	**9.10C'**	8.74f	9.97a	**8.85D'**
Mean	**7.32A**	**6.30B**		**7.64A**	**6.67B**		**8.42A**	**7.28B**		**9.09A**	**7.99B**		**9.73A**	**8.61B**		**9.38A**	**9.18B**	
2nd season																		
Control	6.69d	6.01j	**6.35D'**	6.98f	6.41h	**6.69D'**	7.87e	7.44j	**7.65D'**	7.92e	7.63f	**7.77D'**	9.37c	7.92e	**8.64C'**	9.75c	8.55e	**9.15C'**
Cacl2 1%	7.55b	6.45f	**7.00B'**	7.86c	7.25e	**7.55B'**	8.50d	7.70f	**8.10B'**	9.24b	8.30d	**8.77B'**	9.61b	8.63d	**9.12B'**	9.83c	9.38d	**9.60B'**
Ca(NO3)2 0.6%	8.39a	8.34a	**8.36A'**	8.78a	8.53b	**8.65A'**	9.27a	8.74b	**9.00A'**	9.68a	9.29b	**9.48A'**	10.38a	9.67b	**10.02A'**	9.93b	10.47a	**10.20A'**
Pp333 150ppm	7.20c	6.21e	**6.70C'**	7.73d	6.73j	**7.23C'**	8.62c	7.21h	**7.91C'**	9.01c	7.59f	**8.30C'**	9.41c	7.83f	**8.62D'**	8.51e	8.30f	**8.40D'**
Mean	**7.45A**	**6.75B**		**7.83A**	**7.23B**		**8.56A**	**7.77B**		**8.96A**	**8.20B**		**9.69A**	**8.51B**		**9.50A**	**9.17B**	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level. SS = Spring summer yield AW = Autumn winter yield.

These results are agreement with those found by (**Wills et al, 1980),** as hydrolysis of starch into sugars is completed, no further increase in total sugars percentage occurs and subsequently a decline in this parameter is predictable.

Incidence of rot %: In table (7) concerning pre harvest treatments, control gave highest significant values in both seasons except PP_{333} at the shelf life period 8 and 10 days in the first season, but the lowest significant percentage was recorded by Ca(NO3)2 at 0.6% at most of shelf live factors. Regarding yield time, spring summer (SS) fruits showed higher significant value than autumn winter (AW) one. The interaction between the two studied factors, Ca(NO3)2 at 0.6% with (AW) yield recorded lowest significant values at most shelf life periods in both seasons.

Table (7) Effect of some pre harvest treatments, yield time and their interaction on incidence of rot % of guava fruits at different periods of shelf live (2009/2010 and 2010/2011 seasons).

Shelf life period days	**1ST.season**																	
Treatments…..	**0**			**2**			**4**			**6**			**8**			**10**		
	SS	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**	**SS**	**AW**	**Mean**
Control	0a	0a	**0A'**	47.33a	0d	**23.66A'**	60.40a	0e	**30.20A'**	72.10a	0e	**36.05A'**	84.60b	0e	**42.30B'**	15.30b	0d	**7.65B'**
Cacl2 1%	0a	0a	**0A'**	2.10c	0d	**1.05BC'**	6.20c	0e	**3.10C'**	9.40c	0e	**4.70C'**	12.40c	0e	**6.20C'**	15.20c	0d	**7.60B'**
$Ca(NO3)_2$0.6%	0a	0a	**0A'**	2.01c	0d	**1.00C'**	6.10d	0e	**3.04D'**	9.21d	0e	**4.60D'**	12.30d	0e	**6.15C'**	15.23c	0d	**7.61B'**
Pp333 150ppm	0a	0a	**0A'**	2.29b	0d	**1.10B'**	6.40b	0e	**3.20B'**	9.60b	0e	**4.80B'**	99.90a	0e	**49.95A'**	15.50a	0d	**7.75A'**
Mean	**0A**	**0A**		**13.41A**	**0B**		**19.77A**	**0B**		**25.07A**	**0B**		**52.30A**	**0B**		**15.30A**	**0B**	
2nd season																		
Control	0a	0a	**0A'**	45.30a	0e	**22.65A'**	62.30a	0e	**31.15A'**	70.50a	0d	**35.25A'**	82.40a	0e	**41.20A'**	98.70a	0d	**49.35A'**
Cacl2 1%	0a	0a	**0A'**	2.30c	0e	**1.15C'**	6.40c	0e	**3.20C'**	10.30b	0d	**5.15B'**	12.40c	0e	**6.20C'**	15.10c	0d	**7.55C'**
Ca(NO3)20.6%	0a	0a	**0A'**	2.20d	0e	**1.00C'**	6.30d	0e	**3.15B'**	10.10c	0d	**5.05C'**	12.20d	0e	**6.10D'**	15.03c	0d	**7.51C'**
Pp333 150ppm	0a	0a	**0A'**	2.50b	0e	**1.25B'**	6.60b	0e	**3.30D'**	10.30b	0d	**5.15B'**	12.60b	0e	**6.30B'**	15.30b	0d	**7.65B'**
Mean	**0A**	**0A**		**13.07A**	**0B**		**20.40A**	**0B**		**25.30A**	**0B**		**29.90A**	**0B**		**36.03A**	**0B**	

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level. SS = Spring summer yield AW = Autumn winter yield.

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