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EFFECT OF POLLINATION DATES ON FRUIT SET, MATURITY PERIOD , HARVEST AND FRUIT QUALITIES OF *ANNONA* AT ALEXANDRIA.

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ABSTRACT

Two annona (Cherimoya) species namely; *A. squamosa* (local cultivar called known as Baladi) and *A. atemoya* (Cherimata variety) were pollinated during flowering periods of Using alternative treatments and self pollination to study the effect of pollination date on fruit set and fruit qualities, fruit maturity periods, percentages of harvested fruits and harvest dates. The research aimed to decreasing labors coasts by selecting the most effective dates for hand pollination to increase yield and fruit qualities and controlling the maturity period needed for growers under similar environments to send fruits to markets in suitable time for high gains and offer fruits in different dates. The research also help in choosing suitable pollinators for each cultivar in each date for increasing yield by hand pollination. The data indicated better fruit set reflecting high compatibility using *A. atemoya* (Cherimata variety) treatments either as male or female parents especially during July in both seasons with slight differences between dates due to changes in flowering duration in both seasons. Generally, the maturity periods were higher for pollinated flowers during early and mid-flowering and decreased at the end of flowering season. The fruit qualities showed wide range of differences not only related to pollination dates but also due to variety differences, season and relations between different criterias such as fruit weight and dimension, seed number and weight, peel weight., TSS and acidity. Significant differences were found between dates of pollination of self *A.squamosa treatment* (for fruit length, acidity in 2001 and fruit weight, length, seed weight and TSS in 2002) and between dates of pollination of *A.squamosax A. atemoya* (Cherimata) for seed weight in 2001 and between pollination dates of self *A.atemoya* (Cherimata) treatment for seed number, peel weight and TSS in 2002, while all other treatments showed non significant differences between pollination dates. It was generally found that pollination treatments during July produced higher percentages of fruits than those treatments during June and the harvest was higher in October than November.

INTRODUCTION

The cherimoya (annona spp.) is distributed in tropical and sub tropical zones all around the world. There are famous known edible species such as *A. squamosa, A. atemoya atemoya* (hybrid of *A. cherimolia* x *A. squamosa*). The atemoyas had the sweetness from mother squamosa and the low seed number and flavor from male cherimoya parent. Both atemoyas and squamosas need hand pollination under Alexandria environments to increase yield (Ahmed, 1936, Othman and Badr, 1995) and Badr, 1997). The fruit set depend on pollinator, environments and pollination dates (George, *et al* 1994). The cherimoya (annona) species and varieties differ in their flowering duration, amount of daily produced flowers, pollen viability and compatibility. The pollination date is one of the most effective factors on fruit set depending on variation of the temperature and humidity. The hand pollination is needed for increasing yield of some cultivars, while others could not bear fruits

without hand pollination (Badr, 1997) . Other cultivars need hand pollination for improving fruit qualities (George *et al,* 1994). Richardson and Anderson (1996) reported that cherimoya flowers open over a protracted period, a fact which has a dramatic effect on fruit set, fruit size and yield. The cherimoyas (annonas) need artificial pollination because of it`s flowers nature. The most prominent pollination mode in neotropical Annonaceae is pollination by beetles. Flowers are protogynous and have fruity, spicy or unpleasant odors. The floral chambers is formed by the petals closing over the flower center (Gottsberger, 1999). The beetles are not available any time, so it is better to be replaced by hand pollination. The fruit set percentage differ according to the pollinator. The sugar apple (*Annona squamosa*) originated in tropical America, and is now widely grown in tropical and subtropical areas. The atemoya is a hybrid of A. cherimola (the cherimoya) and A. squamosa. Both crops need warm, protected, frost-free sites, but the sugar apple is better suited than the atemoya to cooler places (TDAI., 2002). Biochemical interactions was found between the pollen and the pistil which allow plants fine control over fertilization (Felipe *et al*, 2003). The efficiency of pollen is related to pollination date as affected by temperature and humidity.

In Alexandria- Egypt, Both Atemoyas and Squamosas are adopted in the area. The flowering period extend for more than two-four months during summer, so labor costs for hand pollination were high during this long period. Selecting the most effective pollination dates could help in decreasing such high costs. The present study tried to determine the suitable and most effective pollination dates to decease the pollination period and for high fruit qualities, increasing fruit set and yield in short time for decreasing labor costs and saving time used in useless pollination treatments with no yield. The atemoya and other annona trees bear hermaphroditic protogynous flowers and self-pollination is rare. Atemoyas are sometimes misshapen, underdeveloped on one side, as the result of inadequate pollination. Hand-pollination will enhance fruit-setting and this is commonly practiced in Egypt. The atemoya is a shy yielder (.Morton, 1987)

MATERIALS AND METHODS

The research was conducted at Alexandria regional station during 2001 and 2002 on trees about 30 years old. The trees were grown in clay soil at 5 x5 meters a part, received the same recommended cultural practices. Flowers at the last stage prior to openning, of *Annona atemoya* cultivar (cherimata), sweet apple (*Annona squamosa*), were collected daily at previous day of treatments and left all the night till anther shed pollen. The pollen was collected in small glass bottles and used in the next day for pollinating available opening flowers of mother trees of the previous annonas using three replicated mother trees for each studied cultivar, using pollination treatments alternatively during the second week of June to the end of July in 2001 and 2002 season. The flowers of mother trees were emasculated to prevent effect of its pollen and hand pollination was done using paint brush (No 2) cutting the ends of Camels hair of the brush to be equal in length to

cover all the ovary aria during pollination for getting regular fruit shape. Each pollination treatment was done daily for available opening flowers (about 30 flowers daily) on three trees of each cultivar. The data on pollinated flower number, fruit set as percentages of total pollinated flowers for each pollination date were recorded. The period from fruit set to maturity was calculated as averages of each pollination date. Fruit qualities including TSS by hand refactometer and citric acid as mg per 100 ml. fruit juice was determined (by titration with 0.1N sodium hydroxide. (AOAC,1990). Fruit physical characteristics were also determined including weight, length diameter, seed weight and number per fruit. The fruit characteristics were done on 5 fruits of each daily treatment in a composite sample on half week basis (The first half A and the second half is B) for the treatments during the last two weeks of June and the for weeks of July according to the harvested fruits). The percentage of harvested fruits during each harvest date were recorded and percentages of fruits obtained from pollination treatments during each week of June and July treatments dates for each treatment were recorded to determine the best pollination week, month, the best harvest and number of harvests during 2001 and 2002 seasons. Statistical analysis of data was done using ANOVA (CRBD) as mentioned by (Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

The data on fruit set and fruit maturity period were illustrated individually for each cherimoya (annona) Spp. On dates according to flowering habit and availability of flowers. The data on fruit analysis were recorded at half week intervals (the first three days (A) and the last three days are (B) for each cherimoya Spp. According to fruit availability (as some dates were cancelled due to the lack of collected fruits) in combined samples of three tree replicates for each treatment

1- Effect of pollination dates on fruit set:

The fruit set percentages of pollination treatments on *A.squamosa in 2001 and 2002* (Fig, 1-a &1-b) showed fluctuations according to pollination dates. The self treatment of *A.squamosa* in 2001 showed slight peak of fruit set (30%) during 26 and 27 June while other values ranged from 10-20 % fruit set. In 2002, the percentages increased to 30% during 2-4 July followed by slight fluctuations then increased to 40% in 14 July and sharp increase to 60 % in 18 July then decreased to 30 % in 20 July. The a. *A. atemoya* (cherimata) treatment on *A.squamosa* mother trees indicated sharp increase of fruit set in 16 July in ,2001, while it was noticed that 40% fruit set was obtained during 21 June, 9,10, 14 July and the highest percentage (50%) was obtained in 8 July of 2002. This indicate that the highest fruit set percentage of cherimata treatment on *A.squamosa* mother tree was around the third week of July in both seasons The self treatment of *A.squamosa*is was higher in 2002 than 2001 with the highest peak in 18 July (the third week also). Generally, the treatments on *A.squamosa*, either selfing or using *A.*

atemoya pollen (Fig, 1-a & b), revealed that the highest fruit set was obtained in peaks beginning from the third week of June.

During early flowering and around the third week of July. the highest fruit set of all treatments in both seasons was that of *A. atemoya x A squamosa* in 2001 (80%) in 16 July followed by *A.squamosa* x *A.squamosa*in 18 July in 2002 (60%), followed by equal percentages of *A. atemoya* x *A.squamosa* (50%) 27 June (2001) and 9 July (2002). These data reflects also the compatibility of *A. atemoya* pollen and *A.squamosa*in. The mechanisms of compatible pollination are less studied than those of incompatible pollination and yet most of the angiosperms show self-compatibility (Lord, 2003). On the other hand there is a need of hand pollination due to flowers which are protogynous and have fruity, spicy or unpleasant odors densely aggregated stamens with their connective shield appear to be a kind of anti predator structure as in Annonaceae (Gottsberger, 1999). On the other hand the end of a flower's attraction to pollinators may be due to a range of visible cues such as permanent flower closure, a color change, and withering or abscission of the petals. Floral attraction may be reduced by pollination Doorn (1997). So, hand pollination using paint brush in the mentioned dates offer good pollination treatment especially using *A. atemoya* for *A.squamosa* to increase fruit set even at the end of flowering period The alteration of peaks of selfing reflect the tendency of alternate bearing of *A.squamosa* and the differences of flowering duration according to season which must be noticed in the following season as noticed by slight changes in peacks dates. Growers should aim to pollinate flowers regularly during the main flowering flush to maximize yields of export quality fruit (Richardson and Anderson 1996).

The first peak of *A.squamosa* x *A. atemoya* in 2001 (Fig, 2-a), was during the period of 18 & 22 June (50%), followed by 20 June and 6 July (30%). The fruit set of the same treatment in 2002 (Fig, 2-b), was higher in 21 June, 9 and 19 July (40%), while the highest in 8 July (50%). These indicate the efficiency of *A.squamosa* treatment during early flowering in the third week of June and during the second week of July in both seasons. The peaks of fruit set of *A. atemoya* x A. *atemoya* (selfing) was later and generally higher than *A squamosa* x *A. atemoya* in both seasons. The first peak in 3 July (30%), the highest in 6, followed by 22 July (50% & 40%), respectively. In 2002, higher peaks were noticed later during 11, 12 , 20 and 24 July (60, 50, 60 and 70 %), respectively. This indicates that the atemoya pollen is more effective in the second season during July. The need of hand pollination of *A. atemoya* and *A.squamosa*was also reported by TDAI (2002). The flowers of both the sugar apple (*A. squamosa)* and the *A.* atemoya have special features, which make it necessary for growers to pollinate the flowers by hand. Although a single flower will have both male and female structures, they will mature at different times ("dichogamy"). The female-stage flowers mature first, just before petal separation. A few days later, the flower progresses into the male stage of flowering, when the anthers begin to shed their pollen. Insect pollination of flowers is rare. Incomplete pollination may result in abnormal fruit, low fruit set and low yields. Poor pollination is perhaps the main problem in producing these two fruits. TDAI. (2002)

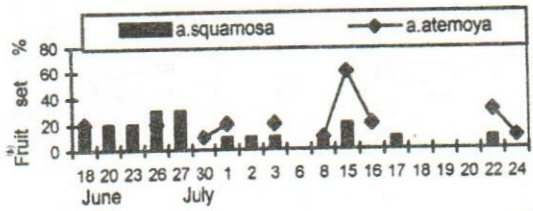


Fig. (1-a): fruit set percentages in different pollination dates of treatments on *A. squamosa in* 2001.

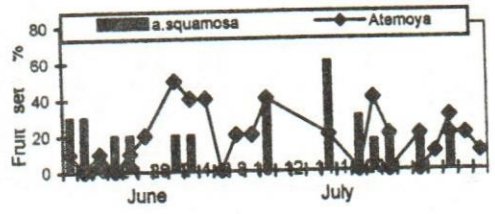


Fig. (1-a): fruit set percentages in different pollination dates of treatments on *A. squamosa in* 2002.

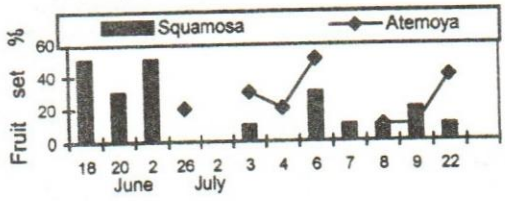


Fig. (2-a): fruit set percentages in different pollination dates of treatments on *A. atemoya* (2001).

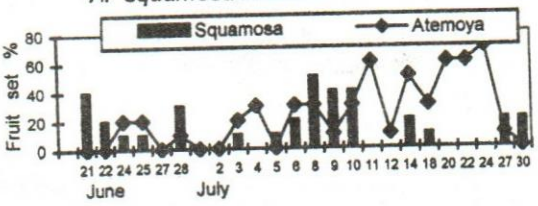


Fig. (2-b): fruit set percentages in different pollination dates of treatments on *A. atemoya* (2002).

2- Effect of pollination dates on fruit maturity (period from fruit set to mature green)

The data in Figures , 3 (a & b) and 4 (a & b) indicated generally that the maturity periods (from fruit set to mature green) were generally higher for fruits pollinated early and mid season while decreased for fruits pollinated at the end of the flowering season with rare exceptions. The maturity of *A.squamosa* self pollinated flowers in 2001 varied from 81-115 days for treatments in 24 July and 23 June , respectively, while in 2002 the periods by days varied from 101-138 for pollination treatments in 24 July and 22 June, respectively, (Fig, 3-a). The maturity periods by days for *A squamosa on A. atemoya* flowers varied from 92-115 days for treatments in 16 and 19 July of 2001 season, while in 2002 the values were 91 - 108 for flowers pollinated in 9 and 16 July, respectively (Fig 3-b). The data illustrated in Fig (4-a), indicated that the maturity periods of self pollinated A. atemoya flowers in 2001 varied from 106-121 days in 23 June and 9 July , respectively, while in 2002 , the values varied from 110 days in 4&10 July to 122 in 29 June (Fig, 4-a). The maturity periods of A. atemoya x *A.squamosa* treatments in 2001 varied from 88-113 days in 15 July and 26 June respectively, while in 2002 the values varied from 109 -130 days in 11 July and 22 June, respectively (Fig, 4-b).

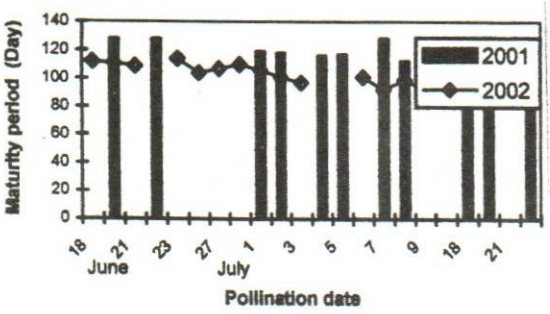


Fig (3-a): Effect of pollinatiion dates on fruit maturity periiod of *A.squamosax A. squamosaa* in 2001 and 2002 seasons

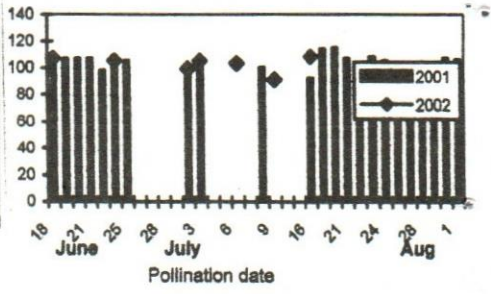


Fig (3-b): Effect of pollinatiion dates on fruit maturity periiod of *A.squamosax A. atemoya* in 2001 and 2002 seasons

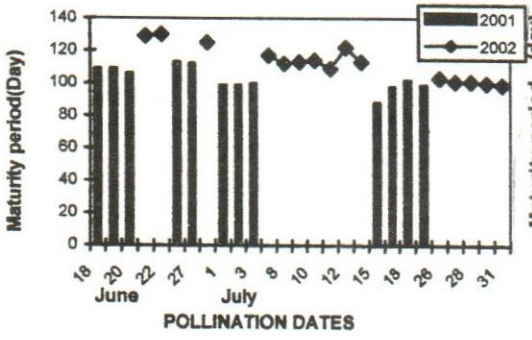


Fig (4-a): Effect of pollinatiion dates fruit on Maturity periiod of *A. atemoya* x *A. atemoya* in 2001 and 2002 seasons

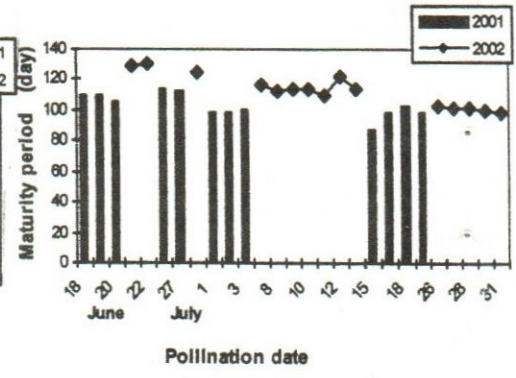


Fig (4-b): Effect of pollinatiion dates on fruit maturity periiod of *A. atemoya* x A. squamosa in 2001 and 2002 seasons

3-Effect of pollination dates on fruit qualities:

The data illustrated in tables (1-8), indicated the effect of pollination dates on fruit qualities of treatments under study. It was found that the highest fruit weight of *A.squamosa* self treatment in 2001 (Table, 1) was obtained during the third followed by the second week of June and the lowest weight was during the third week of July while other treatments were approximately closer. In 2002 , the average fruit weight was higher in First and third week of July respectively, while the lowest was during the fourth week of June.

Generally, the average fruit weight was lower in 2002 than 2001. The medium fruit weight around 100-120 gm. was obtained in the first week of July in both seasons, while other dates were different in both seasons. It was found that the highest fruit weight, length, and lowest seed number was

obtained from pollinated flowers during the second half of the third week of June (3-A) in 2001, but with medium seed weight, peel weight, TSS and acidity percentages. The second week of June (2-b) showed high values of fruit weight, length, diameter and TSS with medium seed number, weight and acidity but high peel weight in 2001 (Table,1). In the same Table, the treatments from June (1-A) to July (2-B) showed medium fruit weight, length and acidity. The highest TSS were those of July (1-A & 2-B) followed by June (2-B & 4-A) treatments (Table, 1).

Table (1): Effect of of pollination dates on fruit quality of *A.squamosa*male parent × *A..squamosa* female parent in 2001 season.

Pollination Date (week)	Fruit			Seed		Peel weight (gm.)	TSS	Citric acid
	Weight (gm,)	Length (cm.)	Diameter (cm.)	Number	Weight (gm.)		%	%
2-B June	150.0^{a}	7.00^{a}	6.90	48.0	16.97	70.00	16.00	0.016^{b}
4-A	099.5	5.45^{b}	6.45	54.0	12.57	30.57	16.45	0.017^{b}
3-B	163.5^{a}	7.10^{a}	6.35	25.0	14.82	32.50	13.45	0.027^{b}
4-A	110,0^{ab}	6.00^{ab}	3.10	47.0	13.39	45.00	11.60	0.019^{ab}
4-B	100,0^{ab}	5.85^{ab}	5.25	34.0	10.18	35.00	14.50	0.020^{ab}
1-A (July)	105.0^{ab}	6.35^{ab}	6.40	65.0	17.07	52.00	18.75	0.016^{ab}
1-B	110.0^{ab}	5.95^{ab}	7.05	61.0	21.19	38.25	15.60	0.021^{ab}
2-A	100.0^{ab}	5.85^{ab}	6.60	50.5	05.91	35.78	13.20	0.019^{ab}
2-B	125.0^{ab}	6.20^{ab}	6.00	31.5	10.15	21.25	17.10	0.032^{ab}
3-A	072.0^{b}	6.10^{ab}	5.35	28.0	06.53	33.25	14.50	0.327^{a}

A= First three days of the week B= last three days of the week
Similar letters on numbers are not significantly.

The data of *A. squamosa* x *A squamosa* in 2002 (Table, 2), showed the highest fruit weight for treatment during July (2-A) with medium seed number, low seed weight and high peel weight and TSS. The highest TSS & peel weight were obtained from treatment of July (3A). The treatment of June (3-A) gave low results in 2002 while gave no fruits at the same date of 2001 as indication that this date is not suitable to self pollination of *A. squamosa*, while treaments of July gave medium results (Table, 2). Significant differences were obtained in both seasons for fruit weight, length, while acidity was significant in 2001 and both TSS and seed weight showed significant differences in 2002 (Tables, 1&2). Kahn *et al*, (1994) Reported that both maternal and paternal parents had significant effects on quantitative and qualitative fruit and seed characteristics.

Although non significant effect of pollination dates on fruit qualities of *A. squamosa* X A.atemoya was found in 2001 and 2002 (Tables, 3&4), but it was generally found that the treatment during the third week of June (3-A)

showed the highest fruit , seed and peel weight in 2001, while the third week of July (3-a) showed better results than other dates in 2002 (Table, 4). The highest TSS was found around 14% to 16.6% in all dates except July (1-B) in 2001 and from July (1-A) to (2-B) in 2002 (Tables ,3 and 4). Treatments of July (2-B) showed the next high values of fruit weight and the highest TSS in both seasons.

Table (2): Effect of of pollination dates on fruit quality of *A.squamosa*male parent × *A..squamosa* female parent in 2002 season.

Pollination Date (week)	Fruit			Seed		Peel weight (gm.)	TSS %	Citric acid %
	Weight (gm,)	Length (cm.)	Diamet-er (cm.)	Number	Weight (gm.)			
3-A June	037.5^{b}	3.9^{c}	3.6	5.0	03.0^{b}	17.5	11.2^{b}	0.135
1-A July	112.5^{b}	7.4^{a}	5.7	25	07.0^{b}	22.5	12.6^{b}	0.136
1-B	107.5^{ab}	5.5^{b}	6.4	16	07.5^{b}	41.0	15.8^{b}	0.153
2-A	145.5^{ab}	5.6^{b}	6.9	21	11.5^{b}	52.5	18.5^{a}	0.179
3-A	115.0^{a}	5.4^{b}	6.3	27	16.0^{b}	53.0	19.5^{b}	0.182
4-A	112.5^{ab}	5.5^{b}	6.3	14	31.0^{a}	48.5	10.5^{b}	0.187

A= First three days of the week B= last three days of the week
Similar letters on numbers are not significantly

The effect of pollination dates on the fruit qualities of the alternate treatment *A. atemoya* male parent × *A. squamosa* showed the highest fruit weight, length and diameter ,seed number and highest TSS in the first week of July (1-A) followed by high fruit weight, seed number, peel weight for treatment of the last week of july (4-A) in 2001. all treatments except (4-B) of june showed TSS around 14.5 to 15.9% (Table, 5). . In 2002, (Table, 6), The highest weight was obtained from treatment in July (2-A) followed by June (3-A) which showed good criterias such as weight, length, diameter, low seed number, moderate peel and seed weight with highest TSS . The TSS values were around 15.0 to 17.2 during the pollination period from June (3-A) to July (3-A) in 2002 showing high results than 2001 while lower in others. Significant differences were found in 2002 between values of seed number, peel weight and TSS (Table, 6).

Table (3): Effect of of pollination dates on fruit quality of *A.squamosa* male parent × *A. atemoya* female parent in 2001 season.

Pollination Date (week)	Fruit			Seed		Peel weight (gm.)	TSS %	Citric acid %
	Weight (gm,)	Length (cm.)	Diameter (cm.)	Number	Weight (gm.)			
3-A June	235.5	7.2	7.1	49	37.4	87.5	15.5	0.024
3-B	227.5	6.9	8.5	53	18.5	59.5	14.4	0.029
1-A July	172.5	7.4	8.1	21	12.9	65.0	15.0	0.023
1-B	105.0	6.2	6.4	26	09.6	34.2	20.6	0.014
3-A	089.0	6.0	7.4	16	07.4	49.0	13.1	0.015
4-B	172.5	6.9	7.6	29	22.9	51.5	13.4	0.023

A= First three days of the week B= last three days of the week
Similar letters on numbers are not significantly

Table (4): Effect of of pollination dates on fruit quality of *A.squamosa* male parent × *A. atemoya* female parent in 2002 season.

Pollination Date (week)	Fruit			Seed		Peel weight (gm.)	TSS %	Citric acid %
	Weight (gm,)	Length (Cm.)	Diameter (cm.)	Number	Weight (gm.)			
3-B June	112.5	5.9	5.8	14.0	08.4	29.5	11.2	0.174
1-A July	120.0	7.3	6.7	10.0	07.0	40.0	13.4	0.265
1-B	075.0	6.5	5.4	10.0	10.3	21.5	12.0	0.194
2-B	0.70.0	4.8	5.5	05.0	05.0	35.0	11.2	0.155
3-A	177.5	7.5	7.2	14.0	07.6	30.7	08.9	0.206
3-B	0.50.0	4.4	4.4	06.5	05.0	22.5	10.5	0.143
4-A	072.5	3.4	3.9	09.0	10.0	35.5	10.9	0.182
4-B	145.0	5.9	6.2	15.5	11.1	49.5	19.0	0.224

A= First three days of the week B= last three days of the week
Similar letters on numbers are not significantly

Table (5): Effect of of pollination dates on fruit quality of *A. atemoya* male parent × *A squamosa.* female parent in 2001 season.

Pollination Date (week)	Fruit			Seed		Peel weight (gm.)	TSS %	Citric acid %
	Weight (gm,)	Length (cm.)	Diameter (cm.)	Number	Weight (gm.)			
3-A June	115.0	6.7	6.3	46	14.7	62.5	15.4	0.022
4-A	132.0	6.5	6.2	55	15.2	38.2	15.6	0.019
4-B	090.0	5.4	5.8	54	16.2	27.5	11.9	0.0016
1-A July	158.0	6..9	6.3	58	12.9	38.3	15.7	0.022
2-A	130.0	5.8	6.8	42	13.4	30.0	14.5	0.033
3-B	107.5	6.1	6.0	45	14.5	28.5	15.0	0.028

A= First three days of the week B= last three days of the week
Similar letters on numbers are not significantly

Table (6): Effect of of pollination dates on fruit quality of *A. atemoya* male parent × *A squamosa.* female parent in 2002 season.

Pollination Date (week)	Fruit			Seed		Peel weight (gm.)	TSS %	Citric acid %
	Weight (gm,)	Length (cm.)	Diameter (cm.)	Number	Weight (gm.)			
3-A June	150.0	8.1	7.5	09^{b}	15.0	40.0^{ab}	17.1^{a}	0.169
3-B	062.5	4.7	5.3	11^{b}	08.5	30.0^{ab}	15.2^{ab}	0.159
4-B	080.0	5.8	4.9	07^{b}	10.0	09.5^{b}	16.2^{a}	0.205
1-A July	092.5	4.9	5.7	12^{b}	10.0	50.0^{ab}	15.2^{ab}	0.266
2-A	162.5	5.5	6.7	21^{b}	20.0	40.0^{ab}	16.9^{a}	0.256
2-B	107.5	5.6	5.9	25^{b}	15.0	50.0^{ab}	16.3^{a}	0.157
3-A	127.5	6.6	6.2	10^{b}	22.5	51.0^{ab}	17.2^{a}	0.159
4-A	095.0	4.1	4.8	09^{b}	10.0	52.5^{a}	11.6^{bc}	0.169
4-B	085.0	4.9	5.8	10^{b}	13.5	39.5^{ab}	10.5^{c}	0.143
1-A August	125.0	5.6	7.1	42^{a}	26.0	37.5^{ab}	13.9^{bc}	0.203

A= First three days of the week B= last three days of the week
Similar letters on numbers are not significantly

The data in Tables (7 and 8) regarding self atemoya treatment indicated the highest results in June (3-B) in 2001 followed by July (2-B) and (2-A) while only the lowest seed number and weight was found in June (4-A). Generally the average seed number was low around 16-29 and the TSS was moderate (14.5 -16.6) during all dates except July (1-B) in 2001 (Table, 7). Although the fruit weight decreased generally in 2002 (Table, 8) but the highest fruit weight was 140 gm. for treatments during July (1-B and 2-B). The seed number, seed weight and acidity were low in all dates of treatments of 2002 than 2001.The highest TSS was also found in July (2-B) treatment. The acidity values were higher than those of 2001 (Tables 7 and 8).

Table (7): Effect of of pollination dates on fruit quality of *A. atemoya* male parent × *A atemoya* female parent in 2001 season.

Pollination Date (week)	Fruit			Seed		Peel weight (gm.)	TSS %	Citric acid %
	Weight (gm,)	Length (cm.)	Diameter (cm.)	Number	Weight (gm.)			
3-B June	225.0	7.8	7.0	21	15.3	73.5	15.7	0.048
4-A	170.0	6.7	5.9	16	09.2	41.5	15.2	0.036
1-A July	137.5	6.9	6.1	21	12.3	48.3	16.6	0.041
1-B	139.0	6.7	6.3	29	15.1	49.0	11.4	0.042
2-A	205.0	8.4	7.6	25	13.7	62.5	14.5	0.014
2-B	222.5	7.8	6.7	20	15.0	41.2	16.1	0.037
3-A	147.5	7.2	5.9	22	11.5	50.8	15.1	0.029

A= First three days of the week B= last three days of the week
Similar letters on numbers are not significantly

Table (8): Effect of of pollination dates on fruit quality of *A. atemoya* male parent × *A atemoya* female parent in 2002 season.

Pollination Date (week)	Fruit			Seed		Peel weight (gm.)	TSS %	Citric acid %
	Weight (gm,)	Length (cm.)	Diameter (cm.)	Number	Weight (gm.)			
4-B June	115.0	6.7	7.1	13	10.0	50.0	12.6	0.296
1-A July	080.0	7.4	7.6	16	09.5	36.5	15.3	0.297
1-B	140.0	6.2	5.3	10	07.5	50..0	14.9	0.195
2-A	095.0	6.1	6.1	16	12.5	45.0	14.1	0.225
2-B	140.0	5.7	7.4	17	17.5	55.0	16.5	0.358
3-A	127.5	6.1	7.1	20	10.0	60.0	09.8	0.266
4-B	095.0	6.2	5.9	15	07.0	48.5	13.7	0.255

A= First three days of the week B= last three days of the week
Similar letters on numbers are not significantly.

The selection criterias mentioned by George, *et al* (1994) including medium or high fruit weight, low seed number (10 seeds / 100 gm. of fruit), low seed weight, low peel weight and high TSS. The data in the present study showed good criteria for selection during June (3-B)) for *A. squamosa* self pollination in 2001 and July (2-A) in 2002 with pronounced decrease in seed number in 2002 (Tables 1 and 2). The *A squamosa* treatment on *A. atemoya*.

increased fruit weight and decreased seed number in 2001 with more decrease in 2002 in fruit weight and seed number with good criteria during Jun (3-B) & July (2-B) in 2001 and July (1-B and 2-B) in 2002 (Tables , 3 and 4). The reverse treatment of *A atemoya x A. squamosa* showed good criterias of fruits for treatment during July (1-A and 2-A) in 2001 and July (2-A) followed by June (3-A) in 2002 . The *A. atemoya* self treatment showed for treatment during June (3-B) and July (2-B) which showed decrease in peel weight. (Table. 7) and July (1-B and 2-B) of 2002.(Tables, 7 and 8)

Flowers which opened in the third and fourth week of flowering period had the best yield potential because of an optimal combination of flower numbers, fruit set and mean fruit weight (Richardson and Anderson 1996). The pollination treatments in the present study were done using emasculation of pollinated flowers in the different pollination dates to study the pure effect of pollen at the same time the use of hand pollination to offer pollen around stigmas to increase fruit set and obtain regular fruit shape. This agree with TDAI (2002) who reported that there is higher fruit set and larger fruit, which have a round, regular shape as a result of artificial pollination. Yields are higher, more stable from one year to the next, and get a higher market price. TDAI. (2002).Using pollination with paint brush method, both sugar apple and atemoya increase their fruit-bearing percentage, sugar apple by 83% and the atemoya by an average of 90%. Furthermore, the fruit from hand-pollinated flowers are uniformly round and regular . The best pollination time for sugar apple is in the morning (5 - 8 AM). For atemoya, the best time for pollination is in the evening Those fruit which do appear may have a poor appearance and quality, as a result of damage to the stigma. TDAI. (2002. The treatments in the present study were done in the morning from 6-9 and gave good resulls for both species due to the humidity in the area near the sea which help in maintaining pollen on stigmas. The present study revealed wide range of seed number and weight was found due to pollination treatments in agreement with Sandra (2002).

Effect of weekly pollination dates during June and July on percentages harvested fruits and harvest dates.

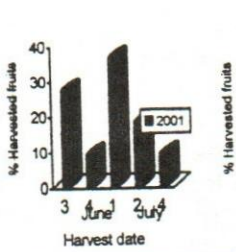
The data illustrated in tables (5-a to 5- h), indicate the effect of weekly pollination dates during June and July of 2001 and 2002 on the percentages of harvested fruits during harvest season (calculating the fruits obtained from weekly treatment during the whole harvest season) and the effect on harvest dates (Calculating the percentage of harvested fruits obtained from treatments during June and July in each collection date). The data in Fig (5-a) revealed that the highest percentage of harvested fruits were those of pollination treatments during the first week of July for *A. squamosa* x *A. squamosa* in 2001 and 2002. On the other hand the pollination treatments during July were higher in 2001 (63.64) and 2002 (86.6) than thos e of June treatments. The effect of pollination dates during June and July on percentage of obtained fruits during each harvest date (Fig, 5-b) indicated that the fruits were harvested from 5 to15 October (five harvest dates) with

peak in 12 and 15 October in the first season , while it was later (28-31 October of 2002) in four successive days with peak in 28 October. (Fig, 5-b). It was found that the pollination treatments of *A. atemoya* x *A. squamosa* (Fig, 5-c) produced the highest percentage of fruits from pollination treatments during the third week of June in 2001 and from treatments of the second week of July in 2002, but generally the treatments during July produced higher fruits (53.2%, 80% in 2001 and 2002 respectively,than those of June. The harvest date was nearly similar to those of *A. squamosa* x *A. squamosa* in both seasons with one more harvest date in 16 October of 2001 and peak in 5 October (33.4%) in 2001 and in 28 & 29 October in 2002 (each 40%) as noticed in Fig (5-d).

The *A. squamosa* x *A. atemoya* treatments (Fig, 5-e) produced the highest percentage of fruits from pollination treatment during the third week of July in 2001 (41.8%) and the second were of July 2002 (50%) than other weeks of pollination. The harvest period was longer in 2001 (15 harvest date) from 2 October to 21 November. Of 2001 with peak in 6 November (Fig, 5-f), but similar in harvest number (4) and dates to previous annona treatments with peak in 29 October in 2002. 68.6% &75% of fruits in 2001 and 2002 respectively were obtained from pollination treatments which were done during July in both seasons.

The data in Fig (5-g) revealed that the highest fruit percentage from fruits pollinated during the third week of July in 2001 and the first & second week of July 2002. 70.5% & 93.2of fruits were obtained from treatments during July of 2001 and 2002, respectively. Fig, 5-h revealed that the harvest peaks were 15 & 28 October of 2001 and 2002, respectively. The harvest period began from 5 October and end in 7 November with seven harvest dates in 2001, while in 2002 they were 6 harvests from 28 October to 8 November.

The data indicated that fruits of *A.squamosa* x *A.squamosa* treatment in 2002 season (Fig, 5-a) were collected during 28 – 31 October (4 days). The highest percentages were harvested during 28 October followed by equal percentages (26.8 %) during 29-30 October and the lowest in 31 October/ On the other hand The effect of pollination dates in 2002 was pronounced for pollination treatment during the first week of July (46.6 %) followed by the third week of July (26.8 %) compressing 86.6 % of all treatments of July while those during June were only 13.4 of collected fruits.



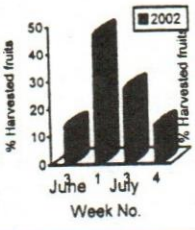
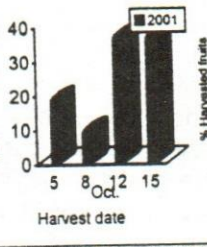


Fig (5-a) : Effect of weekly pollination dates on percentage of harvested fruits of *A. squamosa* x *A. squamosa* in 2001 and 2002.



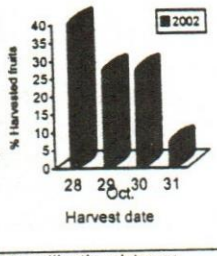
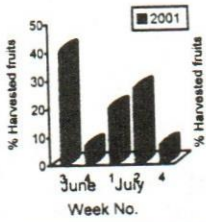


Fig (5-b) : Effect of weekly pollination dates on harcvest dates of *A. squamosa* x *A. squamosa* in 2001 and 2002.



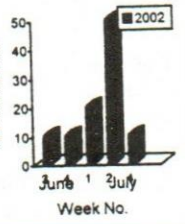
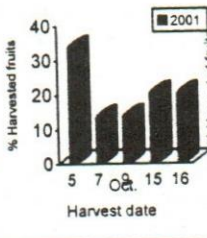


Fig (5-c) : Effect of weekly pollination dates on percentage of harvested fruits of *A. atemoya* x *A. squamosa* in 2001 and 2002.



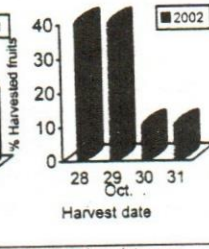
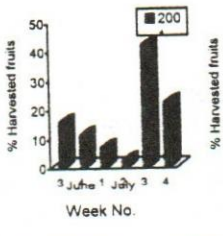


Fig (5-d) : Effect of weekly pollination dates on harcvest dates of *A. atemoya* x *A. squamosa* in 2001 and 2002.



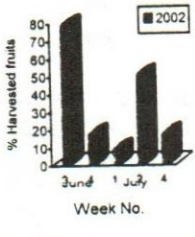
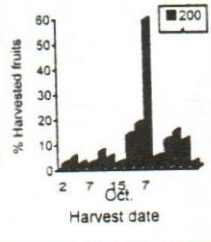


Fig (5-e) : Effect of weekly pollination dates on percentage of harvested fruits of *A. squamosa* x *A. atemoya* in 2001 and 2002.



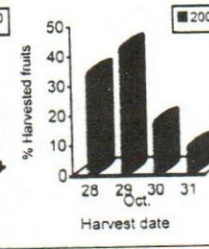
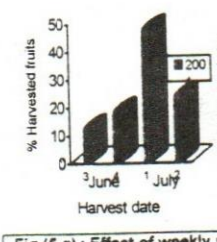


Fig (5-f): Effect of weekly pollination dates on harcvest dates of *A. squamosa* x *A. atemoya* in 2001 and 2002.



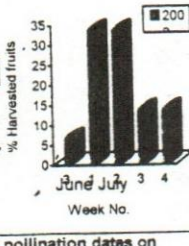
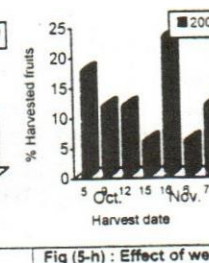


Fig (5-g) : Effect of weekly pollination dates on percentage of harvested fruits of *A. atemoya* x *A. atemoya* in 2001 and 2002.



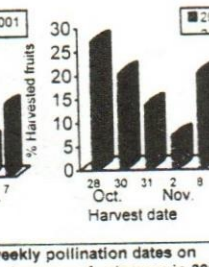


Fig (5-h) : Effect of weekly pollination dates on harcvest dates of *A. atemoya* x *A. atemoya* in 2001 and 2002.

CONCLUSION

The effect of pollination date on fruit set, maturity period and fruit qualities was studied using alternative treatments of both *A.squamosa* and *A. atemoya*, each as male and female parents in 2001 and 2002 seasons. It could be concluded that the use of *A. atemoya* (Cherimata CV.) as male or female parent increased fruit set during July, while the use of *A.squamosa showed* earlier positive effect of pollination dates on fruit set than cherimata treatments except during the third weak of July 2002 which showed higher fruit set than Cherimata. The fruit maturity periods were generally higher for fruits of early treatments, while decreased at the end of the season. The fruit qualities showed some significant differences during pollination dates and according to pollination treatment. The general advice is to use more than one pollinator during flowering period to increase fruit set and improve fruit qualities. In case of the treatments in the present study the use of Cheimata as male or female parent increase fruit set. Regarding that the treatments in the present study used emasculation of female parent (to study the effect of the used pollen only), so in commercial treatments for growers they can do pollination treatments with paint brush leaving the main pollen to increase fruit set. The effect of pollination dates was pronounced on harvest dates and fruit percentages during harvest dates. The treatments on *A.squamosa* showed the highest percentages of collected fruits if were done during than June, while those on *A atemoya* (Cherimata) showed the highest percentage of collected fruits for polliation tresatment during July than June and higher percentages of fruits were harvested during October than November

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تأثير تواريخ التلقيح على نسبه عقد الثمار، فتره النضج وجوده الثمار والجمع للقشطه بلاسكندريه

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أجريت الدراسة خلال موسمى ٢٠٠١ ، ٢٠٠٢ على نوعى القشطه البلدى (اسكواموزا) والأتيمويا صنف شريماتا بالصبحيه بالاسكندريه. أجرى التلقيح اليدوى باستعمال فرشاه رسم متساويه الأطراف فى تواريخ مختلفه بناء على مواعيد تزهير كل نوع باستعمال لقاح من أزهار على وشك التفتح تترك طوال الليل لنثر لقاحها لاستعمالة مبكرا فى اليوم التالى على أزهار متفتحة بعد ازاله لقاحها. أجريت المعاملات بالتبادل مع إجراء تلقيح ذاتى للقشطه البلدي والأتيمويا (شريماتا) على ٣ أشجار من كل منهما اعتبارا من ١٨ يونيو حتى آخر يوليو مع تكييس اللأزهار المعاملة وازاله الغطاء بعد ٣ أيام عند العقد. قدرت نسب العقد للازهار المعلمة ووجد أن معاملات التلقيح للشريماتا سواء كأب أو أم تزيد نسبه العقد خاصه خلال يوليو. وتم حساب فترات النضج (من العقد حتى النضج الفسيولوجى). تركت الثمار لاكتمال النضج فى مكان دافئ وقدر الوزن والأبعاد والمواد الصلبه الكليه والحموضه وعدد البذور ووزن البذور والقشر وجدت فروق معنوية بين التواريخ لبعض المعاملات. مده نضج الثمار زادت للأزهار التى لقحت مبكرا وخلال منتصف فتره التزهير وانخفضت عموما آخر الموسم (خاصه للثمار صغيره الحجم). أظهرت النتائج تأثير مواعيد التلقيح تأثير واضح على نسبة الثمار المجموعه خلال فترات الجمع باختلاف معاملات التلقيح. وجد أن الثمار الناتجه من مجموع معاملات شهر يوليو قد كانت أعلى نسبه من إجمالي الثمار الناتجة من معاملات شهر يونيو. وبحساب نسبة الثمار الناتجه من معاملات التلقيح التى أجريت خلال كل أسبوع على حده، وجد أن أعلى نسبه نتجت من إجمالي معاملات الأسبوع الأول من يوليو للقشطه البلدى (ذاتى) وأيضا معاملة التلقيح الذاتي للأتيمويا صنف شريماتا فى العامين وقد يرجع ذلك الى أن القشطة البلدى أحد الآباء للاتيمويا. مواعيد الجمع للمعاملات على القشطه البلدي كانت خلال إلنصف الأول من أكتوبر ٢٠٠١ فى حين امتدت الى نوفمبر ٢٠٠١ للمعاملات التى أجريت على الشريماتا ، أما فى عام ٢٠٠٢ فقد كانت فترات الجمع خلال أربعه أيام (٢٨-٣١ أكتوبر) لجميع المعاملات ما عدا التلقيح الذاتى للأتيمويا التى امتدت أيضا الى نوفمبر مثل العام السابق. عموما نسبه الثمار التى جمعت خلال أكتوبر كانت أعلى لجميع المعاملات ماعدا البلدى X الأتيويا ٢٠٠١ .