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EFFECT OF PRUNING DATES ON HARVESTING TIME, YIELD, QUALITY AND STORAGE OF GUAVA UNDER DRIP IRRIGATION

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ABSTRACT

This study was undertaken to investigate the effect of pruning dates on harvesting time, yield, fruit quality and storage life of guava. The trees were grown under drip irrigation system in sandy soil under desert condition. The data revealed that, bud break, full bloom and harvest time were earlier by pruning trees at 15 Dec. or Jan. than those pruned at 15 Feb. or Mar. Also, early pruning increased the yield through increasing fruit weight, length and diameter.

Fruits of trees pruned at 15 Dec. or Jan. and stored at 10 °C and 90 % R.H. for 3 weeks gave the highest percent of weight loss (17.03-18.03 %) and (16.42-17.42 %) respectively during the two seasons of study; whereas this percent was (15.27-16.45 %) and (10.23-11.65 %) in fruits from trees pruned at 15 Feb. or Mar. respectively. Also, fruit weight, firmness, V.C, acidity and total phenols gradually decreased with prolonged storage in all applications, but SSC, total sugars and SSC/acid ratio increased. Moreover, pruning application at 15 Mar. (last date) had a good effect on fruit behaviour during storage.

Shelf life of fruits [held 4 days at room temperature after cold storage] have a suitable marketable condition for fruits of trees pruned at 15 Feb. or Mar. compared with fruits of trees pruned at 15 Dec. or Jan. Pruning application at 15 Mar. (last date) gave better effect in this respect.

INTRODUCTION

Guava (*Pisidium guajava* L.) is one of the most common fruits in Egypt. It is popular among all people due to its low price than some other fruits, nourishing value and good taste. It is also a rich and cheap source of vit. C and contain about 2 to 5 time higher than fresh orange juice, and as a good source of calcium and phosphorus (Phandis, 1970 and Siddiqui *et al.*, 1991). It is also rich in pectin, which has industrial use for jelly production, (Bose & Mitra, 1990).

Guava orchards increased in the last few years especially in the newly reclaimed lands. Since, guava trees can grow under a wide range of climatic and soil conditions (Bourk, 1976). The tree is fairly salt and drought-resistant and alkaline soil up to pH 8.2 (Samson, 1980).

In general, pruning is an obvious management technique developed to regulate the balance between production and vegetative growth of guava trees. Moreover, pruning date play an important role on bud behaviour, fruit maturation times and quality. Rinaldelli *et al.* (1988) found that when cv. Sangiovese/ Kober 5BB vines were pruned at a given time between mid-Nov. and the beginning of April over a 2 year period of time of pruning bud break and flowering date varied with pruning date and year date of

Little information about pruning date of guava trees are available under Egypt conditions. EL-Shahat (1984) reported that the first date of pruning (January 1st) on Roomy Ahmar grapevines breaked the vegetative buds earlier by about 1-10 days compared with all other treatments.

pruning can thus be used as a tool for controlling the times of bud break and flowering. Shatat (1993) studied the effect of four pruning dates on yield and fruit quality of guava in the Jordon valley, found that, early pruning (15 Nov.) resulted in the largest fruits with the lowest SSC percentage. While, the latest date (15 Feb.) gave the smallest fruit with the highest SSC percentage. Gorakh *et al.* (2001) found that late pruning date (May) significantly increased the quantum yield harvestable in December and January of Sarada and Allahabad Safeda guava cultivars.

Therefore, the present investigation was carried out to study the effect of different pruning dates on recording picking dates, yield, fruit quality and storage ability of guava fruits under drip irrigation system under desert conditions.

MATERIALS AND METHODS

This study was conducted during two seasons of 2002 and 2003 on common guava trees 12 years old growing in sandy soil under drip irrigation system in private orchard at EL-Noubaria, Behera Governorate. Trees were planted at 5 x 5 meters and received the cultural practices commonly adopted in that area. The trees were almost similar in vigour and free from diseases. 60 trees were selected and arranged in a randomized block design, with three replications per treatment, 5 trees each. The applied treatments were as the following : 1- Trees pruned at 15 Dec. 2- Trees pruned at 15 Jan. 3- Trees pruned at 15 Feb. 4- Trees pruned at 15 Mar.

The bud break, full bloom and harvest time were recorded for all treatments used.

At harvest, when the fruits reached the commercial stage for harvesting (yellowish colour stage), fruits were picked and yield per tree was recorded and fruits were immediately taken to the laboratory. Fruit weight, length, diameters, flesh and core weight, were determined.

For storage study, guava fruits were packed in open carton boxes. Each box was considered as a replicate containing 50 fruits. Three replicates for each treatment were taken and stored at 10 °C with relative humidity about 90 %. Stored fruits were examined at one week interval. A sample of one box was taken at each sampling period and subjected to the following determinations : weight loss %, firmness, acidity %, SSC %, SSC/acid ratio, total sugar, vitamin C and total phenols.

- Vitamin "C" for determination as ascorbic acid, 5 ml samples of fruit juice were used 5 ml of oxalic acid solution were added to each sample and titrated with 2, 6 dichloro-phenol-indophenol solution. The ascorbic acid content was expressed as milligrams ascorbic acid per 100 ml fruit juice (A.O.A.C. 1980).

- Total sugars were determined in fresh fruits as mg/100 ml juice samples according to Somogyi (1952).
- Total phenols (%) were determined according to the method of Swain & Hillis (1959).

For shelf life study, after 3 weeks of cold storage at 10 °C, all fruit packages were removed and kept at ambient conditions for 4 days, after which weight loss, SSC percentage and firmness were evaluated.

The statistical analysis of the data was carried out according to Snedecor & Cochran, (1973).

RESULTS AND DISCUSSION

A- Bud break, full bloom and harvest date :

Data presented in Table (1) indicated that, pruning guava trees at 15 December or January gave earlier bud break, full bloom and harvest than pruning trees at 15 February or March. The harvest date was at July by pruning trees at 15 Dec. or Jan., while, harvest date was late up to Aug. and Sep. for other pruning applications during the two seasons. The obtained results are in agreement with EL-Shahat (1984) and Rinaldelli *et al.*, (1988).

Table (1) : Bud break, full bloom and harvest dates of guava as affected by pruning date.

Pruning date	Bud break		Full bloom		Harvest time	
	2002	2003	2002	2003	2002	2003
15/12 Dec.	15/2	18/2	10/4	18/4	July	July
15/1 Jan.	20/2	24/2	18/4	26/4	July	July
15/2 Feb.	8/3	10/3	6/5	12/5	August	August
15/3 Mar.	29/3	25/3	1/6	2/6	September	September

B- Yield and fruit quality :

Yield :

It is obvious from Table (2) that early pruning of guava trees (15 Dec. & Jan.) significantly increased yield/tree than the late pruning dates in the two seasons of study. The yield per tree reached (63.0-65.0 kg) and (60.6-62.7 kg) in guava trees pruned at 15 Feb. and 15 Jun. respectively. While, the yield/tree due to pruning at 15 Mar. or 15 Feb. recorded (52.6-54.3 kg) and (46.6-47.3 kg) respectively. These results are in agreement with those obtained by Robert *et al.* (1987); EL-Shahat *et al.* (1996) and Gorakh *et al.*, (2001).

Fruit weight :

Data in Table (2) clear that, guava trees pruned at 15 Dec. or Jun. (early pruning) significantly increased fruit weight compared with the other date of pruning during the two seasons. The most effective date was pruning at 15 Dec. (first date) which increased fruit weight to 13.8 and 14.5 gm. respectively compared with the last date of pruning (15 March) in the two seasons. Similar results were found by Shatat, (1993) and EL-Shahat *et al.* (1996).

Table (2): Yield and physical characteristics of guava fruits as affected by pruning dates during season 2002 and 2003.

Pruning date	Yield/tree (kg)		Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)		Flesh weight (g)		Core weight (g)	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
15/12 Dec.	65.0	63.0	156.15	154.17	8.43	8.13	5.81	5.47	123.70	122.7	32.47	31.5
15/1 Jan.	62.67	60.6	154.75	151.47	8.35	7.93	5.74	5.07	122.95	120.8	31.8	30.7
15/2 Feb.	54.33	52.6	147.64	144.52	7.99	7.57	5.51	4.8	117.82	115.7	29.82	28.81
15/3 Mar.	47.33	46.6	142.4	139.63	7.56	7.03	5.07	4.27	114.9	112.6	27.5	27.0
L.S.D at 5%	2.93	5.51	1.181	4.646	0.059	0.195	0.192	0.173	0.885	0.652	0.479	0.637

Fruit length and diameter :

From Table (2) it is clear that, pruning of guava trees at 15 Dec. or Jan. significantly increased fruit length and diameter than the other date (15 Feb. and Mar.) in the two seasons under the study.

Flesh and core weight :

Concerning the effect of pruning dates on flesh and core weight of guava fruits, data in Table (2) indicated that, pruning application at 15 Dec. & Jan. significantly increased flesh and core weight of guava fruits than the other pruning dates in the two seasons of study.

C- Effect of pruning date on fruits during storage :

Weight loss (%) :

Data in Table (3) show the effect of pruning dates on weight loss percentage occurring in guava fruits during cold storage for 3 weeks. It is clear that loss in weight gave the highest values due to the earlier dates of pruning (15 Dec. & Jan.). While, the loss in weight was lower due to late pruning date (15 March).

Loss in weight after two weeks of cold storage ranged between 11.65 and 18.03 % and from 10.23 and 17.03 % during the two seasons, respectively. In general, all pruning dates except (pruning at 15 March) increased loss in weight percentage after 2 weeks of cold storage at 10 °C and 90 % R.H. during the two seasons of study. The weight loss is a result of water loss from the fruit tissues and partially of the respiration process. These results agreed with those reported by Rofael (1985) and Hussein *et al.* (1998) on guava fruits.

Fruit firmness :

Data in Table (3) clearly show that, fruit firmness of guava at harvest, increased significantly with delaying the pruning date during the two seasons of this investigation. The same data cleared that fruit firmness significantly decreased with the extension of the storage period. It is clear that, pruning guava trees at 15 March (last date) induced the firmness of guava fruits during cold storage, but guava firmness declined rapidly in fruits of earlier date of pruning. It was observed that fruit firmness decreased with storage time, as the rate of degradation of insoluble protopectins to simple soluble pectins, increased with the progress of storage time. These findings agreed with those reported by El-Seidy, (1994) and Hussein, (1998).

Table (3) : Weight loss (%), firmness (lb/in^2) and acidity (%) of guava fruits as affected by pruning dates under cold storage.

Pruning date	Weight loss %					Firmness (lb/in^2)					Acidity %				
	Storage period (weeks)					Storage period (weeks)					Storage period (weeks)				
	0	1	2	3	Av.	0	1	2	3	Av.	0	1	2	3	Av.
	Season 2002														
15/12	---	14.43	18.03	---	16.23	6.17	4.83	4.0	---	5.00	0.47	0.45	0.40	---	0.44
15/1	---	13.59	17.42	---	15.51	6.4	4.92	4.0	---	5.11	0.44	0.42	0.39	---	0.42
15/2	---	12.54	16.45	---	14.50	7.33	5.43	4.83	---	5.86	0.44	0.41	0.37	---	0.41
15/3	---	9,48	11.65	15.2	12.11	7.5	7.00	5.17	4.00	5.92	0.41	0.39	0.34	0.30	0.36
L.S.D at 5 %	---	0.354	0.545	---	---	0.373	0.326	0.373	---	---	0.023	0.018	0.016	---	---
	Season 2003														
15/12	---	15.07	17.03	---	16.05	6.5	5.0	4.07	---	5.19	0.45	0.43	0.38	---	0.42
15/1	---	14.07	16.42	---	15.25	6.63	5.57	4.2	---	5.47	0.42	0.40	0.37	---	0.40
15/2	---	11.81	15.27	---	13.54	7.5	5.67	4.5	---	5.89	0.43	0.39	0.35	---	0.39
15/3	---	8.7	10.23	14.53	11.15	7.9	6.53	5.3	4.13	5.97	0.51	0.38	0.31	0.28	0.37
L.S.D at 5 %	---	0.425	0.453	---	---	0.224	0.149	0.265	---	---	N.S	0.012	0.018	---	---

Total acidity % :

The results presented in Table (3) indicated that, the acid values decreased during storage. Guava pruned at 15 March (last date) gave the least values of acidity during cold storage compared with the other pruning dates. The decrease of acid %, during storage period, could be due to the destruction of organic acids through oxidation and consumption of those acids, as an organic substrate in the respiration processes of the fruit tissues. These findings are in line with those reported by Bhullar and Farmahan (1980) and Hussein *et al.* (1998) on guava fruits.

Soluble solids content (SSC %) :

Data recorded in Table (4) clearly show that, soluble solids contents increased gradually and significantly towards the end of storage period. Guava pruned at 15 March (last date) gave the highest increment in this respect while, guava pruned at 15 Dec. (early date) gave the least values of SSC % during the two seasons of this study. The gradual increase in the percentage of SSC % with the storage period could be due to the degradation of complex insoluble compounds, like starch, to simple soluble compounds, like sugars, which are the major component of SSC in the fruits, and also, other complex components, which degraded to soluble forms, as pectin and, so, accumulation of SSC in the fruits, or to water loss by transpiration through storage period.

These results are in accordance with those reported by Rofael (1985) and Hussein *et al.* (1998) on guava fruits.

SSC/acid ratio :

Concerning the effect of various pruning dates on SSC/acid ratio, data in Table (4) show that this ratio was almost similar to that found with SSC. The fruits from trees pruned at 15 March gave the highest values of SSC/acid ratio compared with other pruning dates during the two seasons of the study.

Total sugars :

The results in Table (4) reveal that in fruits of all pruning dates, the total sugars increased gradually as the storage period prolonged. The highest values of total sugars were gained at the end of storage when guava trees were pruned at 15 March. The increase in total sugars values may be chiefly due to loss in water and due to the conversion of complex forms, as carbohydrates like starch, to simple forms of sugars with the enzyme activities in guava fruit as α-amylase.

These findings agreed with those reported by Rofael (1985); Augustin & Osman (1988) and Hussein *et al.* (1998) on guava fruits.

Table (4) : Soluble solids content, SSC/acid ratio and total sugars of guava fruits as affected by pruning dates under cold storage.

Pruning date	SSC (%)					SSC/acid ratio					Total sugars				
	Storage period (weeks)					Storage period (weeks)					Storage period (weeks)				
	0	1	2	3	Av.	0	1	2	3	Av.	0	1	2	3	Av.
	Season 2002														
15/12	9.5	9.7	10.0	—	9.73	18.26	20.16	24.8	—	21.07	6.07	6.32	7.04	---	6.48
15/1	9.0	9.47	10.3	—	9.59	20.46	22.74	26.74	—	23.31	6.43	6.77	7.30	---	6.83
15/2	9.3	10.0	10.87	—	10.06	21.06	24.61	29.39	—	25.02	6.73	7.07	7.67	---	7.16
15/3	9.67	10.67	11.33	11.9	10.89	23.37	27.38	33.35	39.80	30.98	7.3	7.37	8.29	8.87	7.96
L.S.D at 5 %	0.746	0.643	0.229	---	---	1.219	2.298	1.504	---	---	0.197	0.138	0.264	---	---
	Season 2003														
15/12	8.4	9.2	10.0	—	9.2	18.82	21.40	26.29	—	22.17	6.53	6.43	7.17	---	6.71
15/1	9.17	9.6	10.47	—	9.75	21.77	23.81	28.55	—	24.71	6.67	6.93	7.43	---	7.01
15/2	9.47	10.2	10.87	—	10.18	22.02	26.15	30.66	—	26.28	6.9	7.33	7.93	---	7.39
15/3	10.27	10.8	11.5	12.0	11.14	25.67	28.18	36.76	42.38	33.25	7.5	7.73	8.53	8.94	8.18
L.S.D at 5 %	0.428	0.346	0.219	—	—	0.738	1.264	2.346	—	—	3.542	0.200	0.058	---	---

Vitamin "C" :

From Table (5) it is clear that, vitamin "C" content decreased gradually as the storage period advanced. The lowest values of vitamin "C" were gained at the end of storage from guava trees pruned at 15 March (last date) during the two seasons of this study. The loss in ascorbic acid (V.C) content, during storage, could be attributed to the rapid conversion of L-ascorbic acid into dihydro-ascorbic acid in the presence of L-ascorbic acid oxidase. The above results agreed with those obtained by Rofael (1985) and Hussein *et al.* (1998) on guava fruits.

Total phenols :

The results in Table (5) indicated that with all applications, total phenols were gradually decreased as the storage period advanced and the lowest values of total phenols were gained at the end of storage. Moreover, the pruning at 15 Dec. and Jan. (early dates) gave the best values of total phenol at 2 weeks of storage compared with the other dates used during the two seasons. The decrease in total phenols content might be due to the biochemical reactions or high activity of polyphenol oxidase (PPO) enzyme, caused by changing the phenol form to quinone form, or that (PPO) caused the consumption of phenolic compounds during the storage period, which caused flesh browning in fruits. These findings are in line with those of Rofael (1985) and Hussein *et al.* (1998) on guava fruits.

Table (5) : Vitamin "C" and total phenols of guava fruits as affected by pruning dates.

Pruning date	Vitamin "C" mg/100 ml juice					Total phenols				
	Storage period (weeks)					Storage period (weeks)				
	0	1	2	3	Av.	0	1	2	3	Av.
	Season 2002									
15/12	180.0	155.7	77.33	—	137.68	1.36	1.08	0.79	—	1.08
15/1	190.0	171.7	87.7	—	149.8	1.34	1.01	0.73	—	1.03
15/2	193.3	181.7	86.0	—	153.67	1.13	0.91	0.60	—	0.88
15/3	201.3	192.0	93.0	55.33	135.41	0.99	0.79	0.49	0.25	0.63
L.S.D at 5 %	9.027	3.652	2.809	—	—	0.035	0.022	0.010	—	—
	Season 2003									
15/12	179.0	74.67	74.67	—	137.11	1.46	1.19	0.75	—	1.13
15/1	183.3	84.67	84.67	—	145.88	1.38	1.14	0.68	—	1.07
15/2	189.7	83.33	83.33	—	151.0	1.20	1.09	0.62	—	0.97
15/3	199.7	87.0	87.0	49.33	131.33	1.03	0.83	0.51	0.27	0.66
L.S.D at 5 %	5.219	1.491	1.491	—	—	0.215	0.017	0.012	—	—

Shelf-life :

Fruit behaviour during the simulating marketing period for 4 days after removal from cold storage at room temperature is shown in Table (6). Fruit weight loss % was the lowest in fruits of pruning application at 15 Mar. as compared to other treatments in both seasons.

In addition, the data presented that fruit firmness of pruning application at 15 Feb. or Mar. gave the highest values in firmness than all applications in both seasons concerning shelf life period. Data also indicated that fruits of pruning application at 15 Feb. and Mar. showed the highest values of SSC % as compared to other pruning applications during shelf life under the study. From this study, it may be concluded that late guava fruits (late pruning date) were better than early fruits (early pruning date) in storage and shelf life for reduction in weight loss %, retaining its firmness and high contents of SSC, V.C and total sugars, which indicated a high potential for post-harvest handling and marketing.

Table (6) : Shelf life of guava fruits as affected by pruning dates under cold storage.

Pruning date	Season 2002			Season 2003		
	Weight loss %	Firmness (lb/in^2)	SSC %	Weight loss %	Firmness (lb/in^2)	SSC %
15/12	5.23	3.0	10.0	5.0	3.0	10.0
15/1	5.96	3.13	10.2	5.67	3.13	10.17
15/2	5.67	3.17	10.93	5.67	3.2	11.33
15/3	4.23	3.17	12.07	4.3	3.2	12.03
L.S.D at 5 %	0.418	0.457	0.167	0.325	0.396	0.335

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تأثير مواعيد التقليم على ميعاد الجمع والمحصول والجودة والتخزين في ثمار الجوافة تحت ظروف الرى بالتنقيط

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أجريت هذه الدراسة خلال موسمى ٢٠٠٢ ، ٢٠٠٣ لدراسة تأثير مواعيد التقليم على ميعاد الجمع والمحصول والجودة والتخزين في ثمار الجوافة تحت نظام الرى بالتنقيط فى الأراضي الرملية وكان أشجار الجوافة عمرها ١٢ سنة وعلى أبعاد ٥ x ٤ متر.

وكانت مواعيد تقليم الأشجار كالآتى (١) ١٥ ديسمبر (٢) ١٥ يناير (٣) ١٥ فبراير (٤) ١٥ مارس.

أوضحت الدراسة أن التقليم المبكر لأشجار الجوافة (ديسمبر ، يناير) تسبب فى تبكير مواعيد كل من تفتح البراعم والإزهار الكامل وكذلك ميعاد جمع المحصول. حيث أن ميعاد الجمع كان فى شهر يوليو لكل من معاملتى التقليم في ١٥ ديسمبر ، يناير وكان الجمع فى شهر أغسطس وسبتمبر لكل من معاملة التقليم فى ١٥ فبراير ، ١٥ مارس على التوالى.

زاد المحصول زيادة معنوية فى الأشجار التى تم تقليمها مبكراً عن التى تم تقليمها متأخراً. وكان أقل محصول للأشجار التى تم تقليمها في ١٥ مارس خلال موسمى الدراسة حيث أن معاملة التقليم في ١٥ ديسمبر أعطت محصول ٦٣-٦٥ كجم/شجرة أما الميعاد الأخير (١٥ مارس) أعطى محصول ٤٦-٤٧ كجم/شجرة.

أما عن صفات الثمار عند الجمع ، فإن تقليم الأشجار في المواعيد المبكرة أدى إلى زيادة في وزن وطول وعرض الثمار وكذلك وزن اللحم واللب.

تخزين الثمار في درجة حرارة ١٠ °م ورطوبة نسبية ٩٠ % لمدة ٣ أسبوع أوضح أن الفقد في وزن الثمار أثناء التخزين البارد كان عالياً فى ثمار الأشجار التى تم تقليمها فى ١٥ من ديسمبر أو يناير وكان الفقد فى الوزن أقل فى الثمار التى تم تقليم أشجارها فى ١٥ من فبراير أو مارس حيث النسبة المئوية للفقد فى وزن الثمار بعد أسبوعين من التخزين (١٧,٠٣-١٨,٠٣ %) ، (١٦,٤٢-١٧,٤٢ %) ، (١٥,٢٧-١٦,٤٥ %) ، (١٠,٢٣-١١,٦٥ %) لكل من ثمار الأشجار التي قلمت في ١٥ ديسمبر ويناير وفبراير ومارس على التوالي.

كما زادت صلابة الثمار في ثمار الأشجار التي تم تقليمها متأخراً (١٥ فبراير أو مارس) عن التي تم تقليمها مبكراً (١٥ ديسمبر أو يناير) بعد أسبوعين من التخزين.

كما زادت المواد الصلبة الذائبة والسكريات مع تقدم التخزين وكان محتوى الثمار منها بعد أسبوعين من التخزين في الثمار التي تم تقليمها متأخراً (١٥ فبراير أو مارس) أعلى بالمقارنة بثمار الأشجار التي تم تقليمها مبكراً (١٥ ديسمبر أو يناير).

كما أن نسبة الحموضة وفيتامين (ج) و الفينولات فقد قلت مع تقدم التخزين. وكانت السكريات الكلية وفيتامين (ج) أعلى بعد أسبوعين في ثمار الأشجار التي تأخر تقليمها مبكراً. وأما الفينولات فكانت أعلي بعد أسبوعين من التخزين في الثمار التي تم تقليمها مبكراً (١٥ ديسمبر أو يناير) عن ثمار الأشجار التي تم تقليمها متأخراً (١٥ فبراير أو مارس).

الثمار التي وضعت بعد فترة التخزين البارد في جو الغرفة لمدة ٤ أيام للتسويق أعطت ثمار الأشجار التي تم تقليمها في ١٥ مارس أعلي قدرة تسويقية حيث أعطت أقل قيمة في الفقد في وزن الثمار و زيادة في صلابة الثمار و المواد الصلبة الذائبة خلال موسمي الدراسة.