RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

I. Cytological studies :

The Chromosomal behaviour and pollen grains viability of some pome fruits were investigated under this topic pertaining their relationship to the fertility of such pome species / cultivars. Therefore, meiotic divisions in pollen mother cells " PMC's" of a) Anna apple; b) Ein Shamer apple; c) Dorsett Golden apple; d) Le-Conte pear, e) Bartlett pear; f) Calleryana pear and g) Balady quince were investigated to study chromosomal behaviour, beside, stainability and germination potentiality were also involved as follows:

I.1. Chromosomal behaviour:

From cytological examinations throughout meiosis in pollen mother cells (microsporocytes) from the floral buds of the aforesaid seven pomes species/cultivars, it was generally noticed that chromosomal number of all tested species/cultivars, was found to be 34. These observations indicating that such species and cultivars are diploids with 2n= 34.

Nevertheless, at Leptotene stage, chromosomes appeared to be rather longer and entangled, therefore they were very difficult to be examined. Moreover, in both Zygotene and Pachytene stages, chromosomes were thicker and shorter than in Leptotene stage, but they also were still too difficult to be examined. Meanwhile, at Diakinesis, it was quite clear that chromosomes became more feasible to be examined and characterized through their distribution into 17 bivalents within the nucleus as shown from, Figures: (1-A) ; (3-A); (5-

A) and (6-A). These bivalent chromosomes were mostly ring shaped. On the other hand, cytological examination of the pollen mother cells at the meiotic stages of either Diakinesis or early Metaphase I, exhibited in some cases the presence of bivalent chromosomes besides the univalent ones as shown from, Figs: (2-A); (3-B); (5-B); (6-B) and (7-A) for the PMC's of Dorsett Golden apple, Ein Shamer apple, Anna apple, Le-Conte pear and Balady quince, respectively. In addition, no multivalent associations were detected from the examination throughout meiosis of the investigated pome species and cultivars.

At first Metaphase, the nucleolus was disappeared and the bivalent chromosomes arranged in equatorial plate, Figs: (2-A) and (5-C). At the first Anaphase, the 17 bivalents separated into two sets each of 17 chromosomes and distributed normally towards the two opposite poles, each pole receiving only one set i.e., 17 chromosomes. Figs: (1-B); (2-B) and (4-A). At the beginning of the first Telophase, chromosomes were grouped so closely at the two haploid nuclei which were not accompanied by the formation of the cell wall. The two nuclei remained in a common mass of the cytoplasm and underwent to the second meiotic division (second Telophase or Telophase II). The end result of this division was the production of four chromosomal groups, each group was 17 chromosomes, Fig: (2-C). In some cases, particularly in Le-Conte pear and Balady quince, three chromosomal groups (a triad) were observed instead of four groups in normal case in the pollen mother cells as a result of tripolar separation, Figs: (6-C) and (7-B).

Furthermore, four haploid nuclei were formed, each was surrounded by a cell wall within the pollen mother cell (tetrad), Fig: (2-D). The wall of the pollen mother cell, however, soon disintegrated leaving the microspores (tetrads) free in the cavity of the anther.

As for the chromosomal association " pairing" throughout meiosis of the studied pome species/ cultivars, Table (1) revealed obviously that most examined pollen mother cells " PMC's" showed 17 bivalent chromosomes at both Diakinesis and first Metaphase stages. On the other hand, all studied pome species and cultivars exhibited also the presence of some univalent chromosomes besides the bivalent ones with different proportions in their examined pollen mother cells "PMC's". In addition, non of the examined PMC's showed any multivalent chromosomes.

Consequently, it was so quite clear that the seven investigated pome species/cultivars were diploids ($2x=34$) with haploid chromosomal number of $x=17$ chromosomes as shown from data presented in Table (1) and cytological examination illustrated by Figs: (1-A); (2-A) ; (3-A); (3-B); (5-A); (5-B); (6-A); (6-B) and (7-A).

From studying the chromosomal behaviour through cytological examination (observation) of the pollen mother cells "PMC's" of the investigated seven pome species and cultivars: (1-Anna apple; 2-Ein Shamer apple; 3- Dorsett Golden apple; 4-Le-Conte pear; 5- Bartlett pear; 6-Calleryana pear and 7- Balady quince), Table (1) shows obviously the presence of bivalent chromosomes besides the univalent ones at various proportions which greatly varied from one pome species or cultivar to another.

Nevertheless, data presented in Table (1) regarding cytological examination of "PMC"s" of either late Diakinesis or early Metaphase I stages during both 1995 and 1996 seasons pointed out that the investigated seven pome species and cultivars could be arranged according to the percentage of their examined "PMC's" which showed the presence of 17 bivalent chromosomes only into the following three categories:

1-Both Bartlett pear and Dorsett Golden apple are representative of the first category that exhibited the highest percentage of examined PMC's showing the presence of 17 bivalent chromosomes only at both Diakinesis and Metaphase I stages. Since, 98.28% and 99.07% of the Bartlett pear PMC's showed 17 bivalents, while with the Dorsett Golden apple the corresponding percentage was 96.84% and 97.76% during both 1995 and 1996 seasons, respectively. On the contrary, both members of such category showed the least percentage of PMC's which showed some univalent chromosomes i.e. (1.72% & 0.93%) and (3.16% & 2.24%) for both former and later pome species during two 1995 and 1996 seasons, respectively. The higher rate in chromosomal pairing may be considered as the real reason for the higher pollen fertility of these two pome species as will be discussed later. It might be concluded that Bartlett pear and Dorsett Golden apple were cytologically stable. Figs: (1-A); (1-B); (2-A); (2-B); (2-C) and (2-D).

2-The second category including both Calleryana pear and Ein Shamer apple, whereas their examined PMC's exhibited an intermediate percentage of the complete chromosomal pairing i.e. the presence of 17 bivalent chromosomes only at Diakinesis and Metaphase I. Hence, 88.51% and 85.90% of the examined PMC"s showed the presence of 17 bivalents only for Calleryana pear during both 1995 and 1996 seasons, respectively, while Ein Shamer apple showed approximately the same values i.e. (86.27% and 84.27%). These results indicated that meiotic behaviour in Calleryana pear and Ein Shamer apple was nearly normal and cytologically they were nearly stable, Figs: (3-A); (3-B); (4-A) and (4-B).

3-The third category which represented the pome species/cultivars of the least percentage of chromosomal pairing, whereas the percentage of their examined PMC's having the 17 bivalent chromosomes only could be arranged into the following descending order:a) (67.19% &74.17%); b)- (65.03% & 71.02%) c)- (60.94% & 64.20%) for Anna apple; Le-Conte pear and Balady quince during both 1995 and 1996 seasons, respectively. The relatively lower pairing % of chromosomes in Anna apple; Le-Conte pear and Balady quince may indicate the hybrid nature with low ecological and /or botanical relationship of their origin parents.

The presence of univalent chromosomes disturbed the meiotic cycle as they lag behind during the Metaphase and Anaphase stages.

These laggards might not include in daughter nuclei. This might lead to the abortion of the PMC's products. Irregular chromosomal distribution often leads to the formation of microspore groups comparising spores varying in size and number instead of the normal tetrads. These results stated that meiotic behaviours in Anna apple; Le-Conte pear and Balady quince have some abnsormalities which indicated that these genera were cytologically unstable, Figs: (5-A); (5-B); (5-C) (5-D); (6-A); (6-B); (6-C); (7-A) and (7-B).

All these results go in line with the findings of **Madbouly (1974); Negru (1984); Rudenko and Rotaru (1988); Fougat et al. (1990) Blando et al. (1992); Atawia and Helail (1993); Liang et al. (1994); Schuster and Büttner (1995); Liang Guolu et al. (1996) and Schuster et al (1997).**

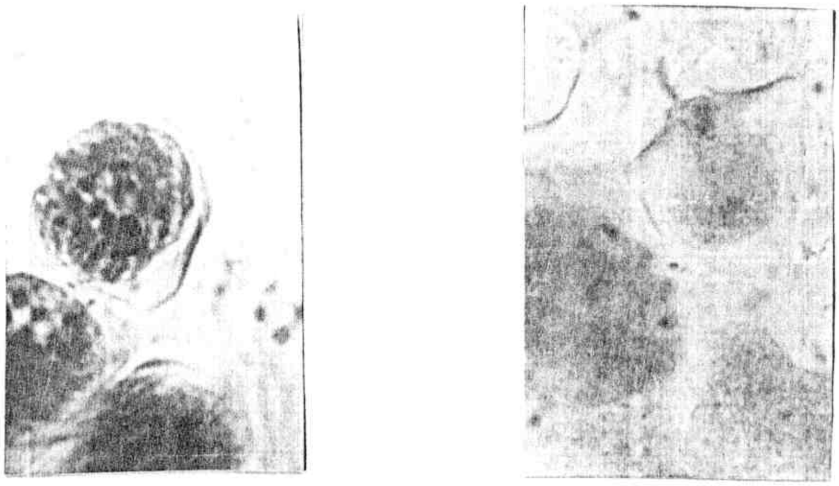
From the other point of view, the abovementioned aberration in chromosomal pairing "association" exhibited occasionally in some examined pollen mother cells " PMC's"as shown from Table (1) was varied from one pome species/cultivar to another not only in percentage of its occurrence but also pertaining the chromosomal configurations at which both bivalent and univalent chromosomes could be detected at Diakinesis and Metaphase I as follows:

A- The first chromosomal configuration at which 16 bivalents plus 2 univalent chromosomes were observed together in the same PMC. This form represented the most frequency of disturbance in chromosomal association observed at Diakinesis and Metaphase I stages of meiotic division for all studied pome species and cultivars. However, such case was the unique for the presence of both univalent and bivalent chromosomes together in PMC of both Bartlett pear and Dorsett Golden apple. Meanwhile, it exceeded more than 50% of these PMC's having both bivalent and univalent chromosomes for the other pome species/cultivars except Balady quince which its proportion was slightly decreased below 50%

B- Second chromosomal configuration was that one whereas the examined PMC's displayed the presence of 15 bivalent chromosomes plus 4 univalent ones at Diakinesis and Metaphase I stages. The rate of its occurrence came next with approximately less than one half of the aforesaid case (16 bivalents+2

Table (1): Chromosomal behaviour through Diakinesis and Metaphase I stages of meiosis in studied pome species and cultivars (1995 & 1996 seasons).

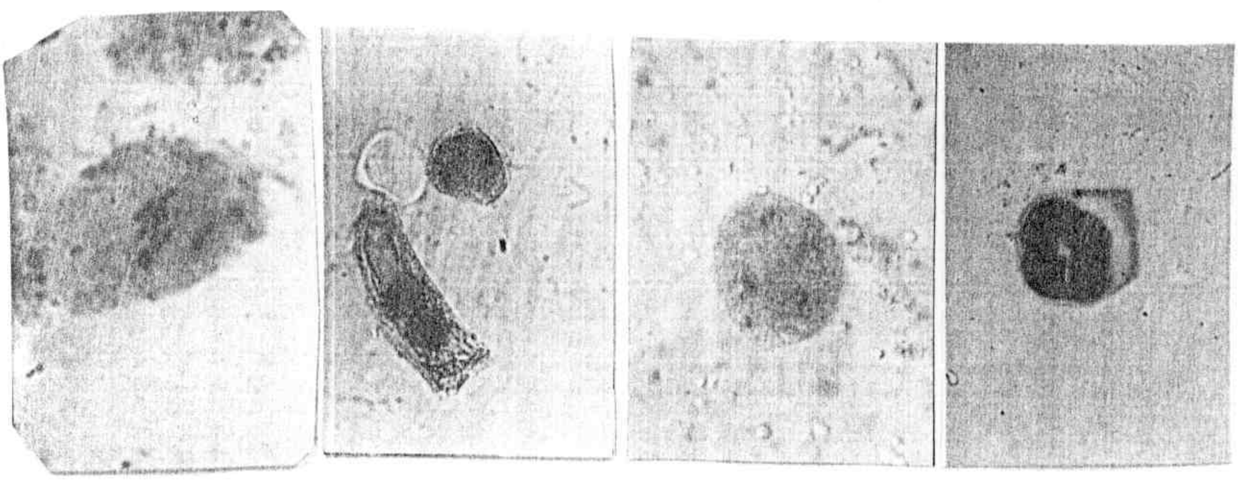
Pome species/cultivar (Source of examined PMC's)	No. of PMC's examined	Pairing at Diakinesis and Metaphase I stages				PMC's with 17 bivalents	PMC's with univalents
		1995					
		$^{17}\mathrm{II}$	$^{16}\mathrm{II}+{}^{2}\mathrm{I}$	$^{15}\mathrm{II}+{}^{4}\mathrm{I}$	$^{14}\mathrm{II}+{}^{6}\mathrm{I}$	%	%
1- Anna apple	128	86	24	11	7	67.19	32.81
2- Ein Shamer apple	102	88	8	4	2	86.27	13.73
3- Dorsett Golden apple	95	92	2	1	-	96.84	3.16
4- Le-Conte pear	143	93	31	10	9	65.03	34.97
5- Bartlett pear	116	114	2	-	-	98.28	1.72
6- Calleryana pear	87	77	6	2	2	88.51	11.49
7- Balady quince	64	39	11	8	6	60.94	39.06
1996							
1- Anna apple	151	112	30	5	4	74.17	25.83
2- Ein Shamer apple	89	75	7	4	3	84.27	15.73
3- Dorsett Golden apple	134	131	3	-	-	97.76	2.24
4- Le-Conte pear	176	125	34	12	5	71.02	28.98
5- Bartlett pear	107	106	1	-	-	99.07	0.93
6- Calleryana pear	78	67	5	4	2	85.90	14.10
7- Balady quince	81	52	14	10	5	64.20	35.80



(A) **(B)**

Fig. (1): Meiosis in microsporocytes of Bartlett pear showing: the presence of 17 bivalents at Diakinesis stage (A) and 17 chromosomes at each pole during Anaphase I (B).

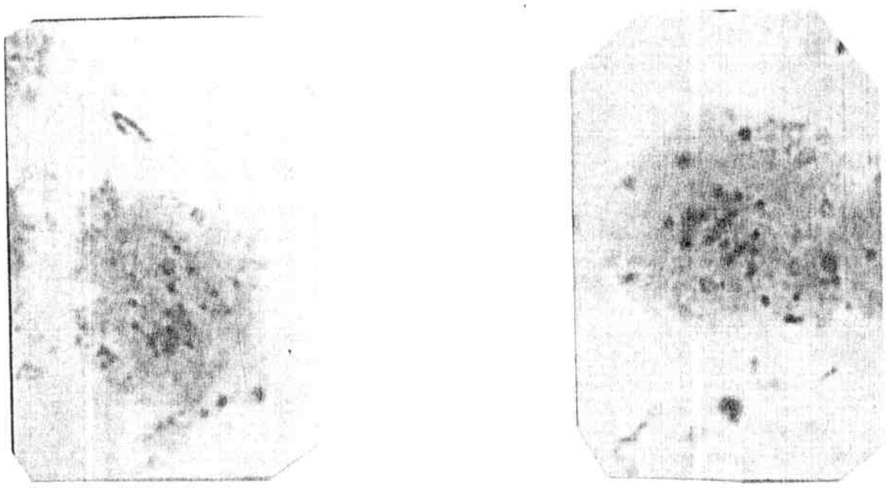
(X= 10 x 100)



(A) (B) (C) (D)

Fig. (2): Meiosis in microsporocytes of Dorsett Golden apple showing: 16 bivalents plus 2 univalents at Metaphase I stage (A); 17 chromosomes at each pole at Anaphase I (B); 4 chromosomal groups resulting from normal tetrapolar separation at early Telophase II (C) and a regular tetrad with 4 microspores at Telophase II (D).

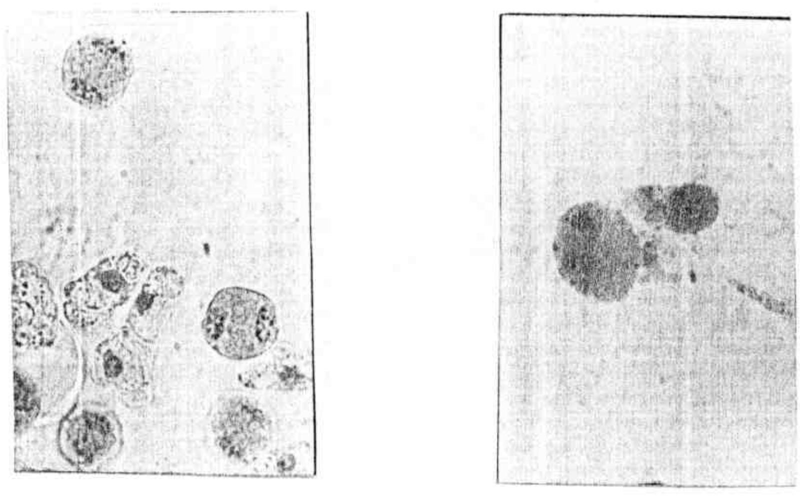
(X= 10 x 100)



(A) (B)

Fig. (3):Meiosis in microsporocytes of Ein Shamer apple showing: the presence of 17 bivalents at Diakinesis stage (A) and 16 bivalents besides 2 univalents at Diakinesis (B).

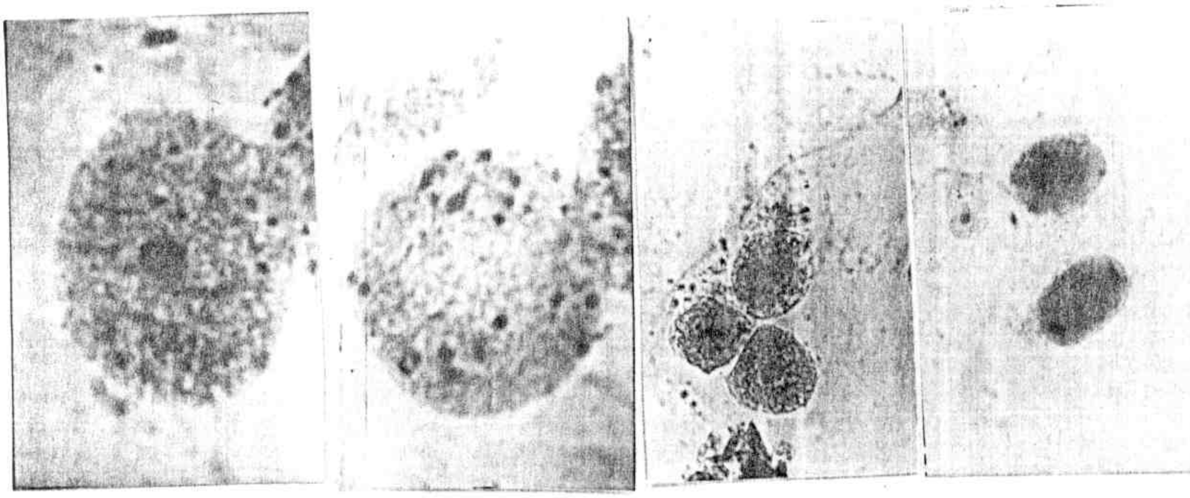
(X= 10 x 100)



(A) (B)

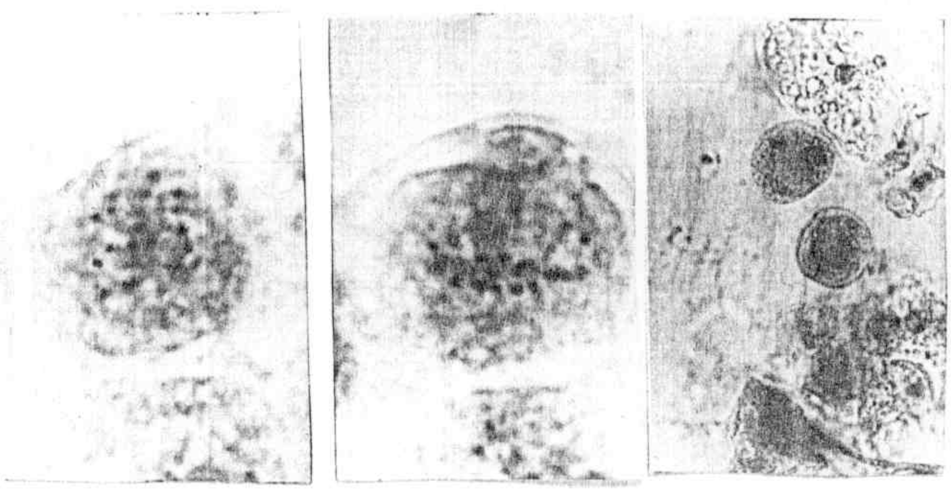
Fig. (4): Meiosis in microsporocytes of Calleryana pear showing: the presence of 17 chromosomes at each pole during Anaphase I stage (A) and two chromosomal groups plus lagging chromosomes at Anaphase I (B).

(X= 10 x 100)



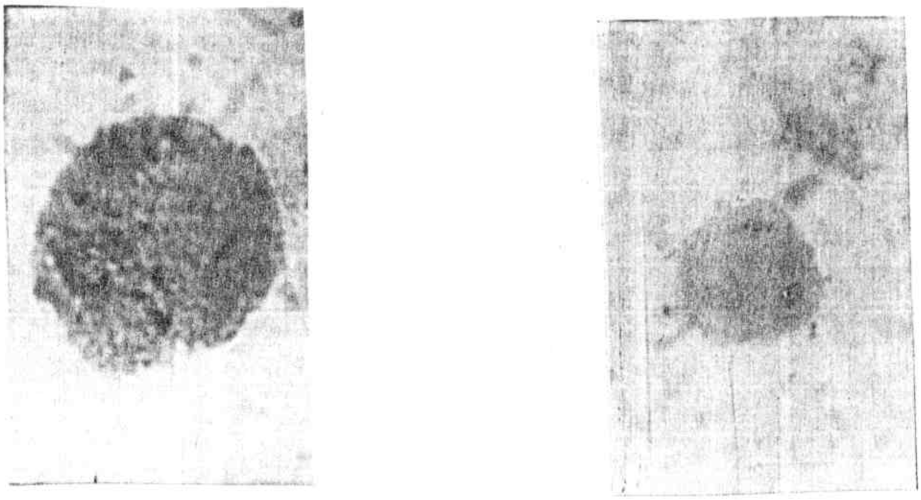
(A) (B) (C) (D)

Fig. (5): Meiosis in microsporocytes of Anna apple showing: the presence of 17 bivalents at Diakinesis stage (A); 15 bivalents besides 4 univalents at Diakinesis (B); secondary associations of bivalents plus lagging chromosomes during Metaphase I (polar view) (C) and two chromosomal groups besides lagging chromosomes in lower cell at Anaphase I and one chromosomal group plus lagging chromosomes in upper one (D). (X= 10 x 100)



(A) (B) (C)

Fig. (6):Meiosis in microsporocytes of Le-Conte pear showing: the presence of 17 bivalents at Diakinesis stage (A); 14 bivalents besides 6 univalents at Diakinesis (B) and three chromosomal groups (a triad) instead of 4 groups in normal case as a result of tripolar separation at early Telophase II (C). (X= 10 x 100)



(A) (B)

Fig. (7): Meiosis in microsporocytes of Balady quince showing: 14 bivalents besides 6 univalents at Diakinesis stage (A) and three chromosomal groups (a triad) instead of 4 groups in normal case as a result of tripolar separation at early Telophase II (B).

(X= 10 x 100)

univalents). However, the occurrence of such configuration in the examined PMC's of Anna apple, Le-Conte pear and Balady quince was relatively more pronounced than in Ein Shamer apple and Calleryana pear. On the other hand, it was completely absent in PMC's of Bartlett pear (1995 & 1996 seasons, and Dorsett Golden apple in second season (1996).

C- Third configuration of chromosomal pairing detected from the cytological examination of chromosomal behaviour was dealing with that form whereas 14 bivalents plus 6 univalent chromosomes were observed. The proportion of such chromosomal form was the least with a relative higher tendency to be occurred in Anna apple; Le-Conte pear and Balady quince than Calleryana pear and Ein Shamer apple.

I.2. Pollen grains viability:

Stainability and germination percentage were the two measurements employed for evaluating the pollen grains viability of the investigated seven pome species / cultivars (Anna apple; Ein Shamer apple; Dorsett Golden apple; Le-Conte pear; Bartlett pear; Calleryana pear and Balady quince). Since, viability of pollen grains and consequently their fertility could be easily distinguished by their complete stainability; germination and normal shape, while the sterile or aborted pollen grains were unstainable, uncapable to germinate and defective in shape. Data obtained during both 1995 and 1996 seasons are presented in Table (2) and illustrated by Figs: (8-A); (8-B); (8-C); (8-D); (8-E); (8-F);(8-G) and (9)

I.2.a. Stainability percentage of pollen grains:

Table (2) shows obviously that the highest percentage of stainable pollen grains was detected with the Bartlett pear (94.62% & 95.63%) during 1995 & 1996 seasons, respectively.

Dorsett Golden apple ranked statistically second (92.91% & 94.17%) followed by both Ein Shamer apple (91.23% & 92.54%) and Celleryana pear (90.15% & 91.09%) during 1995 & 1996 seasons, respectively. On the contrary, Balady quince was statistically the inferior which exhibited the lowest percentage of stainable grains during both 1995 and 1996 seasons i.e. (74.30% & 77.15%), respectively. Moreover, Anna apple and Le-Conte pear were in between, whereas their stainable grains exhibited (88.45% & 90.76%) and (82.88% & 85.32%) for both former and later ones during 1995 and 1996 seasons, respectively.

I.2.b. Germination percentage of pollen grains :

Concerning the germination percentage of pollen grains, it is quite clear from data obtained during both 1995 and 1996 seasons that the same trend previously discussed with the grains stainability was also detected, however, the values of germination were relatively lower as compared to the corresponding ones of the stainability during each individual season. Hence, it could be safely concluded that germination potentiality of the investigated seven pome species and cultivars could be statistically arranged into the following descending order:

a-Bartlett pear (80.39% & 78.28%); b)–Dorsett Golden apple (77.28% &75.86%);c)–Ein Shamer apple(72.13%& 73.35%);d)–Calleryana pear (71.09% & 69.95%); e) Anna apple (68.27% &65.16%);f)- Le-

Conte pear (65.74% & 62.91%) and g)- Balady quince (63.17% & 61.72%) during both 1995 & 1996 seasons, respectively.

The obtained results are in general agreement with the earlier findings previously detected by **Madbouly(1974); Stino <u>et</u> <u>al</u>. (1985); Yehia(1989); Guirguis <u>et</u> <u>al.</u> (1990); Ali (1992) or Atawia and Helail (1993).**

It could be safely concluded that data obtained from studying the chromosomal behaviour are coincident to that of pollen grains viability (of either their stainability or germination potentiality).

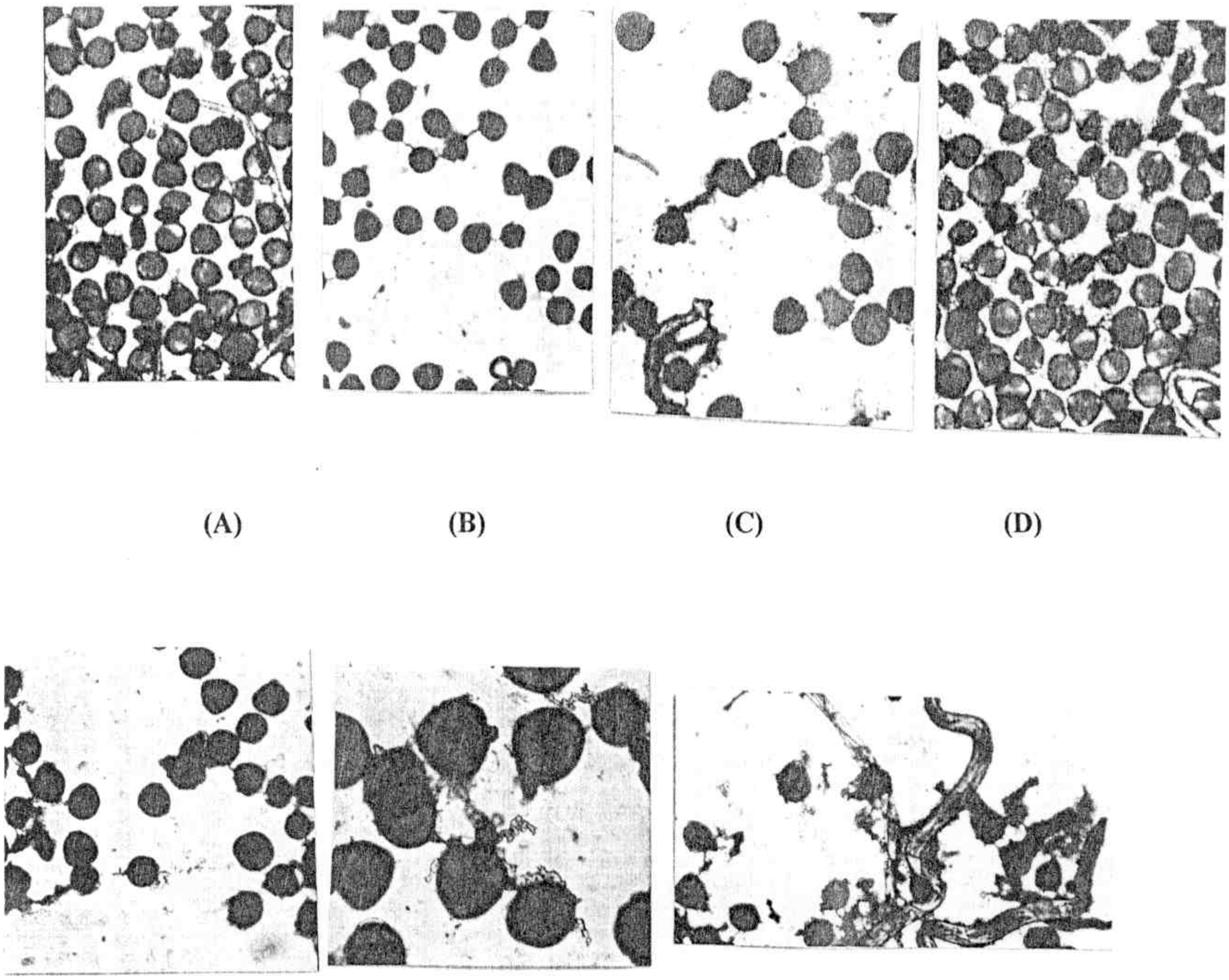
Hence, the characteristic feature of meiotic behaviour at Diakinesis and Metaphase I stages for a given pome species or cultivar was certainly reflected on viability of its pollen grains. Accordingly, Bartlett pear and Dorsett Golden apple were cytologically the most stable (having the lowest percentage of univalent chromosomes at Diakinesis and Metaphase I) induced significantly the most viable pollen grains. The reverse was true with Balady quince, Le-Conte pear and Anna apple which having more formation of univalent chromosomes and the lowest viable grains. Moreover, both Ein Shamer and Calleryana pear were in between the abovementioned extents as the occurrence rate of univalent chromosomes at meiosis and both measurements of their pollen grains viability were concerned. The closed relationship between the chromosomal behaviour and pollen grains viability for a given pome species /cultivar could be logically explained depending upon such fact that occurrence of the univalent chromosomes at higher percentage in PMC's of any species/ cultivar were sometimes left and ultimately lost in cytoplasm resulting in a deficiency of chromatin material in some produced nuclei and further irregular separation. Therefore, such abnormalities were certainly reflected negatively on pollen grains viability and fertility.

Conclusively, it could be safely recommended that Bartlett pear and Dorsett Golden apple are considered the most desirable pollinizers for Le-Conte pear and Anna apple, respectively with comparison to the other investigated pome species and cultivars.

Table (2): Pollen grains stainability and germination of some pome species and cultivars (1995 & 1996 seasons).

Source of examined pollen grains	Stainable pollen grains (%)		Germinated pollen grains (%)	
	1995	1996	1995	1996
1- Anna apple	88.45D	90.76 D	68.27E	65.16E
2- Ein Shamer apple	91.23C	92.54 C	72.13C	73.35C
3- Dorsett Golden apple	92.91B	94.17 B	77.28B	75.86B
4- Le-Conte pear	82.88E	85.32 E	65.74F	62.91F
5- Bartlett pear	94.62A	95.63 A	80.39A	78.28A
6- Calleryana pear	90.15C	91.09 D	71.09D	69.95D
7- Balady quince	74.30F	77.15 F	63.17G	61.72F

* *Values with the same letters within the same column are not significantly different.*



(A) (B) (C) (D)

(E) (F) (G)

Fig. (8): Pollen grains stainability of Bartlett pear (A); Dorsett Golden apple (B): Ein Shamer apple (C); Calleryana pear (D); Anna apple (E). Le-Conte pear (F) and Balady quince (G). (X= 10 x 20)

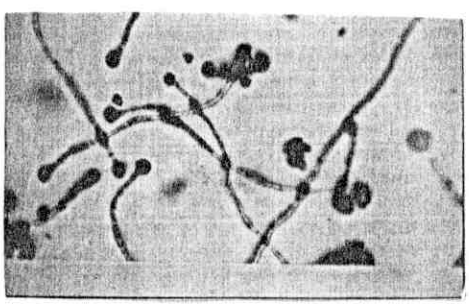


Fig. (9): Germination of Anna apple pollen grains showing: the germinated fertile pollen grains and ungerminated sterile ones. (X= 10 x 20)

II. Pollination studies :

The response of Anna apple and Le-Conte pear trees to the nine pollination treatments investigated during both 1995 and 1996 seasons was evaluated through the following measurements:

II.1. Fruit set percentage :

Ragarding the influence of various pollination treatments on fruit set percentage of Le-Conte pear and Anna apple cultivars, data obtained during both 1995and 1996 seasons are tabulated in Table (3).

A- Le-Conte pear:

Table (3) reveals obviously that fruit set percentage in Le-Conte pear cultivar was widely varied from one pollination treatment to another. Since, the hand cross pollinated flowers of Le-Conte pear with Bartlett pollen grains (T_7) exhibited statistically the highest value of fruit set percentage i.e. (37.65% &36.14%) during 1995 & 1996 seasons, respectively, followed in a descending order by the hand cross pollinated flowers with the pollen grains of Calleryana pear (T_8); Dorsett Golden apple (T_6) and Ein Shamer apple (T_5) whereas they exhibited fruit set values of (33.42% & 30.78%); (26.48% & 25.06%) and (22.27%& 20.30%) during both 1995 and 1996 seasons, respectively. Differences between these cross pollination treatments were significant as comparing each to others during both seasons of study. On the other hand, emasculation and bagging treatment was the inferior whereas its treated flowers exhibited the lowest percentage of fruit set during both seasons of 1995 and 1996 (6.59% & 5.66%).Meanwhile, other investigated pollination treatments exceeded statistically the parthenocarpic fruiting (T_3) from one side and could be arranged into the following increasing order from the other: a) bagging only i.e., naturally self pollination (T_2); b) hand cross pollination with Balady quince pollens (T_9); c) open pollination (control) and d) hand self pollination (T_4) whereas they exhibited during both 1995 & 1996 seasons fruit set percentage of (9.77% & 8.04%) ; (12.65% and 11.52%); (14.01% and 12.15%) and (16.23% and 14.06%), respectively. These results seem to agree with the findings of **Madbouly(1974); Dhaliwal et al. (1982); Arafat (1989); Ali (1992); Atawia and Helail (1993)** on some pear cvs.

B- Anna apple:

It is quite evident from Table (3) that fruit set percentage in Anna apple cultivar was responded significantly to the various pollination treatments investigated during both 1995 and 1996 seasons. Hence, the hand cross pollination with Dorsett Golden apple pollens was the superior treatment i.e. exhibited fruit set percentage of (40.25% and 43.68%) during 1st. and 2nd. seasons, respectively. However, the hand cross pollination with pollens of either Ein Shamer apple (T_5) or Bartlett pear (T_7) ranked statistically second and third and exhibited during both 1995 and 1996 seasons fruit set values of (37.87% & 41.70%) and (20.86% & 22.47%) for the former and later treatments, respectively. Moreover, Anna apple flowers received any of the four pollination treatments of (T_1, T_4, T_8 and T_9) i.e, open pollination, hand self pollination and hand cross pollination with pollens of either Calleryana pear or Balady quince were approximately the same from one hand and ranked statistically fourth from the other. In addition, Anna apple flowers declared obviously a lower pontentiality for parthenocarpic fruiting, whereas the emasculation and bagging treatment (T_3) was significantly the inferior

Table (3): **Fruit set percentage of " Le-Conte" pear and Anna apple cultivars as influenced by different pollination treatments in (1995 &1996 seasons).**

Pollination treatments	Fruit set (%)			
	Le-Conte pear		Anna apple	
	1995	1996	1995	1996
T1- Open pollination "Control"	14.01F	12.15F	14.85E	16.19C
T2- Bagging only	9.77H	8.04G	8.05G	9.21D
T3-Emasculation and bagging	6.59I	5.66H	4.30H	4. 61E
T4-Hand self pollination	16.23E	14.06E	18.47D	17.54C
Hand cross pollination with:				
T5- Ein Shamer apple pollens	22.27D	20.30D	37.87B	41.70A
T6- Dorsett Golden apple pollens	26.48C	25.06C	40.25A	43.68A
T7- Bartlett pear pollens	37.65A	36.14A	20.86C	22.47B
T8- Calleryana pear pollens	33.42B	30.78B	16.68 DE	17.67C
T9- Balady quince pollens	12.55G	11.52F	12.78F	14.78C

* *Values with the same letters within the same column are not significantly different.*

(4.30% & 4.61%) preceeding with the bagging only treatment (T_2) which showed (8.05% & 9.21%) during both 1995 & 1996 seasons, respectively.

These results are in harmony with those reported earlier by **Crocker et al. (1979); Yehia (1989), Pornbacher (1991); El-Sherbini et al. (1991); Niu et al. (1994); Arafat et al. (1994) and Peeters et al. (1996)** on some apple cvs.

Generally the obtained results of fruit set in both Anna apple and Le-Conte pear in response to pollination treatments could be logically explained depending upon the results observed from the histological examination as will be discussed later. Since, the treatments of hand cross pollination with (Dorsett Golden apple or Ein Shamer apple) resulted in increasing number of seeds per Anna apple fruit as shown from Figs: [(10(E); 11 (A,B) ;12 (B,C) and 14(A,B)] , whereas the hand cross pollination with Dorsett Golden apple was the superior as shown from Figs: [11(B) ; 12(C) and 14(B)] . These trend " The increased number of seeds per fruit" was positively reflected on fruit set.

II.2.Fruit retention:

In this respect percentage of retained Anna apple fruits at either late June (after June drop) or at harvesting date (mature fruits) in response to the various pollination treatments were concerned.

Remained fruit percentage at last week of June:

Table (4) shows obviously that the highest percentage of Anna apple fruits retained at the last week of June was always concomitant to the hand cross pollinated flowers with Dorsett Golden apple pollens i.e. (T_6) during both seasons followed by those pollinated with Ein Shamer apple pollens.

Difference between the aforesaid two superior treatments was significant during 1995 season only. Contrary to that the least percentage of fruits retained after June drop was closely related to the parthenocarpic fruits induced by the third pollination treatment (emasculation and bagging) preceeding by the naturally self pollination treatment (bagging only) whereas both exhibited (2.15% & 2.18%) and (4.73% & 4.83%) during both 1995 & 1996 seasons, respectively. In addition, other pollination treatments i.e. open pollination (control); hand self pollination and hand cross pollination with pollens of Bartlett pear, Calleryana pear or Balady quince were in between the abovementioned two extents. However, both hand self pollination and hand cross pollination with Bartlett pear pollens treatments tended to exceed statistically the three other ones of the intermediate category.

These results go in line with the finding of **Jackson (1986); Beruter and Droz (1991) and Fourez (1995).**

Mature fruits percentage :

The percentage of mature fruits remained until harvesting date of Anna apple cultivar in response to various pollination treatments followed typically the same trend previously detected with the retained fruits percentage measured at the last week of June.

Similar results were reported earlier by **Zuniga- Guevara (1992); Gautam <u>et al</u>. (1994); Torre- Grossa (1996); Benedek and Nyeki (1997).**

Table (4): Fruit retention of "Anna" apple cultivar as influenced by different pollination treatments in (1995 &1996 seasons).

Pollination treatments	Remaining fruits (%) after June drop		Mature fruits (%)	
	1995	1996	1995	1996
T1- Open pollination "Control"	8.14D	11.84C	5.75EF	8.69C
T2- Bagging only	4.73E	4.83D	2.84G	2.65D
T3-Emasculation and bagging	2.15F	2.18D	1.20H	1.21D
T4-Hand self pollination	13.12C	12.96C	10.93C	9.84C
Hand cross pollination with:				
T5- Ein Shamer apple pollens	28.53B	32.73A	22.50B	28.30A
T6- Dorsett Golden apple pollens	30.14A	35.19A	24.09A	30.28A
T7- Bartlett pear pollens	12.46C	16.97B	8.63D	13.14B
T8- Calleryana pear pollens	8.46D	12.70C	6.52E	9.58C
T9- Balady quince pollens	7.22D	9.93C	4.79F	7.75C

** Values with the same letters within the same column are not significantly different.*

II.3. Fruit quality:

A- Fruit physical properties of Anna apple:

Average weight; dimensions " height and diameter"; shape index "height: diameter", false pulp thickness; firmness of Anna apple fruit, as well as number of seeds (well developed, shrivelled and total) per each in response to the various pollination treatments were the concerned fruit physical properties investigated in this respect. Data obtained during 1995 and 1996 seasons are presented in Tables (5) and (6), respectively.

A.1.Fruit weight:

Tables (5) and (6) reveal obviously that the hand cross pollinated flowers with pollens of Dorsett Golden apple and Ein Shamer apple induced Anna apple fruits having significantly the heaviest average weight. The reverse was true with the emasculated and bagged Anna apple flowers (parthenocarpic fruiting treatment) whereas the lightest fruits were achieved. Moreover, other pollination treatments were in between the aforesaid two extents.

A.2.Fruit dimensions

Concerning the effect of various pollination treatments on Anna apple fruit height data obtained during both 1995 and 1996 seasons revealed clearly that open pollination (T_1) bagging only (T_2); hand self pollination (T_4) and hand cross pollination with pollens of either Bartlett or Calleryana pear (T_7 & T_8) induced the tallest fruits.

Contrary to that parthenocarpic fruiting i.e.(emasculation and bagging) and hand cross pollination with Balady quince pollens were the inferior. In addition, other pollination treatments i.e. hand cross pollination with pollens of either Dorsett Golden or Ein Shamer apple cultivars were in between. Such result reflected clearly the effect of pollen grains on the characteristics of mother tissues (fruit flesh) which so- called metaxenia.

As for the fruit diameter it is quite evident that the response to various pollination treatments was less pronounced especially during 1995 season, whereas the differences were not significant. However, it could be observed that the hand cross pollinated flowers of Anna apple with pollens of Dorsett Golden apple and Ein Shamer apple induced the thickest fruits during both seasons.

A.3. Fruit shape index "height : diameter":

Referring the fruit shape index of Anna apple cultivar in response to the nine investigated pollination treatments, data obtained during both 1995 & 1996 seasons declared that two opposite trends could be detected in this concern. The first trend included such pollination treatments which induced fruits tended to be round (having the least values of fruit height: fruit diameter ratio), whereas hand cross pollinated flowers with pollens of Dorsett Golden apple came first followed by both hand cross pollination with either Ein Shamer apple or Balady quince . Such tendency could be logically explained on the base of that fact previously discussed pertaining the unparallelled responses of both fruit dimensions (height and diameter) to these three pollination treatments. On the other hand, second trend represented the six other pollination treatments whereas Anna apple fruits tended to be slightly oblonged, since differences between these treatments were not significant especially in the second season. This tendency could be explained by the parallelled response of both fruit dimensions to each of these pollination treatments.

A.4. False pulp thickness :

Data obtained during both 1995 & 1996 seasons, revealed that the thickest false pulp was generally in closed relationship to such "Anna apple fruits induced by the hand cross pollination with pollens of either Dorsett Golden apple or Ein Shamer apple, while the reverse was true with parthenocarpic fruits (induced by the emasculation and bagging). Differences were significant during 1st. season only.

Similar results were reported earlier by **Madbouly (1974); Khalil (1989); Arafat (1989); Ali; (1992); Atawia and Helail (1993) and Torre- Grossa (1996).**

A.5. Fruit firmness:

Regarding the response of the fruit firmness of Anna apple to the differential investigated pollination treatments, it was so worthy to be noticed that hand cross pollination with Dorsett Golden apple pollens followed by hand cross pollination with Ein Shamer apple pollens induced significantly more firmer fruits as compared to those of the other investigated pollination treatments. Such trend was true during both seasons. Meanwhile, fruits of other pollination treatments having approximately flesh of the same firmness.

These results are in general agreement with the findings of **Madbouly (1974); Ali (1992) ; Atawai and Helail (1993).**

A.6. Fruit seediness :

In this regard, number of :a) well developed seeds, b) shrivelled seeds and c) sum of both types per fruit, as well as d) the percentage of the well developed seeds were the four seediness measurements studied in response to the different pollination treatments.

It is quite evident that the number of well developed seeds (nourished ones) and total number of seeds per fruit followed the same trend of response to pollination treatments. Since, data in Tables (5) & (6) and Figures : 14(B,A) and 15 (A,B) exhibited that greatest number of both well developed seeds and total number of seeds per fruit was detected by such fruits resulted by hand cross pollination with Dorsett Golden apple pollens followed by the cross pollinated flowers with pollen grains of Ein Shamer apple. On the contrary the parthenocarpic fruits (emasculation and bagging) were completely seedless followed by those fruits resulted by the bagging only and hand cross pollination with Balady quince pollens as well as fruits of control (open pollination) especially as the number of well developed seeds per fruit was concerned. Moreover, other pollination treatments showed approximately the same values of number of either well developed seeds or total number of seeds per fruit which ranked generally in between the abovementioned two extents.

As for the number of shrivelled seeds per fruit, it could be generally concluded that both treatments of hand self pollination and hand cross pollination with pollen grains from Ein Shamer apple resulted significantly in the highest number of shrivelled seeds per fruit. However, other treatments except (emasculation and bagging) were equally the same in this respect.

Nevertheless, percentage of well developed seeds in relation to investigated pollination treatments followed a firmer trend whereas such treatments could be descendingly arranged into the following order: a) hand cross pollinatioin with Dorsett Golden apple pollens

Table (5) : Fruit physical properties of "Anna" apple cultivar as influenced by different pollination treatments in(1995 season).

Pollination treatments	Fruit weight (gm)	Fruit height (cm) (H)	Fruit diameter (cm) (D)	Fruit shape index (H/D)	Thickness of false pulp (cm)	Fruit firmness (kg/cm^2)	Number of developed seeds per fruit			Well developed seeds (%)
							Well developed seeds	Shrivelled seeds	Total number of seeds	
T1- Open pollination "Control"	118.05B	7.93A	5.55AB	1.43AB	2.21C	4.76CD	2.75E	2.25B	5.00D	54.87E
T2- Bagging only	112.15CD	7.90A	5.43AB	1.46A	2.13DE	4.63D	1.25F	1.75D	3.00F	41.90F
T3-Emasculation and bagging	109.65D	7.00E	5.25B	1.34BC	2.12E	4.54D	0.00G	0.00E	0.00G	0.00G
T4-Hand self pollination	115.05BC	7.60BC	5.68AB	1.34BC	2.20CD	4.88CD	3.75CD	2.50A	6.25C	59.98D
Hand cross pollination with:										
T5- Ein Shamer apple pollens	123.48A	7.48CD	6.13A	1.22DE	2.32B	5.35B	5.50B	2.25AB	7.75B	70.95B
T6- Dorsett Golden apple pollens	126.28A	7.30D	6.20A	1.18E	2.43A	5.80A	7.00A	1.75CD	8.75A	80.00A
T7- Bartlett pear pollens	118.40B	7.78AB	5.78AB	1.35BC	2.24C	5.12BC	4.00C	2.00BC	6.00C	66.73C
T8- Calleryana pear pollens	116.33BC	7.90A	5.75AB	1.38ABC	2.22C	4.98BCD	3.50D	1.75CD	5.25D	66.63C
T9- Balady quince pollens	113.58BCD	7.03E	5.50AB	1.28CD	2.23C	4.77CD	2.50E	1.75CD	4.25E	58.81DE

** Values with the same letters within the same column are not significantly different.*

Table (6): Fruit physical properties of "Anna" apple cultivar as influenced by different pollination treatments in (1996 season).

Pollination treatments	Fruit weight (gm)	Fruit height (cm) (H)	Fruit diameter (cm) (D)	Fruit shape index (H/D)	Thickness of false pulp (cm)	Fruit firmness (kg/cm^2)	Number of developed seeds per fruit			Well developed seeds (%)
							Well developed seeds	Shrivelled seeds	Total number of seeds	
I1- Open pollination "Control"	117.20C	7.80A	5.70CD	1.37AB	2.18A	4.82C	2.25E	2.00B	4.25F	52.98E
T2- Bagging only	113.05D	7.68AB	5.45E	1.41A	2.14A	5.10BC	1.00F	2.00B	3.00G	33.34F
T3-Emasculation and bagging	107.35E	7.15D	5.23F	1.37AB	2.11A	4.75C	0.00G	0.00D	0.00H	0.00G
T4-Hand self pollination	114.08D	7.73AB	5.78BCD	1.34AB	2.17A	5.23BC	3.50D	2.25A	5.75D	60.83D
Hand cross pollination with :										
T5- Ein Shamer apple pollens	123.15B	7.55AB	5.98B	1.27BC	2.33A	5.67AB	6.00B	2.25A	8.25B	72.72B
T6- Dorsett Golden apple pollens	127.58A	7.45BC	6.18A	1.21C	2.35A	6.12A	6.75A	2.00B	8.75A	77.13A
T7- Bartlett pear pollens	116.00CD	7.70AB	5.85BC	1.32AB	2.23A	5.34BC	4.50C	1.75C	6.25C	72.01B
T8- Calleryana pear pollens	115.03CD	7.78A	5.80BCD	1.34AB	2.19A	5.52B	3.50D	1.75C	5.25E	66.64C
T9- Balady quince pollens	113.33D	7.23CD	5.63DE	1.29BC	2.21A	4.90C	2.25E	2.00B	4.25F	52.98E

** Values with the same letters within the same column are not significantly different.*

was the superior, b) hand cross pollination with Ein Shamer apple pollens, c) hand cross pollination with Bartlett pear pollens, d) hand cross pollination with Calleryana pear pollens, e) hand self pollination, f) both hand cross pollination with Balady quince pollens and open pollination and g) bagging only, and lastly the emasculation and bagging treatment which induced completely seedless fruits.

These results go in line with the finding of **Murneek (1954); Madbouly (1974); Arafat (1989); Yehia (1989); Yamada et al. (1991); Ali (1992); Atawia and Helail (1993) Arafat et al. (1994) and Ketchie et al. (1996).**

B. Fruit chemical properties :

Starch percentage, total sugars percentage, fruit juice percentage of both total soluble solids (T.S.S) percentage and titratable acidity as well as T.S.S/acid ratio were the investigated chemical characteristics of Anna apple fruits pertaining their response to different pollination treatments. Data obtained during both 1995 & 1996 seasons are tabulated in Table (7).

B.1. Starch percentage:

Data obtained during both 1995 and 1996 seasons revealed that Anna apple fruits induced by the hand cross pollinated flowers with pollens of Dorsett Golden apple contained statistically the highest percentage of starch (14.93% & 13.91%) followed by those of hand cross pollination with pollens of Ein Shamer apple (14.24% & 13.65%), however, difference was significant during 1995 season only.On the other hand, fruits of other investigated pollination treatments contained approximately the same percentage of starch.

B.2. Total sugars percentage :

Table (7) reveals obviously the superiority of cross pollination with pollens of Dorsett Golden apple and Ein Shamer apple cultivars in increasing the sugars contents of Anna apple fruits. Moreover, three pollination treatments of hand self pollination and hand cross pollination with pollens of either Bartlett or Calleryana pear cultivars increased also total sugars percentage in Anna apple fruits during 2nd. year (1996) only. On the other hand, fruits of other pollination treatments contained relatively lower sugars percentage, however, the parthenocarpic fruits (emasculation and bagging) trended to be the poorest ones in this respect.

B.3. Total soluble solids percentage (T.S.S%) :

Regarding the response of fruit juice total soluble solids percentage (T.S.S%) of Anna apple cultivar to the pollination treatments, data in Table (7) declared that the hand cross pollination with pollens of either Dorsett Golden apple or Ein Shamer apple and the hand self pollination produced the richest fruits in their T.S.S% .

However, fruits resulted by emasculation and bagging (parthenocarpic fruits) and hand cross pollination with pollens of Balady quince were the poorest ones in their T.S.S%. Moreover, other pollination treatments induced fruits with intermediate values of T.S.S%.

B.4. Acidity percentage:

It is quite evident from data in Table (7) that the response of fruit juice titratable acidity percentage to the various pollination treatments took the other way around as compared to that trend previously detected with T.S.S%. Since, the lowest value of acidity %

Table (7): Fruit chemical properties of "Anna" apple cultivar as influenced by different pollination treatments in (1995 & 1996 seasons).

Pollination treatments	Starch (%)		Total sugars (%)		T. S. S (%)		Acidity (%)		T.s.s /acid ratio	
	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996
T1- Open pollination "Control"	12.83C	13.25BCD	6.65CD	6.46BC	11.75BCD	11.25CD	0.68C	0.70A	17.36BC	16.09CD
T2- Bagging only	12.64C	12.86CDE	6.32DE	6.41BC	11.70CD	11.08CD	0.68C	0.69B	17.21C	16.06CD
T3-Emasculation and bagging	12.24C	13.10CDE	6.20E	6.18C	10.90E	10.85D	0.69B	0.69B	15.80D	15.73D
T4-Hand self pollination	12.68C	12.77DE	6.52CDE	7.09A	11.88ABC	12.00AB	0.68C	0.67D	17.47BC	17.92AB
Hand cross pollination with:										
T5- Ein Shamer apple pollens	14.24B	13.65AB	7.11AB	7.15A	12.03AB	12.15A	0.66E	0.65E	18.22AB	18.71A
T6- Dorsett Golden apple pollens	14.93A	13.91A	7.38A	7.27A	12.10A	12.20A	0.66E	0.64F	18.48A	19.07A
T7- Bartlett pear pollens	13.98B	12.78DE	6.86BC	6.92AB	11.63CD	11.55BC	0.67D	0.67D	17.42BC	17.25BC
T8- Calleryana pear pollens	12.70C	12.57E	6.56CDE	7.05A	11.50D	11.35CD	0.68C	0.68C	16.87C	16.70CD
T9- Balady quince pollens	12.31C	13.36BC	6.37DE	6.43BC	11.00E	10.93D	0.70A	0.70A	15.72D	15.61D

** Values with the same letters within the same column are not significantly different.*

was always concomitant to fruits gained by the hand cross pollination with pollens of either Dorsett Golden apple or Ein Shamer apple.

However, the reverse was true with such fruits resulted by hand cross pollination with pollens of Balady quince and to great extent parthenocarpic fruits (emasculation and bagging) which were the richest ones in this respect. In addition, other pollination treatments were in between .

B.5. Total soluble solids / acid ratio (T.S.S/ acid ratio) :

Concerning the effect of different pollination treatment on fruit juice total soluble solids/ acid ratio, Table (7) shows that Anna apple fruits of the hand cross pollinated flowers with pollens from Dorsett Golden apple or Ein Shamer apple and those of hand self pollination exhibited statistically the highest ratio during both 1995 and 1996 seasons. The reverse was true with fruits of both emasculation and bagging and cross pollinated flowers with Balady quince pollens. Moreover, other pollination treatments were in between.

These results are in harmony with the findings of **Madbouly (1974); Ali (1992); Atawia and Helail (1993).**

II.4. Histological studies :

Cross sections examination of the Anna apple and Le-Conte pear ovaries revealed that the ovary contains normally five carpels in general which are regular in their shape, symmetrical with each other.

Each carpel in the normal ovary contains 2 well developed ovules similar in both shape and size. A single normal ovule is morphologically composed of : integuments, embryo sac, nucellus and an embryo which is formed later after fertilization. (Fig. :11 (B)) .

The abnormal ovary contains less than five developed or undeveloped carpels with one or without ovules and sometimes, some of these carpels are absent. These carpels showed neither regularity in shape nor symmetry in size. [Figs.: 10 (A,B,C,D,E), 11 (A) and 16].

These observations are in agreement with the findings of **Arafat (1989); Rohitha and Klinac (1990).**

Regarding to ovule deterioration , some of the aborted ovules were noticed at 3 days after hand self pollination as shown in Le Conte pear ovary. Fig. (16) .

Fecundation tookplace within 3-7 days after pollination treatment as shown in Anna apple ovaries after 3 days from hand self pollination; open pollination; hand cross pollination with pollen grains of Calleryana pear; Bartlett and Ein Shamer apple as well as shown in Le-Conte pear ovary after 3 days from hand self pollination. Fig : 10 (A,B,C,D,E) and Fig. (16). Also, at 7 days after cross pollination of Anna apple ovaries with pollen grains of Ein Shamer apple and Dorsett Golden apple, well developed fertilized ovules could be noticed clearly as shown in Fig:11 (A,B).

These results go in line with those reported by **Anvari and Stosser (1981); Sato et al. (1988); Yehia (1989); Yamashita et al. (1990); El- Sherbini et al. (1991) and Yamada et al. (1991).**

After Fecundation, dimensions of developing ovules including thickness of integuments showed progressive increase, embryo sac began to enlarge and the divisions of zygote and endosperm nuclei were observed in the fertilized ovules within 21 days after hand cross pollination of Anna apple with pollen grains of Bartlett pear, Ein Shamer apple Dorsett Golden apple. Figs:12(A,B,C).

After 30 days from bagging only of Anna apple, three undeveloped carpels with three aborted ovules were observed in examined ovary, Fig : 13(C), while ten shrivelled ovules in Anna apple ovary were detected after 30 days from emasculation and bagging treatment (parthenocarpic fruiting).Fig : 13(D).

At 30 days after hand cross pollination of Anna apple flowers with pollen grains of Calleryana pear and Balady quince, two well developed carpels with four well developed ovules were clearly seen in examined ovary as shown in Fig: 13(A,B).

At 45 days from hand cross pollination of Anna apple flowers with pollen grains of Ein Shamer apple and Dorsett Golden apple , examined ovaries showed that there were four well developed carpels with eight seeds, some of them were aborted. Fig : 14(A,B).

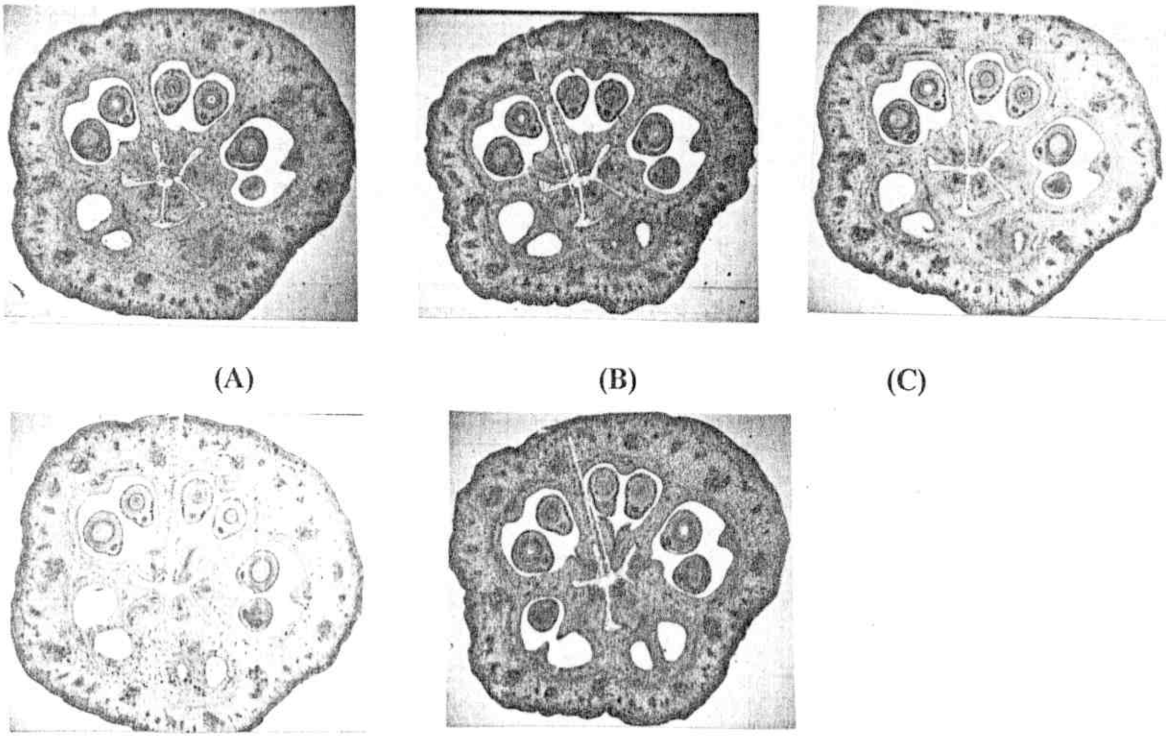
After 60 days of hand cross pollination for Anna apple flowers with pollen grains of Dorsett Golden apple and Ein Shamer apple, it could be observed a well developed carpel with two seeds, one of both was aborted. Fig:15(A), and the other one contains one well developed seeds. Fig:15(B). Also, Fig:(15) showed well developed embryos, endosperm and remainder of nucellus that began to disappear as well as seeds coats completely differentiated.

From another point of view, the number of well developed ovules was higher when Dorsett Golden apple, Ein Shamer apple and Bartlett pear were used as pollinizers, where Dorsett Golden apple showed superiority in this respect. Fig:12(A,B,C) and Fig: 14 (A,B).

This may be attributed to a degree of cross incompatibility. Hand self pollination, open pollination, hand cross pollination with pollen grains of Calleryana pear and Balady quince produced lower number of fertilized ovules in Anna apple ovaries, Fig: 10 (A,B,) and

Fig: 13(A,B), as well as ovaries of hand self pollinated flowers of Le-Conte pear showed shrivelled ovules were more aborted in their appearance than those of the hand self pollinated flowers of Anna apple. Fig:10(A) and Fig:(16). Thus it could be concluded that there was a degree of self incompatibility within the individual trees of the same species or zygote exhaustion of fertilized ovules. However, bagged flowers of Anna apple showed deteriorated ovules which were nearly absorbed by ovary tissues. Fig:13(C). Moreover, shrivelled ovules (seedlessness or parthenocarpic fruiting) in Anna apple fruits obtained from emasculation and bagging may be attributed to the failure of well differentiated ovules to be continued their development without fertilization as shown in Fig:13(D).

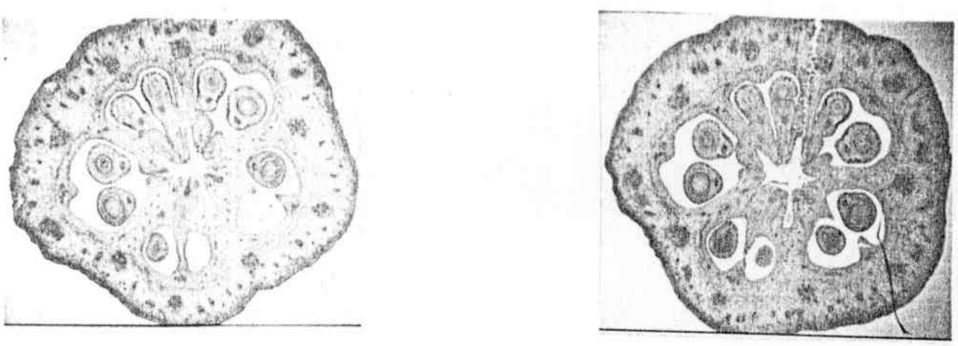
The obtained results were in harmony with the earlier findings of **Anvari and Stosser (1981); El- Sherbini (1982); Herrero and Gascon (1987); Yehia (1989); Yamashita et al. (1990); El- Sherbini et al. (1991) ; Yamada et al. (1991); Xu and Shao (1993) and Robbie and Atkinson (1994).**



(A) (B) (C)

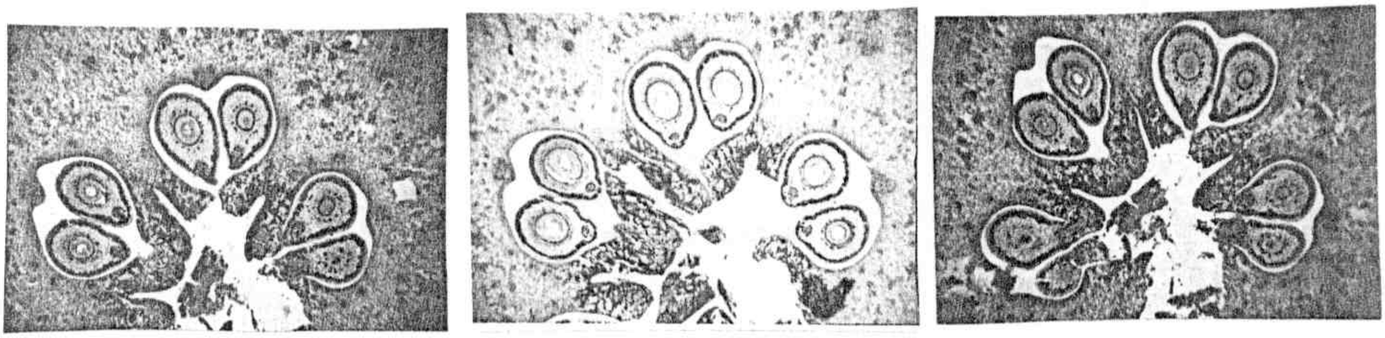
(D) (E)

Fig. (10): C.S. in Anna apple ovary after 3 days from hand self pollination (A); open pollination (B); hand cross pollination with pollen grains of Calleryana pear (C); Bartlett pear (D) and Ein Shamer apple (E). (X = 4 x 6)



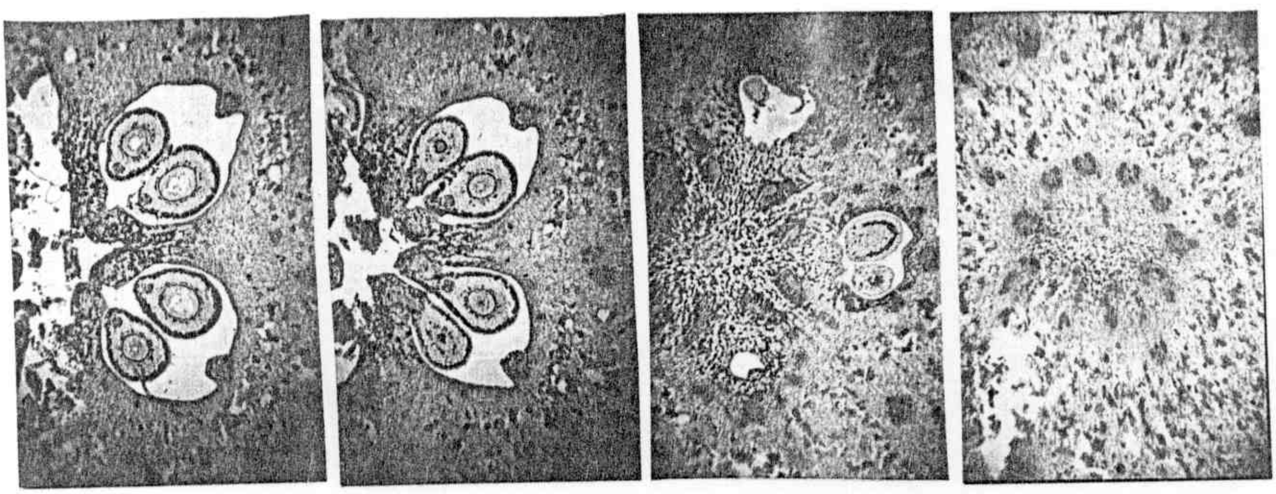
(A) (B)

Fig. (11): C.S. in Anna apple ovary after 7 days from hand cross pollination with pollen grains of Ein Shamer apple (A) and Dorsett Golden apple (B). (X = 4 x 6)



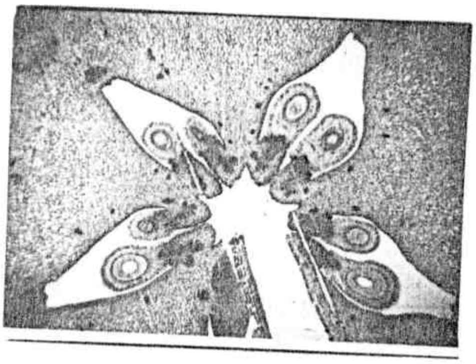
(A) (B) (C)

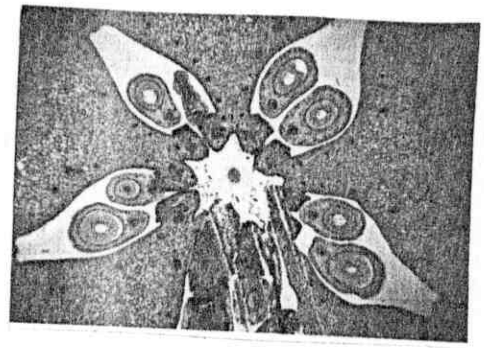
Fig. (12): C.S. in Anna apple ovary after 21 days from hand cross pollination with pollen grains of Bartlett pear (A); Ein Shamer apple (B) and Dorsett Golden apple (C). (X = 4 x 6)



(A) **(B)** **(C)** **(D)**

Fig. (13): C.S. in Anna apple ovary after 30 days from hand cross pollination with pollen grains of Calleryana pear (A); Balady quince (B); bagging only (C) or emasculation and bagging (D). (X = 4 x 6)

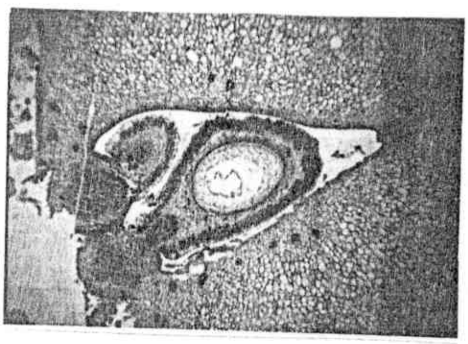


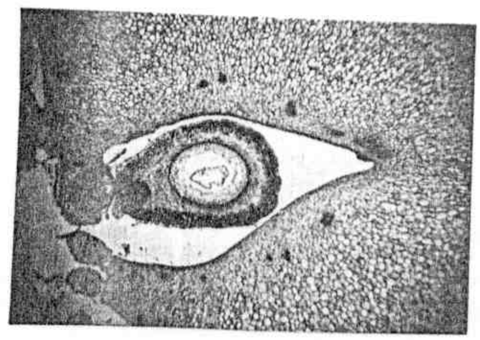


(A)

(B)

Fig. (14): C.S. in Anna apple ovary after 45 days from hand cross pollination with pollen grains of Ein Shamer apple (A) and Dorsett Golden apple (B). (X = 4 x 6)





(A)

(B)

Fig. (15): C.S. in Anna apple ovary after 60 days from hand cross pollination with pollen grains of Dorsett Golden apple (A) and Ein Shamer apple (B). (X = 4 x 6)

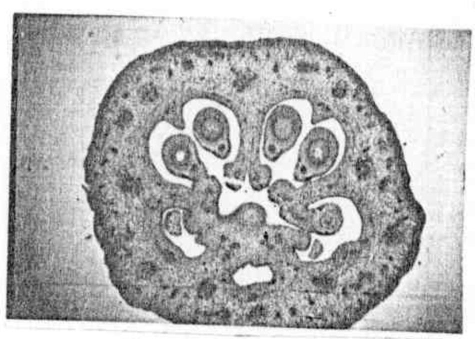


Fig. (16): C.S. in Le-Conte pear ovary after 3 days from hand self pollination.

(X = 4 x 6)

III. Physiological studies :

In this respect, some measurements of vegetative growth, flowering and fruiting aspects, as well as anatomical examinations dealing with the flower bud differentiation of fruitfull Anna apple and Le-Conte pear trees in response to paclobutrazol (PP_{333}) and cycocel (CCC) foliar sprays at various concentrations (0.0,1000 and 2000 p.p.m) and dates (full bloom and mid- June) were investigated during both experimental seasons of 1995/96 and 1996/97. Therefore, two factorial experiments were conducted each dealing with investigating the effect of (2 growth retardants x 3 concentrations x 2 spraying dates) from one side, whereas first experiment was devoted for Anna apple trees and 2nd. one for Le-Conte pear trees from the other.

III.1. Vegetative growth measurements :

Shoot length and average number of leaves per each as well as leaf length, width, shape index, area and dry weight in response to specific effects of the three investigated factors (kind of growth retardants, applied concentration and spraying date)and the interaction effect of their various combinations were the investigated growth measurements.

Experiment, I " Anna apple cultivar":

Data obtained during both seasons pertaining the response to specific effect of spraying dates, concentrations and kind of growth retardants, beside their combinations (interaction) are presented in Table 8(A,B,C,D and E).

A. Specific effect of investigated factors:

Regarding the specific effect of growth retardant kind, Table 8 (A) revealed obviously that most growth measurements of Anna apple trees sprayed with PP_{333} exhibited significantly more pronounced depressions as compared to the analogous ones resulted by the other growth retardant (CCC). In other words, PP_{333} exceeded significantly CCC in reducing shoot length, number of leaves per shoot, leaf length, leaf shape index and leaf area, while the trend took the way around with both width and dry weight of leaf. Such trend was true during both seasons of study.

Referring the specific effect of the applied concentrations at which both growth retardants were applied Table 8 (A) shows that both 1000 and 2000 p.p.m concentrations were statistically more effective than the control "0.0 p.p.m" in stunting all growth measurements. However, the highest concentration (2000 p.p.m) was statistically the most depressive with all growth measurements except leaf width and leaf dry weight whereas both 1000 and 2000 p.p.m were statistically the same.

Concerning the specific effect of spraying dates, data obtained during both seasons as shown from Table 8 (A) revealed that full bloom foliar sprays was markedly more effective in reducing shoot length, number of leaves per shoot, leaf length, leaf shape index, leaf area while the reverse was true with leaf width and leaf dry weight.

Differences were significant during both experiment seasons.

Interaction effect of various combinations between growth retardants, concentrations and spraying dates:

B.Interaction effect of (growth retardants x spraying dates):

Table 8 (B) reveals that the response of studied growth measurements to the various combinations of spraying both growth retardants (PP_{333} & CCC) at either full bloom or mid- June varied from one measurement to another. However, shoot length, number of leaves per shoot and leaf length exhibited statistically the severest reduction by spraying paclobutrazol at full bloom, while the lightest decrease was detected by mid- June CCC foliar sprayed Anna apple trees. On the other hand, leaf width, leaf index, leaf area and leaf dry weight were not significantly responded to the differential combinations between the two growth retardants (PP_{333} & CCC) and their both spraying dates (full bloom and mid- June).

C-Interaction effect of (growth retardants x concentrations):

It is quite evident from tabulated data in Table 8(C) that studied growth measurements of Anna apple trees varied greatly in their response to the interaction effect of different combinations between both growth retardants (PP_{333} & CCC) from one hand and their three concentrations (0.0,1000 and 2000 p.p.m) applied from the other. The 2000 p.p.m PP_{333} foliar sprayed trees of Anna apple showed statistically the shortest shoots with the lowest number of leaves per each and the least values of leaf length, shape index and area, followed in a descending order by 1000 p.p.m PP333 foliar spray, 2000 p.p.m CCC foliar spray, 1000 p.p.m CCC foliar spray and control (0.0 p.p.m) which ranked last and showed the highest values of these growth measurements. Such trend was true during both seasons, however, differences were more pronounced with shoot length, number of leaves per shoot and leaf shape index rather than leaf length and area. On the other hand, the trend of leaf dry weight response took the other way around whereas the control and CCC sprayed trees at either 2000 or 1000 p.p.m induced leaves having the lightest dry weight per each, while PP_{333} sprays at 1000 or 2000 p.p.m induced statistically the heaviest leaves.

D-Interaction effect of (spraying dates x concentrations):

Regarding the interaction effect of spraying dates x concentrations of growth retardants applied on growth measurements of Anna apple trees, data obtained during both seasons of (1995/96 & 1996/97) are presented in Table 8 (D). It could be clearly noticed that the severest reduction in shoot length, number of leaves per shoot, leaf length and leaf index was significantly resulted by the full bloom sprayed growth retardants at 2000 p.p.m followed statistically in a descending order by full bloom sprays at 1000 p.p.m and mid- June spray either at 1000 or 2000 p.p.m. Meanwhile, differences in leaf width and leaf area due to the interaction effect of the six combinations between the three, growth retardants, concentrations and their two spraying dates were so minor and did not reach level of significance during both seasons of study. In addition, leaf dry weight tended to be slightly increased with the full bloom sprays especially at 2000 p.p.m, while it decreased in control trees, whereas differences were significant during 2nd. season only.

Table (8): Some growth measurements of Anna apple trees as affected by PP_{333} & CCC foliar sprays at various concentrations and dates during (1996 & 1997 seasons).

A- Specific effect of growth retardants, concentrations and spraying dates.

Investigated factors		Shoot length (cm)		No.of leaves per Shoot		Leaf length (cm)		Leaf width (cm)		Leaf index		Leaf area (cm^2)		Leaf dry weight (mg)	
		1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Growth retardants	PP333	33.3B	28.7B	21.7B	18.8B	8.6B	8.7B	5.6A	5.7A	1.54B	1.51B	24.3B	23.7B	293A	296A
	CCC	38.1A	33.3A	24.9A	21.8A	8.8A	8.9A	5.5B	5.6B	1.60A	1.57A	25.3A	24.6A	291B	293B
Concentrations	Control	42.2A	39.8A	27.8A	26.3A	8.9A	8.9A	5.5B	5.6B	1.62A	1.61A	25.7A	25.0A	290B	292B
	1000 p.p.m	33.5B	27.5B	21.9B	17.9B	8.7B	8.7B	5.6A	5.7A	1.56B	1.52B	24.6B	23.9B	293A	295B
	2000 p.p.m	31.3C	25.9C	20.3C	16.8C	8.6C	8.6C	5.6A	5.8A	1.53C	1.50C	24.1C	23.6B	294A	297A
Spraying dates	F.B	34.0B	29.7B	22.3B	19.4B	8.6B	8.7B	5.6A	5.7A	1.54B	1.52B	24.6B	23.9A	293A	296A
	M.J	37.3A	32.3A	24.4A	21.2A	8.8A	8.8A	5.6B	5.7B	1.59A	1.56A	25.1A	24.5A	292B	294B

B- Interaction effect of (growth retardants x spraying dates).

Gro.ret. / Spr. dat	Shoot length (cm)		No.of leaves per Shoot		Leaf length (cm)		Leaf width (cm)		Leaf index		Leaf area (cm^2)		Leaf dry weight (mg)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
1996														
F.B	31.0C	37.1B	20.2D	24.3B	8.5C	8.8AB	5.6A	5.6A	1.50A	1.58A	23.9A	25.2A	294A	292A
M.J	35.6B	39.1A	23.3C	25.5A	8.7B	8.9A	5.6A	5.5A	1.57A	1.61A	24.7A	25.4A	292A	291A
1997														
F.B	27.3B	32.1A	17.8B	21.1A	8.6C	8.8A	5.8A	5.7A	1.49A	1.56A	23.3A	24.5A	298A	294A
M.J	30.2AB	34.5A	19.8A	22.6A	8.7B	8.9A	5.7A	5.6A	1.53A	1.58A	24.1A	24.8A	294A	293A

C- Interaction effect of (growth retardants x concentrations).

Gro.ret. / Con.	Shoot length (cm)		No.of leaves per Shoot		Leaf length (cm)		Leaf width (cm)		Leaf index		Leaf area (cm^2)		Leaf dry weight (mg)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
1996														
Control	42.2A	42.2A	27.8A	27.8A	8.9A	8.9A	5.5A	5.5A	1.62A	1.62A	25.7A	25.7A	290B	290B
1000p.p.m	30.0D	37.1B	19.4D	24.4B	8.5B	8.8A	5.6A	5.6A	1.52C	1.59AB	24.1B	25.2A	294A	291B
2000 p.p.m	27.8E	34.8C	18.0E	22.6C	8.4C	8.8A	5.7A	5.6A	1.48D	1.58B	23.2C	25.1A	295A	292B
1997														
Control	40.0A	40.0A	26.3A	26.3A	8.9A	8.9A	5.6C	5.6C	1.61A	1.61A	25.0A	25.0A	292D	292D
1000p.p.m	24.0D	31.0B	15.6D	20.1B	8.6B	8.9A	5.8A	5.7B	1.48C	1.57B	23.2A	24.7A	297B	293CD
2000 p.p.m	22.4E	29.3C	14.4E	19.1C	8.4C	8.8A	5.8A	5.7B	1.45D	1.55B	22.9A	24.3A	299A	294C

** Values with the same letters within the same column are not significantly different.*

Continued Table (8).....

D- Interaction effect of (spraying dates x concentrations).

Spr. dat. / Con.	Shoot length (cm)		No.of leaves per Shoot		Leaf length (cm)		Leaf width (cm)		Leaf index		Leaf area (cm^2)		Leaf dry weight (mg)	
	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J
								1996						
Control	42.2A	42.2A	27.8A	27.8A	8.9A	8.9A	5.5A	5.5A	1.62A	1.62A	25.7A	25.7A	290A	290A
1000 p.p.m	31.5A	35.5B	20.6C	23.1B	8.6C	8.8AB	5.6A	5.6A	1.53C	1.59AB	24.3A	24.9A	294A	292A
2000 p.p.m	28.3D	34.2B	18.4D	22.3B	8.4D	8.7B	5.7A	5.6A	1.49D	1.57B	23.7A	24.5A	295A	292A
								1997						
Control	39.8A	39.8A	26.3A	26.3A	8.9A	8.9A	5.6A	5.6A	1.61A	1.61A	25.0A	25.0A	292D	292D
1000p.p.m	26.0C	28.9B	16.8C	19.0B	8.7C	8.8B	5.8A	5.7A	1.50C	1.55B	23.6A	24.3A	296B	294CD
2000 p.p.m	23.4D	28.3B	15.3D	18.3B	8.5D	8.7BC	5.8A	5.7A	1.47D	1.52BC	23.1A	24.2A	298A	295BC

E- Interaction effect of (growth retardants x concentrations x spraying datas).

Gro.ret. / Spr. dat. & Con.	Shoot length (cm)		No.of leaves per Shoot		Leaf length (cm)		Leaf width (cm)		Leaf index		Leaf area (cm^2)		Leaf dry eight (mg)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
								1996						
Control	42.2A	42.2A	27.8A	27.8A	8.9A	8.9A	5.5A	5.5A	1.62A	1.62A	25.7A	25.7A	290A	290A
Full bloom														
1000p.p.m	26.6C	36.4B	17.3C	24.0B	8.4B	8.8A	5.7A	5.6A	1.48B	1.57A	23.6A	25.1A	295A	292A
2000 p.p.m	24.1C	32.5B	15.5C	21.3B	8.1B	8.8A	5.8A	5.6A	1.42B	1.56A	22.5A	24.9A	297A	293A
Mid- June														
1000p.p.m	33.2B	37.9A	21.5A	24.8A	8.7A	8.9A	5.6A	5.5A	1.56A	1.62A	24.4A	25.4A	293A	290A
2000p.p.m	31.4B	37.1A	20.5B	24.0B	8.6A	8.9A	5.6A	5.6A	1.54A	1.60A	23.9A	25.2A	294A	291A
								1997						
Control	39.8A	39.8A	26.3A	26.3A	8.9A	8.9A	5.6A	5.6A	1.61A	1.61A	25.0A	25.0A	292A	292A
Full bloom														
1000 p.p.m	22.2C	29.8B	14.3C	19.3B	8.5B	8.8A	5.9A	5.7A	1.45B	1. 55A	22.7A	24.5A	299A	294A
2000 p.p.m	19.9C	26.9B	12.8C	17.8B	8.3B	8.8A	5.9A	5.8A	1.41B	1.53A	22.2A	23.9A	302A	295A
Mid – June														
1000 p.p.m	25.7B	32.1A	17.0B	21.0A	8.7A	8.9A	5.8A	5.6A	1.51B	1.59A	23.7A	24.8A	295A	292A
2000 p.p.m	25.0B	31.7B	16.0B	20.5B	8.6A	8.9A	5.8A	5.7A	1.49B	1.56A	23.7A	24.6A	296A	294A

* *Values with the same letters within the same column are not significantly different.*

E. Interaction effect of (growth retardants x concentrations x spraying dates):

Data of Table 8 (E) displayed clearly that the full bloom sprays with PP_{333} at either 1000 or 2000 p.p.m were statistically the most restrictive treatments for most growth measurements of Anna apple trees. Since, the shortest shoots with the fewest number of leaves per each and least values of leaf length and leaf index were detected, followed by both PP_{333} and CCC sprayed at mid- June and full bloom, respectively, regardless of concentration at which each growth retardant was sprayed. In addition, control trees exhibited the maximum values of the aforesaid four growth measurements.

Moreover, the response of leaf area followed the same trend previously discussed with the aforesaid measurements, but differences did not reach level of significance. Meanwhile, the leaf width and leaf dry weight were slightly increased by any of PP_{333} and CCC as compared to control regardless of time and concentration of application, however, differences were not significant.

These results seem to agree with the findings of **Comai (1990); El- Khoreiby <u>et</u> <u>al</u>. (1990); Holubowicz and Musielak (1991); Kara and Kaska (1991); Hao <u>et al.</u> (1991); Greene (1991); Estabrooks (1993); Struklec and Modic (1994); Lipecki and Wieniarska (1995) and Khurshid <u>et</u> <u>al</u>. (1997).**

Experiment, II "Le-Conte pear cultivar":

Data obtained during both seasons of 1995/96 & 1996 /97 regarding the specific effect of three investigated factors and interaction effect of their combinations are presented in Table 9 (A,B,C,D and E).

A.Specific effect of investigated factors:

It is quite evident as shown from Table 9(A) that Le-Conte pear trees followed the same trend of response to the specific effect of growth retardants type previously detected with Anna apple trees.

Since, PP_{333} was more effective than CCC in reducing values of shoot length, number of leaves per shoot, leaf length, leaf shap index and leaf area measurements. Differences were significant during both seasons. On the other hand, both leaf width and leaf dry weight followed an opposite trend, whereas CCC was significantly more restrictive.

Regarding the specific effect of growth retardants concentrations, it is so clear that the highest concentration (2000 p.p.m) followed by the lower one (1000p.p.m) exhibited significantly an obvious reduction than control (0.0p.p.m) pertaining most growth measurements (shoot length, number of leaves per shoot, leaf length, leaf shape index and leaf area). On the contrary, the trend took the other way around with both leaf width and its dry weight.

Nevertheless the full bloom spray exceeded specifically the mid- June spray with most growth measurements except leaf width and its dry weight, whereas, the reverse was true.

B. Interaction effect of (growth retardants x spraying dates):

Data presented in Table 9(B) revealed that Le-Conte pear trees typically followed the same trend previously detected with Anna apple trees regarding the response of vegetative growth measurements to the interaction effect of various combinations between two growth retardants and both dates of spraying. Since, the PP_{333} sprays at full bloom resulted significantly in the severest reduction of shoot length, number of leaves per shoot and leaf length, while leaf width, leaf index and leaf area were not significantly responded. On the contrary, leaf dry weight was slightly increased by full bloom PP_{333} sprays.

C- Interaction effect of (growth retardants x concentrations):

Table 9(C) displays obviously that the 2000 p.p.m paclobutrazol (PP_{333}) sprayed trees of Le-Conte pear cultivar exhibited statistically the severest reduction in the their most growth measurements i.e. shoot length, number of leaves per shoot, leaf length, leaf shape index and leaf area, descendingly followed by PP_{333} at 1000 p.p.m and CCC at 2000 or 1000 p.p.m. This trend took the other way around with both leaf width and dry weight, whereas the PP_{333} sprays at 2000 or 1000 p.p.m increased them significantly than the other combinations.

D- Interaction effect of (spraying dates x concentrations):

Data in Table 9 (D) displayed that growth measurements of Le-Conte pear trees varied in their response to the interaction effect of various combinations between spraying dates and concentrations of growth retardants. It could be noticed that the full bloom sprays of growth retardants at 2000 p.p.m was significantly the superior in restricting the shoot length, number of leaves per shoot, leaf length and leaf index, descendingly followed by full bloom sprays at 1000 p.p.m, mid-June sprays at 2000 p.p.m and 1000 p.p.m. However, the response of leaf width, leaf area and leaf dry weight was less pronounced and did not reach level of significance except with two later measurements in the first season during it both exhibited significant responses.

E. Interaction effect of (growth retardants x concentrations x spraying dates):

Data presented in Table 9 (E) revealed obviously that the tap water sprayed Le-Conte pear trees (control) exhibited generally the greatest values of all studied growth measurements except leaf dry weight whereas the lightest weight was exhibited. Such trend was detected during both seasons, however, differences were more pronounced with shoot length, number of leaves per shoot, leaf length where variance were significant during both seasons and to some extent leaf dry weight (difference was significant in 1st. only). On the contrary, the combinations of PP_{333} full bloom sprays at either 1000 or 2000 p.p.m (especially higher concentration) resulted significantly in the severest restriction of shoot length, number of leaves per shoot and leaf length measurements during both seasons of study followed by both combinations of PP_{333} mid- June sprays at 1000 or 2000 p.p.m and the combinations of CCC sprays regardless of neither concentration nor spraying date. Moreover leaf width, leaf shape index and leaf area exhibited the least pronounced response to the various combinations of (growth retardant type x concentration x spraying date), whereas differences were so slight to reach level of significance and consequently could be safely neglected during both seasons.

Obtained results regarding the growth measurements of Le-Conte pear go in line with the findings of **Bist (1990); Mike and Tymoszuk (1990); Othman (1991); Klinac et al. (1991); Helail and Atawia (1992); Rai and Bist (1992); Atawia and Hassan (1995); Costa et al. (1995); Mei et al. (1995); Roouen (1995) and Houter (1996).**

Table (9): Some growth measurements of Le-Conte pear trees as affected by PP_{333} & CCC foliar sprays at various concentrations and dates during (1996 & 1997 seasons).

A- Specific effect of growth retardants, concentrations and spraying dates.

Investigated factors		Shoot length (cm)		No.of leaves per Shoot		Leaf length (cm)		Leaf width (cm)		Leaf index		Leaf area (cm^2)		Leaf dry weight (mg)	
		1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Growth retardants	PP_{333}	36.9B	32.6B	21.3B	18.8B	8.7B	8.6B	5.6A	5.6A	1.55B	1.53B	24.9B	23.7B	297A	300A
	CCC	40.1A	37.5A	23.2A	21.6A	8.9A	8.8A	5.4B	5.5B	1.63A	1.61A	25.9A	24.8A	292B	295B
Concentrations	Control	43.8A	45.1A	25.3A	26.0A	8.9A	8.9A	5.4B	5.4B	1.66A	1.66A	26.3A	26.8A	290C	291B
	1000 p.p.m	36.8B	31.3B	21.3B	18.0B	8.8B	8.6B	5.6A	5.6A	1.58B	1.53B	25.2B	23.2B	296B	300A
	2000 p.p.m	35.0C	28.6C	20.1C	16.6C	8.6C	8.5C	5.6A	5.7A	1.54C	1.50C	24.8B	22.9B	298A	301A
Spraying dates	F.B	37.6B	33.9B	21.6B	19.5B	8.7B	8.6B	5.6A	5.6A	1.57B	1.54B	25.1B	23.9B	296A	299A
	M.J	39.5A	36.1A	22.8A	20.9A	8.8A	8.7A	5.5B	5.5B	1.61A	1.59A	25.7A	24.6A	293B	296B

B- Interaction effect of (growth retardants x spraying dates).

Gro.ret. / Spr. date	Shoot length (cm)		No.of leaves per Shoot		Leaf length (cm)		Leaf width (cm)		Leaf index		Leaf area (cm^2)		Leaf dry weight (mg)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
1996														
F.B	35.5C	39.7A	20.3C	22.9A	8.6C	8.8AB	5.6A	5.5A	1.53A	1.62A	24.5A	25.7A	300A	293BC
M.J	38.4B	40.6A	22.2B	23.4A	8.8B	8.9A	5.5A	5.4A	1.58A	1.65A	25.3A	26.2A	294B	292C
1997														
F.B	30.9C	37.0A	17.7C	21.3A	8.5C	8.8A	5.7A	5.5A	1.50A	1.59A	23.2A	24.6A	302A	295A
M.J	34.2B	38.0A	19.8B	21.9A	8.7B	8.8A	5.6A	5.4A	1.55A	1.62A	24.2A	25.1A	298A	294A

C- Interaction effect of (growth retardants x concentrations).

Gro.ret. / Con.	Shoot length (cm)		No.of leaves per Shoot		Leaf length (cm)		Leaf width (cm)		Leaf index		Leaf area (cm^2)		Leaf dry weight (mg)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
1996														
Control	43.8A	43.8A	25.3A	25.3A	8.9A	8.9A	5.4C	5.4C	1.66A	1.66A	26.3A	26.3A	290D	290D
1000p.p.m	34.5D	39.2B	19.9D	22.6B	8.7C	8.8AB	5.7A	5.4BC	1.53C	1.63AB	24.5B	25.8A	299B	293C
2000 p.p.m	32.5E	37.4C	18.6E	21.6C	8.5D	8.8B	5.7A	5.5B	1.48D	1.60B	23.9B	25.6A	302A	295C
1997														
Control	45.1A	45.1A	26.0A	26.0A	8.9A	8.9A	5.4C	5.4C	1.66A	1.66A	26.8A	26.8A	291C	291C
1000p.p.m	28.4C	34.3B	16.3C	19.8B	8.5C	8.8B	5.7A	5.5B	1.48C	1.59B	22.4C	24.0B	303A	296B
2000p.p.m	24.2D	33.1B	14.0D	19.1B	8.3D	8.7B	5.8A	5.6B	1.43D	1.57B	22.0C	23.8B	305A	297B

* *Values with the same letters within the same column are not significantly different.*

Continued Table (9) ...

D- Interaction effect of (spraying dates x concentrations)

Spr. dat. / Con.	Shoot length (cm)		No.of leaves per Shoot		Leaf length (cm)		Leaf width (cm)		Leaf index		Leaf area (cm^2)		Leaf dry weight (mg)	
	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J
							1996							
Control	43.8A	43.8A	25.3A	25.3A	8.9A	8.9A	5.4A	5.4A	1.66A	1.66A	26.3A	26.3A	290D	290D
1000 p.p.m	35.6C	38.1B	20.5C	22.0B	8.7B	8.8B	5.6A	5.5A	1.56C	1.60B	24.7CD	25.6AB	298B	294C
2000 p.p.m	33.3D	36.6C	19.1D	21.1C	8.5C	8.8B	5.7A	5.5A	1.50D	1.58BC	24.2D	25.3BC	301A	296C
							1997							
Control	45.1A	45.1A	26.0A	26.0A	8.9A	8.9A	5.4A	5.4A	1.66A	1.66A	26.8A	26.8A	291A	291A
1000 p.p.m	30.1C	32.7B	17.1C	18.9B	8.6C	8.7B	5.7A	5.6A	1.50C	1.57B	22.7A	23.6A	301A	298A
2000 p.p.m	26.7D	30.6C	15.4D	17.8BC	8.4D	8.6B	5.8A	5.6A	1.46D	1.54B	22.3A	23.5A	303A	299A

E- Interaction effect of (growth retardants x concentrations x spraying dates).

Gro.ret. / Spr. dat. & Con.	Shoot length (cm)		No.of leaves per Shoot		Leaf length (cm)		Leaf width (cm)		Leaf index		Leaf area (cm^2)		Leaf dry weight (mg)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
							1996							
Control	43.8A	43.8A	25.3A	25.3A	8.9A	8.9A	5.4A	5.4A	1.66A	1.66A	26.3A	26.3A	290F	290F
Full bloom														
1000p.p.m	32.7C	38.5A	18.8B	22.3A	8.6E	8.8ABC	5.8A	5.5A	1.50A	1.62A	24.0A	25.4A	303B	294DE
2000 p.p.m	29.9C	36.8A	17.0B	21.3B	8.3F	8.8BCD	5.8A	5.6A	1.42A	1.58A	23.2A	25.2A	307A	295CD
Mid - June														
1000 p.p.m	36.3B	39.8A	21.0B	23.0A	8.7CDE	8.9A	5.6A	5.4A	1.56A	1.65A	25.0A	26.3A	296CD	292EF
2000 p.p.m	35.2B	38.1A	20.3B	22.0A	8.7DE	8.9A	5.7A	5.4A	1.54A	1.63A	24.6A	26.1A	297C	294DE
							1997							
Control	45.1A	45.1A	26.0A	26.0A	8.9A	8.9A	5.4A	5.4A	1.66A	1.66A	26.8A	26.8A	291A	291A
Full bloom														
1000 p.p.m	26.6C	33.5B	15.0C	19.3B	8.4D	8.7B	5.8A	5.6A	1.45A	1. 56A	21.7A	23.7A	305A	297A
2000 p.p.m	21.0C	32.4B	12.0C	18.8B	8.1E	8.7B	5.9A	5.6A	1.38A	1.55A	21.1A	23.4A	309A	298A
Mid – June														
1000 p.p.m	30.2B	35.2B	17.5B	20.3B	8.6C	8.8AB	5.7A	5.5A	1.52A	1.62A	23.0A	24.3A	301A	295A
2000 p.p.m	27.5C	33.7B	16.0C	19.5B	8.5C	8.8AB	5.8A	5.5A	1.49A	1.59A	22.9A	24.1A	302A	297A

* *Values with the same letters within the same column are not significantly different.*

III.2. Flowering measurements:

Number of spurs and inflorescences per tree estimated in the following spring of spraying growth retardants were the flowering measurements investigated in this concern pertaining their response to the specific and interaction effects of kind, concentration and spraying date of some growth retardants.

Experiment, I "Anna apple cultivar":

Data obtained during both seasons regarding the response of such flowering measurements to the specific effects of three investigated factors and interaction effect of their different combinations are presented in Table 10 (A,B,C,D and E).

A-Specific effect of investigated factors:

Tabulated data in Table 10 (A) displayed that both flowering measurements i.e number of both fruiting spurs and inflorescences per an individual Anna apple tree were significantly responded to the effect of growth retardant type. Since, PP_{333} increased both measurements significantly than CCC during both seasons.

As for the specific effect of concentration at which growth retardants were applied, it is quite clear that both 1000 and 2000 p.p.m surpassed statistically the control (0.0 p.p.m) in this concern. However, the higher concentration (2000 p.p.m) was more effective than the lower one (1000 p.p.m) but differences were more pronounced and reached level of significance during both seasons with the number of inflorescences only.

Referring the specific effect of spraying date, data in Table 10 (A) declared obviously that the full bloom sprays increased significantly number of both fruiting spurs and inflorescences per tree of Anna apple cultivar as compared to the corresponding values resulted by mid-June spray during both seasons of study.

Interaction effect of various combinations between the three investigated factors:

B-Interaction effect of (growth retardants x spraying dates):

Concerning the interaction effect of different combinations between both growth retardants (PP_{333} & CCC) from one hand and two spraying dates (full bloom & mid- June) from the other, data in Table 10 (B) showed that the full bloom sprays with PP_{333} tended relatively to increase both flowering measurements. However, differences were not significant during both seasons of study for both flowering measurements.

C-Interaction effect of (growth retardants x concentrations):

Table 10 (C) reveals obviously that numbers of both fruiting spurs and inflorescences per tree were significantly affected by the interaction effect of different combinations between growth retardants and the concentrations. Whereas The highest number of both flowering measurements was achieved by the PP_{333} sprays at 2000 or 1000 p.p.m followed by both concentrations of 2000 and 1000 p.p.m CCC sprays.

Such trend was true during both seasons of study, however, differences between two concentrations of each growth retardant were not significant during both seasons except with the number of inflorescences whereas the higher concentration of PP_{333} (2000 p.p.m) was significantly more effective than the lower one (1000 p.p.m). Moreover, tap water sprayed Anna apple trees (control) showed the lowest number of both flowering measurements and was significantly the inferior in this respect.

D. Interaction effect of (spraying dates x concentrations):

Regarding the interaction effect of various combinations between two spraying dates (full bloom and mid-June) from one hand and three concentrations (0.0, 1000 and 2000 p.p.m) from the other, data in Table 10 (D) pointed out that both flowering measurements of the full bloom sprayed Anna apple trees with growth retardants at 2000 or 1000 p.p.m were greatly enhanced, followed by those of mid-June sprays and control. Differences were significant during 2<u>nd.</u> season only for both flowering measurements.

E- Interaction effect of (growth retardants x concentrations x spraying dates):

Data in Table 10 (E) indicated that full bloom sprayed Anna apple trees with PP_{333} at both concentrations (1000 & 2000 p.p.m) induced relatively higher number of spurs and inflorescences, while the reverse was true with control. On the other hand , differences were not significant in both flowering measurements during two seasons. It could be concluded that the variation in response of both flowering measurements to the interaction effect of the combinations between growth retardants and concentrations was more pronounced rather than observed between the combinations of (growth retardants x spraying dates) while the interaction effect of (spraying dates x concentrations) was in between.

These results generally are in agreement with the findings of some investigators on some apple cvs. i.e **Zika and Kricnarova (1981); Porebski and Nosal (1985); Tymoszuk and Mika (1986) Buban (1986); Unrath (1986) Tromp (1987); Jones <u>et al.</u> (1988); El-Hodairi and Canham (1988); Holubowizcz and Musielak (1991); Hao <u>et al.</u> (1991); Greene (1991); Estabrooks (1993); Struklec and Modic (1994).**

Table (10): Some flowering measurements of " Anna" apple trees as affected by PP_{333} & CCC foliar sprays at various concentrations and dates during (1996 & 1997 seasons).

A- Specific effect of growth retardants, concentrations and spraying dates.

Investigated factors		No. of spurs per tree		No. of inflorescences per tree	
		1996	1997	1996	1997
Growth retardants	PP_{333}	173.5A	189.9A	109.7A	125.4A
	CCC	164.2B	174.5B	100.2B	111.1B
Concentrations	Control	156.5B	168.0B	95.0C	106.3C
	1000 p.p.m	173.3A	187.6A	107.5B	121.5B
	2000 p.p.m	176.7A	191.0A	112.3A	126.9A
Spraying dates	F.B	170.6A	185.1A	107.0A	121.1A
	M.J	167.0B	179.3B	102.8B	115.3B

B- Interaction effect of (growth retardants x spraying dates).

Gro. ret. / Spr. dat.	No. of spurs per tree		No. of inflorescences per tree	
	PP_{333}	CCC	PP_{333}	CCC
		1996		
F.B	175.4A	165.8A	112.3A	101.8A
M.J	171.5A	162.5A	107.1A	98.6A
		1997		
F.B	193.7A	176.6A	129.5A	112.8A
M.J	186.2A	172.4A	121.3A	109.4A

C- Interaction effect of (growth retardants x concentrations).

Gro. ret. / Con.	No. of spurs per tree		No. of inflorescences per tree	
	PP_{333}	CCC	PP_{333}	CCC
		1996		
Control	156.5C	156.5C	95.0D	95.0D
1000 p.p.m	180.0A	166.5B	114.1B	100.9C
2000 p.p.m	183.9A	169.5B	119.9A	104.6C
		1997		
Control	168.0C	168.0C	106.3D	106.3D
1000 p.p.m	198.5A	176.8B	131.0B	112.0C
2000 p.p.m	203.3A	178.8B	138.9A	115.0C

* *Values with the same letters within the same column are not significantly different.*

Continued Table (10)....

D- Interaction effect of (spraying dates x concerntrations).

Con. \ Spr. dat.	No. of spurs per tree		No. of inflorescences per tree	
	F.B	M.J	F.B	M.J
		1996		
Control	156.5A	156.5A	95.0A	95.0A
1000 p.p.m	175.5A	171.0A	109.9A	105.1A
2000 p.p.m	179.9A	173.5A	116.1A	108.4A
		1997		
Control	168.0C	168.0C	106.3D	106.3D
1000 p.p.m	191.9A	183.4B	125.6B	117.4C
2000 p.p.m	195.5A	186.5B	131.5A	122.4BC

E- Interaction effect of (growth retardants x concentrations x spraying dates).

Spr. dat. & Con. \ Gro. ret.	No. of spurs per tree		No. of inflorescences per tree	
	PP_{333}	CCC	PP_{333}	CCC
		1996		
Control	156.5A	156.5A	95.0A	95.0A
Full bloom				
1000 p.p.m	183.0A	168.0A	118.0A	101.8A
2000 p.p.m	186.8A	173.0A	123.8A	108.5A
Mid- June				
1000 p.p.m	177.0A	165.0A	110.3A	100.0A
2000 p.p.m	181.0A	166.0A	116.0A	100.8A
		1997		
Control	168.0A	168.0A	106.3A	106.3A
Full bloom				
1000 p.p.m	204.0A	179.8A	137.0A	114.3A
2000 p.p.m	209.0A	182.0A	145.3A	117.8A
Mid-June				
1000 p.p.m	193.0A	173.8A	125.0A	109.8A
2000 p.p.m	197.5A	175.5A	132.5A	112.3A

* *Values with the same letters within the same column are not significantly different.*

Experiment , II "Le-Conte pear cultivar":

Referring The response of both flowering measurements in Le-Conte pear trees to the specific and interaction effects of the three investigated factors i.e. kind of growth retardants, concentration and spraying date, as well as their various combinations, data obtained during both 1995 / 96 and 1996 / 97 seasons are presented in Table 11 (A,B,C,D and E).

A-Specific effect of investigated factors:

Table 11 (A) shows that number of both spurs and inflorescences per Le-Conte pear tree followed typically the same trends of response to specific effect of each studied factor (type of growth retardant, concentration and spraying date) previously detected with Anna apple trees. Since , the PP_{333}, higher concentration (2000 p.p.m) and full bloom sprays were specifically more effective in increasing both flowering measurements as compared to CCC , lower concentration (1000 p.p.m) and mid-June sprays , respectively.

B-Interaction effect of (growth retardants x spraying dates):

Tabulated data in Table 11 (B) declared that number of both spurs and inflorescences per the individual Le-Conte pear tree followed the same trend of response to the interaction effect of (growth retardants x spraying dates) previously found with Anna apple trees. Since, the full bloom sprays with PP_{333} slightly increased both flowering measurements than other combinations, however, differences were so few to be significant during both seasons of study.

C -Interaction effect of (growth retardants x concentrations):

Regarding the interaction effect of the various combinations between both growth retardants (PP_{333} & CCC) from one hand and the three investigated levels of concentrations (0.0, 1000 and 2000 p.p.m) from the other, data in Table 11(C) revealed that both flowering measurements of Le-Conte pear trees were responded significantly. Since, both combinations of spraying PP_{333} at either 1000 or 2000p.p.m were statistically the superior followed by the analogous combinations of CCC, while control (0.0 p.p.m) was the inferior. Such trend was true during both seasons and differences between the aforesaid three categories were significant except with number of fruiting spurs during the second season. On the other hand, the higher concentration of each growth retardant tended to be more effective, however, difference was significant only when the effect of higher concentration (2000 p.p.m) of PP_{333} was compared to the lower one (1000 p.p.m) regarding the number of inflorescences per tree during the second season.

D-Interaction effect of (spraying dates x concentrations):

Referring the response to interaction effect of different combinations between both spraying dates (full bloom & mid- June) and the applied concentrations of two growth retardants (0.0., 1000 and 2000 p.p.m) , Table 11 (D) shows that the full bloom sprays at 2000 p.p.m was the superior followed in a descending order by the combinations of full bloom spray at 1000 p.p.m , mid-June spray at 2000 p.p.m and mid-June spray at 1000p.p.m as all statistically surpassed the control (0.0 p.p.m).

Such trend was true with two flowering measurements during both seasons, however, differences were significant with only the number of inflorescences per tree.

Table (11): Some flowering measurements and fruit set of " Le-Conte" pear trees as affected by PP_{333} &CCC foliar sprays at various concentrations and dates during (1996 & 1997 seasons).

A- Specific effect of growth retardants, concentrations and spraying dates.

Investigated factors		No. of spurs per tree		No. of inflorescences per tree		Fruit set (%)	
		1996	1997	1996	1997	1996	1997
Growth retardants	PP_{333}	293.0A	305.4A	188.3A	200.4A	29.6A	30.4A
	CCC	281.6B	298.5B	172.7B	187.8B	23.7B	24.2B
Concentrations	Control	276.0B	292.0B	165.5C	180.0C	20.0C	20.2C
	1000 p.p.m	290.9A	304.9A	184.6B	198.0B	29.3B	30.2B
	2000 p.p.m	295.1A	309.1A	191.4A	204.3A	30.6A	31.6A
Spraying dates	F.B	290.1A	304.1A	184.6A	198.0A	27.4A	28.0A
	M.J	284.5B	299.8B	176.3B	190.2B	25.9B	26.7B

B- Interaction effect of (growth retardants x spraying dates).

Gro. ret. / Spr. dat	No. of spurs per tree		No. of inflorescences per tree		Fruit set (%)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
			1996			
F.B	297.0A	283.3A	194.0A	175.3A	30.3A	24.4A
M.J	289.0A	280.0A	182.6A	170.1A	28.8A	23.0A
			1997			
F.B	308.0A	300.3A	205.3A	190.7A	31.2A	24.8A
M.J	302.8A	296.8A	195.4A	184.9A	29.7A	23.7A

C- Interaction effect of (growth retardants x concentrations).

Gro. ret. / Con.	No. of spurs per tree		No. of inflorescences per tree		Fruit set (%)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
			1996			
Control	276.0C	276.0C	165.5c	165.5C	20.0E	20.0E
1000 p.p.m	299.5A	282.3BC	196.3A	172.9BC	33.5B	25.1D
2000 p.p.m	303.5A	286.6B	203.1A	179.6B	35.2A	26.0C
			1997			
Control	292.0A	292.0A	180.0D	180.0D	20.2E	20.2E
1000 p.p. m	310.0A	299.8A	206.9B	189.1C	34.7B	25.7D
2000 p.p.m	314.3A	303.9A	214.3A	194.3C	36.4A	26.7C

** Values with the same letters within the same column are not significantly different.*

Continued Table (11)......

D-Interaction effect of (spraying dates x concentrations).

Spr.dat. / Con.	No. of spurs per tree		No. of inflorescences per tree		Fruit set (%)	
	F.B	M.J	F.B	M.J	F.B	M.J
			1996			
Control	276.0A	276.0A	165.5D	165.5D	20.0E	20.0E
1000 p.p.m	296.3A	285.5A	190.6AB	178.5C	30.6B	28.1D
2000 p.p.m	298.1A	292.0A	197.8A	185.0BC	31.5A	29.7C
			1997			
Control	292.0A	292.0A	180.0D	180.0D	20.2D	20.2D
1000 p.p. m	307.4A	302.4A	202.5B	193.5C	31.6AB	28.9C
2000 p.p.m	313.0A	305.1A	211.5A	197.0BC	32.2A	31.0B

E- Interaction effect of (growth retardants x concentrations x spraying dates).

Gro. ret. / Spr.dat. & Con.	No. of spurs per tree		No. of inflorescences per tree		Fruit set (%)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
			1996			
Control	276.0A	276.0A	165.5A	165.5A	20.0A	20.0A
Full bloom						
1000 p.p.m	307.0A	285.5A	205.0A	176.3A	34.9A	26.3A
2000 p.p.m	308.0A	288.3A	211.5A	184.0A	36.1A	26.9A
Mid - June						
1000 p.p.m	292.0A	279.0A	187.5A	169.5A	32.1A	24.0A
2000 p.p.m	299.0A	285.0A	194.8A	175.3A	34.3A	25.1A
			1997			
Control	292.0A	292.0A	180.0A	180.0A	20.2A	20.2A
Full bloom						
1000 p.p. m	312.5A	302.3A	212.5A	192.5A	36.1A	27.0A
2000 p.p.m	319.5A	306.5A	223.5A	199.5A	37.2A	27.1A
Mid- June						
1000 p.p.m	307.5A	297.3A	201.3A	185.8A	33.3A	24.5A
2000 p.p.m	309.0A	301.3A	205.0A	189.0A	35.6A	26.4A

** Values with the same letters within the same column are not significantly different.*

E- Interaction effect of (growth retardants x concentrations x spraying dates):

Table 11 (E) shows that spraying PP_{333} at full bloom regardless of applied concentration increased number of both spurs and inflorescences per tree in the following spring, while control showed the lowest values.

However, differences were not significant with both flowering measurements during two seasons.

These results go in line with the findings of **Pieber (1982); Dheim and Browning (1988); Bootsma (1988); Othman (1991); Helail and Atawia (1992); Rai and Bist (1992); Atawia and Hassan (1995) and Mei et al. (1995)** on some pear cultivars.

II.3. Fruiting measurements:

Under this heading, fruit set percentage; fruit retention (estimated at either last week of June or harvesting date); number of mature fruits per inflorescence and yield per tree (kg) were concerned.

Experiment, I "Anna apple cultivar":

Data obtained during both 1995/ 96 and 1996/97 seasons regarding the response of these fruiting measurements of Anna apple cultivar to the specific and interaction effects of the three investigated factors (growth retardants, concentrations and spraying dates) and their combinations are presented in Table 12 (A,B,C,D and E).

1-Fruit set percentage:

A-Specific effect of investigated factors:

Table 12 (A) shows that fruit set perecentage in Anna apple cultivar was responded specifically to each of the three investigated factors. Hence the highest percentage of fruit set was closely related to the PP_{333} sprayed trees, the higher concentration (2000 p.p.m) and the full bloom application whereas differences were significant as compared to CCC, 1000 p.p.m and mid–June sprays, respectively.

B-Interaction effect of (growth retardants x spraying dates):

Table 12 (B) shows that variations in fruit set percentage as affected by various combinations between two growth retardants (PP_{333} & CCC) and two spraying dates (full bloom & mid –June) were not significant. However, full bloom sprayed trees with PP_{333} having relatively higher percentage of fruit set during both seasons.

C-Interaction effect of (growth retardants x concentrations):

Table 12 (C) shows that fruit set percentage of Anna apple cultivar responded significantly to the interaction effect of (growth retardants x concentrations). The combinations of PP_{333} sprays at either 1000 or 2000 p.p.m were statistically the superior followed by both treatments of spraying CCC at 1000 and 2000 p.p.m , however, the control (water sprayed trees) was statistically the inferior during both seasons of study.

D-Interaction effect of (spraying dates x concentrations):

Referring the response of fruit set percentage in Anna apple trees to the interaction effect of the combinations between spraying dates and concentrations of growth retardants , Table 12 (D) shows that data obtained during both 1996 & 1997 seasons displayed that control (water sprayed trees) exhibited the lowest value. However, differences were significant during 1997 season only. On the other hand, full bloom sprays at either 1000 or 2000 p.p.m ranked first while those of mid-June sprays at both concentrations came second, however, differences were significant in second season only .

E-Interaction effect of (growth retardants x concentrations x spraying dates):

In spite of differences in fruit set percentage of Anna apple cultivar due to interaction effect of various combinations of the three investigated factors during both 1996 & 1997 seasons as shown from tabulated data in Table 12 (E) were not significant. However, the full bloom spray of PP_{333} and to great extent its application in mid-June regardless of concentration resulted in more 50% increase in fruit set percentage rather than control.

Similar results were earlier reported by **Greene and Murray (1983); Stinchcombe et al. (1984); Tymoszuk and Mika (1986); Miller and Swietlik (1986); Greene (1986); El-Hodairi and Canham (1988); Jones et al. (1991) and Hao et al. (1991).**

2-Fruit retention:

The remained fruits percentage at both the last week of June and harvesting date in response to the spraying date and concentration of PP_{333} and CCC were the concerning measurements.

A-Specific effect of investigated factors:

Data in Table 12 (A) displayed that both fruit retention measurements followed typically the same trends of response previously detected with fruit set percentage regarding the specific effect of each investigated factors during both seasons of study.

B-Interaction effect of (growth retardants x spraying dates):

Table 12 (B) shows that fruit retentions followed the same trend previously found with fruit set percentage whereas differences did not reach level of significance.

C-Interaction effect of (growth retardants x concentrations):

Table 12 (C) shows that both measurements of retained Anna apple fruits were coincident with the fruit set percentage in their response to the interaction effect of various combinations between the two growth retardants (PP_{333} & CCC) and their concentrations applied (0.0, 1000 and 2000 p.p.m). However, differences were more pronounced with fruit retention and were significant between most combinations during both seasons.

D-Interaction effect of (spraying dates x concentrations):

Data in Table 12 (D) revealed that both fruit retention and fruit set percentage were similarly responded to the interaction effect between spraying dates and concentrations of growth retardants whereas the variations were so little to be significant.

E-Interaction effect of (growth retardants x concentrations x spraying dates):

Table 12 (E) clears that both fruit retention measurements were parallelled to the fruit set perecentage pertaining their response to interaction effect of various combinations of the three investigated factors during both seasons of study.

3-Number of mature fruits per inflorescence and yield in kg per tree:

Both fruiting measurements of Anna apple trees i.e. number of mature fruits per each individual inflorescence as an indicator for tree productivity and weight of harvested fruits per tree (the exact tree cropping) in response to the specific and interaction effects of the three investigated factors (growth retardants, concentrations and spraying

Table (12): Fruiting aspects of "Anna" apple trees as affected by PP_{333} & CCC foliar sprays at various concentrations and dates during (1996 & 1997 seasons).

A- Specific effect of growth retardants, concentrations and spraying dates

Investigated factors		Fruit set (%)		Remaining fruits (%) after June drop		Mature fruits (%)		No.of fruits per inflorescence		Yield /tree (kg)	
		1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Growth retardants	PP_{333}	25.1A	28.9A	18.7A	21.1A	15.7A	17.5A	0.8A	0.9A	13.0A	15.6A
	CCC	21.6B	24.3B	15.7B	18.1B	13.4B	15.3B	0.7B	0.8B	11.1B	13.1B
Concentrations	Control	18.3B	21.0C	13.1C	14.2C	11.1C	11.7C	0.6B	0.6B	9.5C	11.0C
	1000 p.p.m	25.5A	28.8B	18.7B	21.4B	15.7B	18.3B	0.8A	0.9A	12.8B	15.4B
	2000 p.p.m	26.2A	30.1A	19.8A	23.2A	16.8A	19.2A	0.8A	1.0A	13.8A	16.7A
Spraying dates	F.B	24.0A	27.6A	17.8A	20.4A	15.1A	17.1A	0.8A	0.8A	12.5A	14.9A
	M.J	22.7B	25.6B	16.6B	18.8B	13.9B	15.7B	0.7B	0.8B	11.6B	13.8B

B- Interaction effect of (growth retardants x spraying dates) .

Gro. ret. / Spr. dat.	Fruit set (%)		Remaining fruits (%) after June drop		Mature fruits (%)		No. of fruits per inflorescence		Yield /tree (kg)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
					1996					
F.B	25.6A	22.4A	19.2A	16.4A	16.3A	13.9A	0.8A	0.7A	13.5A	11.4A
M.J	24.5A	20.8A	18.2A	15.1A	15.1A	12.8A	0.8A	0.6A	12.4A	10.8A
					1997					
F.B	29.9A	25.4A	21. 9A	18.8A	18.2A	16.1A	0.9A	0.8A	16.1A	13.7A
M.J	27.9A	23.3A	20.2A	17.3A	16.7A	14.6A	0.8A	0.7A	15.1A	12.5A

C-Interaction effect of (growth retardants x concentrations).

Gro. ret. / Con.	Fruit set (%)		Remaining fruits (%) after June drop		Mature fruits (%)		No. of fruits per inflorescence		Yield /tree (kg)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
					1996					
Control	18.3C	18.3C	13.1C	13.1C	11.1D	11.1D	0.6C	0.6C	9.5C	9.5C
1000 p.pm	28.3A	22.8B	21.0A	16.4B	17.2B	14.2C	0.9A	0.7B	14.1A	11.5B
2000 p.p.m	28.6A	23.8B	21.9A	17.6B	18.8A	14.8C	0.9A	0.7B	15.3A	12.3B
					1997					
Control	21.0C	21.0C	14.2E	14.2E	11.7C	11.7C	0.6C	0.6C	11.0E	11.0E
1000 p.p.m	32.0A	25.5B	23.5B	19.3D	20.1A	16.5B	1.00A	0.8B	17.1B	13.7D
2000 p.p.m	33.7A	26.6B	25.5A	20.8C	20.7A	17.8B	1.0A	0.9B	18.7A	14.7C

* *Values with the same letters within the same column are not significantly different.*

Continued Table (12)...

D- Interaction effect of (spraying dates x concentrations).

Spr. dat. / Con.	Fruit set (%)		Remaining fruits (%) after June drop		Mature fruits (%)		No. of fruits per inflorescence		Yield /tree (kg)	
	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J
					1996					
Control	18.3A	18.3A	13.1A	13.1A	11.1A	11.1A	0.6A	0.6A	9.5A	9.5A
1000 p.p.m	26.5A	24.6A	19.2A	18.2A	16.4A	15.0A	0.8A	0.8A	13.3A	12.3A
2000 p.p.m	27.3A	25.1A	21.0A	18.6A	17.9A	15.7A	0.9A	0.8A	14.6A	12.9A
					1997					
Control	21.0D	21.0D	14.2D	14.2D	11.7D	11.7D	0.6D	0.6D	11.0C	11.0C
1000 p.p.m	30.1AB	27.5C	22.2B	20.6C	19.1B	17.5C	1.0AB	0.9C	15.8B	14.9B
2000 p.p.m	31.9A	28.4BC	24.7A	21.6BC	20.7A	17.8C	1.0A	0.9BC	17.9A	15.5B

E- Interaction effect of (growth retardants x concentrations x spraying dates).

Gro. ret. / Spr. date & Con.	Fruit set (%)		Remaining fruits (%) after June drop		Mature fruits (%)		No. of fruits per inflorescence		Yield /tree (kg)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
					1996					
Control	18.3A	18.3A	13.1A	13.1A	11.1A	11.1A	0.6A	0.6A	9.5A	9.5A
Full bloom										
1000 p.p.m	29.2A	23.7A	21.4A	17.0A	17.8A	14.9A	0.9A	0.7A	14.7A	11.9A
2000 p.p.m	29.4A	25.2A	22.9A	19.1A	19.9A	15.9A	1.00A	0.8A	16.4A	12.8A
Mid- June										
1000 p.p.m	27.5A	21.8A	20.6A	15.9A	16.5A	13.6A	0.8A	0.7A	13.5A	11.1A
2000 p.p.m	27.8A	22.5A	20.9A	16.2A	17.7A	13.7A	0.9A	0.7A	14.2A	11.7A
					1997					
Control	21.0A	21.0A	14.2A	14.2A	11.7A	11.7A	0.6A	0.6A	11.0A	11.0A
Full bloom										
1000 p.p.m	33.3A	26.8A	24.3A	20.0A	21.0A	17.2A	1.1A	0.9A	17.4A	14.3A
2000 p.p.m	35.4A	28.3A	27.2A	22.3A	22.0A	19.4A	1.1A	1.0A	19.9A	15.9A
Mid- June										
1000 p.p.m	30.8A	24.2A	22.7A	18.5A	19.2A	15.9A	1.0A	0.8A	16.8A	13.1A
2000 p.p.m	32.1A	24.8A	23.8A	19.4A	19.4A	16.2A	1.0A	0.8A	17.5A	13.5A

** Values with the same letters within the same column are not significantly different.*

dates) and their various combinations followed typically the same trends detected with the aforesaid three fruiting measurements i.e. fruit set percentage and remained fruits percentage at either last week of June or harvesting date. These trends were true during both seasons with the specific effect of growth retardants , concentrations, and spraying dates as well as interactions effect of various combinations of (growth retardants x spraying dates), (growth retardants x concentrations), (spraying dates x concentrations) and (growth retardents x concentrations x spraying dates) as shown from data of Table 12 (A,B, C,D and E) , respectively.

These results are in harmony with the findings of **Greene (1986); Jones et al. (1988); Elfving et al. (1990); Jones et al. (1991); Hao et al. (1991); Estabrooks (1993); Xia Chun Sen et al. (1994) and Lipecki and Wieniarska (1995).**

Experiment, II "Le-Conte pear cultivar":

The fruit set percentage was only the fruiting measurements investigated regarding the response of Le-Conte pear cultivar to the specific and interaction effects of the three investigated factors and their combinations. Data obtained during both 1996 & 1997 seasons are presented in Table 11 (A,B,C,D and E).

Specific effect of investigated factors:

Table 11 (A) shows that fruit set percentage of Le-Conte pear cultivar was specifically responded to each investigated factor as it followed the same trends previously detected with Anna apple cultivar.

Since, the PP_{333} surpassed CCC, full bloom was more effective than mid-June sprays and the higher concentration was the superior in this regard.

Interaction effect of various combinations between the investigated factors:

The specific effect of each investigated factor was reflected on the interaction effect of their various combinations. Hence, the response to interaction effect of (growth retardants x spraying dates) was less pronounced [Table 11 (B)], while the variations due to combinations of (growth retardants x concentrations) as shown in Table 11 (C) was more pronounced. Moreover, the interaction effect of (spraying dates x concentrations) was in between the aforesaid two extents as shown from Table 11 (D) . In addition, PP_{333} sprayed trees of Le-Conte pear regardless of spraying dates and concentrations represented the most effective four combinations (especially 2000 p.p.m full bloom sprays), however differences were not significant as shown from Table 11 (E).

Obtained results seem to agree with the findings of **Othman (1991); Atawia and Helail (1992); Hassan and Atawia (1995).**

III.4. Fruit quality:

III.4.a. Fruit physical properties:

Fruit weight, fruit height, fruit diameter, fruit shape index, thickness of false pulp, fruit firmness, number of well developed, shrivelled, total seeds per fruit and percentage of well developed seeds were the fruit physical properties of Anna apple cv. investigated in response to the specific and interaction effects of the three investigated factors individually and their combinations, respectively.

Data obtained during 1996 and 1997 seasons are presented in Tables 13 (A,B,C,D and E) and 14 (A,B,C,D and E), respectively.

A-Specific effect of investigated factors:

Concerning the specific effect of growth retardants, tabulated data in Tables 13 (A) and 14 (A) showed that PP_{333} resulted in a significant reduction in fruit weight, fruit height, fruit shape index and number of shrivelled seeds per fruit as compared to CCC during 1996 and 1997 seasons, respectively. The reverse was true with the fruit diameter, thickness of false pulp, fruit firmness, number and percentage of well developed seeds per fruit, whereas the PP_{333} increased them significantly as compared to CCC during both 1996 & 1997 seasons. In addition, the total number of seeds per fruit was not affected by the kind of the growth retardant, may be due to the unparallelled response of both well developed and shrivelled seeds to each of PP_{333} and CCC, whereas each parameter took the opposite trend of the other with every growth retardant.

As for the specific effect of the growth retardent concentration, Tables 13 (A) and 14 (A) reveal that various measurements of physical properties of Anna apple cv. followed two opposite trends. However, spraying growth retardants at both 1000 & 2000 p.p.m decreased significantly fruit weight, fruit height, fruit shape index and number of shrivelled seeds as compared to control (0.0 p.p.m). On the other hand, the reverse was true with the fruit physical measurements of fruit diameter, thickness of false pulp, fruit firmness, number and percentage of well developed seeds , whereas both concentrations of 1000 and 2000 p.p.m increased them significantly as compared to the water spray (control).

Moreover, the total number of seeds per fruit did not respond to the applied concentration of growth retardant.

Referring the specific effect of spraying date, data in Tables 13 (A) and 14 (A) displayed that full bloom sprays increased significantly some measurements of fruit physical properties i.e. fruit diameter, fruit firmness, number and percentage of well developed seeds per fruit, while the other measurements of Anna apple fruit physical properties did not specifically respond to spraying date. Such trend was true during both seasons of study .

B-Interaction effect of (growth retardants x spraying dates):

Tables 13 (B) and 14 (B) display that variations in all measurements of fruit physical properties of Anna apple cv. due to interaction effect of various combinations between growth retardants (PP_{333} & CCC) from one hand and spraying dates (full bloom & mid-June) from the other were so little to be significant during both seasons of study.

C-Interaction effect of (growth retardants x concentrations):

With regard to the interaction effect resulted by different combinations between the growth retardants (PP_{333} & CCC) from one hand and the concentrations applied (0.0, 1000 and 2000 p.p.m) from the other Tables 13 (C) and 14 (C) show that various fruit physical properties followed two opposite trends during both seasons of study. Since, the fruit weight, fruit height, fruit shape index and number of shrivelled seeds per fruit were decreased by any of the four combinations of spraying both PP_{333} and CCC at either 1000 or 2000 p.p.m as compared to control (0.0 p.p.m), however the PP_{333} at 2000 p.p.m was more restrictive in this respect.

The differences were not significant except with fruit shape index during 1st. season only and number of shrivelled seeds per fruit during 1st. and 2nd. seasons.

Nevertheless, an opposite trend to the previously dicussed with the aforesaid four measurements of Anna apple fruit physical properties was detected pertaining the response of other investigated measurements.

Whereas, the fruit diameter, thickness of false pulp, fruit firmness, number and percentage of well developed seeds were increased by the four combinations between (PP_{333} & CCC) and (1000 & 2000 p.p.m) as compared to control (0.0 p.p.m). The differences were more pronounced and reached level of significance especially both combinations of PP_{333} at 2000 or 1000 p.p.m as compared with control for all included measurements except thickness of false pulp during 1st. season (1996).

D-Interaction effect of (spraying dates x concentrations):

Regarding the interaction effect of various combinations between the concentrations and spraying dates on different fruit physical properties of Anna apple cv. data in Table 13 (D) revealed that to some extent, two general trends could be detected during both seasons. The first showed a slight increase resulted by various combinations of 1000 & 2000 p. p.m and full bloom & mid-June (especially full bloom sprays at 2000 p.p.m) with some fruit physical measurements i.e. fruit diameter, thickness of false pulp, fruit firmness, number and percentage of well developed seeds, however, differences were not significant except in second season (1997) with only the number of well developed seeds per fruit. The second trend took an opposite direction whereas any of various combinations between 1000 & 2000 p.p.m x full bloom & mid-June sprays restricted the measurements values of fruit weight, fruit height, fruit shape index and number of shrivelled seeds per fruit, however, such reduction was not significant during both seasons.

E-Interaction effect of (growth retardants x concentrations x spraying dates):

Referring the interaction effect of various combinations between the three investigated factors (growth retardants x concentrations x spraying dates), data in Tables 13 (E) and 14 (E) revealed that variations did not reach level of significance during both 1996 & 1997 seasons.

However, the differential investigated physical properties of Anna apple fruits tended to be classified into two conflicted groups regarding their response in this respect. The 1st. group included fruit weight, fruit height, fruit shape index and number of shrivelled seeds per fruit, whereas they tended to be decreased below control with spraying any of PP_{333} & CCC combinations regardless of concentration and spraying date, however, the full bloom spray with PP_{333} at 2000 p.p.m was the most effective during both seasons. On the other hand, second group included the fruit diameter, thickness of false pulp, fruit firmness, number and percentage of well developed seeds all followed an opposite trend to that previously detected with the previously discussed measurements. Hence, a relative increase was resulted by applying any growth retardant (PP_{333} & CCC) irrespective of their concentrations and spraying dates as compared to control. Meanwhile, the PP_{333} foliar sprays at 2000 p.p.m & 1000 p.p.m especially at full bloom was more effective.

The obtained data regarding the various respones of the differential investigated fruit physical properties to the investigated three factors and their combinations could be explained depending upon the direct and indirect effects on some physiological processes as follows:

1-The decrease in fruit weight and height resulted by growth retardants may be due to its restrictive effect on cell wall extention of developing fruits especially the polar dimension during the development stage of cell enlargement, which will be reflected negatively on fruit size, weight and height.

2-The increase in fruit diameter, thickness of false pulp and number of well developed seeds per fruit resulted by growth retardant application may be attributed to its indirect effect in depressing vegetative growth activity i.e. reduced the depletion of the carbohydrates and other nutritive substances and consequently reserved and accumulated a surplus of these essential materials required and favour such measurement.

3- The increase in fruit flesh firmness resulted by spraying growth retardants could be considered as a direct result of depressing the cell wall extention within various fruit tissues which finally resulted in inducing fruits with smaller cells (having thicker walls) and narrow intercellular spaces, whereas both are mainly responsible in increasing fruit firmness.

4- The decrease in fruit shape index (fruit height: fruit diameter) resulted by growth retardant spray could be attributed to the unparallelled response of both fruit dimensions, whereas the fruit height was greatly restricted by growth retardant, while the diameter took the other way around.

These results seem to go line with the findings of:

1-**Greene (1986); Embree et al. (1987); Blanco (1989); Costa et al. (1995) and Khurshid et al. (1997)** on fruit dimensions, shape index and thickness of false pulp.

2-**Helail (1986) and Othman (1991)** on seediness.

3-**Greene (1986); Blanco (1989); Elfving et al. (1990); Greene (1991); Othman (1991); Atawia and Helail (1992); Hassan and Atawia (1995) and Khurshid et al. (1997)** on fruit firmness.

Table (13): Fruit physical properties of "Anna" apple trees as affected by PP_{333} & CCC foliar sprays at various concentrations and dates during (1996 season).

A- Specific effect of growth retardants, concentrations and spraying dates.

Investigated factors		Fruit Weight (gm)	Fruit height (cm) (H)	Fruit diameter (cm) (D)	Fruit shape index (H/D)	Thickness of false pulp (cm)	Fruit firmness (kg/cm^2)	Number of developed seeds per fruit: Well developed seeds	Shrivelled seeds	Total number of seeds	Well developed seeds (%)
Growth retardants	PP_{333}	114.0B	7.8B	5.9A	1.34B	2.22A	5.3A	2.56A	1.69B	4.25A	60.7A
	CCC	116.4A	7.9A	5.7B	1.39A	2.20B	4.9B	2.38B	1.86A	4.24A	56.4B
Concentrations	Control	119.3A	8.0A	5.6B	1.43A	2.18B	4.8B	2.25B	1.98A	4.23A	54.5B
	1000 p.p.m	113.8B	7.8B	5.8A	1.34B	2.22A	5.2A	2.54A	1.69.B	4.23A	60.0A
	2000 p.p.m	112.6B	7.8B	5.9A	1.33B	2.23A	5.4A	2.61A	1.66B	4.27A	61.2A
Spraying dates	F.B	114.3A	7.9A	5.8A	1.35A	2.22A	5.2A	2.53A	1.75A	4.27A	59.5A
	M.J	116.0A	7.9A	5.7B	1.38A	2.20A	5.0B	2.41B	1.80A	4.21A	57.6B

B-Interaction effect of (growth retardants x spraying dates).

Gro.ret. / Spr.dat.	Fruit weight (gm)		Fruit height (cm)(H)		Fruit diameter (cm)(D)		Fruit shape index (H/D)		Thickness of false pulp (cm)		Fruit firmness (Kg/cm^2)		Number of developed seeds per fruit: Well developed seeds		Shrivelled seeds		Total number of seeds		Well developed seeds (%)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
F.B	113.1A	115.6A	7.8A	7.9A	5.9A	5.8A	1.33A	1.38A	2.24A	2.20A	5.4A	5.0A	2.63A	2.42A	1.67A	1.83A	4.30A	4.24A	61.6A	57.3A
M.J	114.8A	117.3A	7.9A	7.9A	5.8A	5.7A	1.35A	1.41A	2.21A	2.19A	5.2A	4.9A	2.49A	2.33A	1.71A	1.90A	4.19A	4.23A	59.8A	55.5A

C- Interaction effect of (growth retardants x concentrations).

Gro.ret. / Con.	Fruit weight (gm)		Fruit height (cm)(H)		Fruit diameter (cm)(D)		Fruit shape index (H/D)		Thickness of false pulp (cm)		Fruit firmness (Kg/cm^2)		Number of developed seeds per fruit: Well developed seeds		Shrivelled seeds		Total number of seeds		Well developed seeds (%)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
Control	119.3A	119.3A	8.0A	8.0A	5.6C	5.6C	1.43A	1.43A	2.18A	2.18A	4.8B	4.8B	2.25C	2.25C	1.98A	1.98A	4.23A	4.23A	54.5C	54.5C
1000 p.p.m	112.0A	115.5A	7.8A	7.9A	6.0A	5.7B	1.31C	1.38B	2.24A	2.20A	5.5A	5.0A	2.66A	2.43B	1.56C	1.83B	4.21A	4.25A	63.0A	57.0B
2000 p.p.m	110.6A	114.5A	7.7A	7.9A	6.0A	5.8B	1.28C	1.37B	2.26A	2.21A	5.7A	5.1A	2.78A	2.45B	1.53C	1.79B	4.30A	4.24A	64.5A	57.8B

* *Values with the same letters within the same column are not significantly different.*

Continued Table (13) ...

D- Interaction effect of (spraying dates x concentrations).

Spr. dat. / Con.	Fruit weight (gm)		Fruit height (cm)(H)		Fruit diameter (cm)(D)		Fruit shape index (H/D)		Thickness of false pulp (cm)		Fruit firmness (Kg/cm^2)		Number of developed seeds per fruit: Well developed seeds		Shrivelled seeds		Total number of seeds		Well developed seeds (%)	
	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J
Control	119.3A	119.3A	8.00A	8.00A	5.6A	5.6A	1.43A	1.43A	2.18A	2.18A	4.8A	4.8A	2.25A	2.25A	1.98A	1.98A	4.23A	4.23A	54.5A	54.5A
1000 p.p.m	112.5A	115.0A	7.8A	7.9A	5.9A	5.8A	1.32A	1.36A	2.23A	2.21A	5.4A	5.1A	2.63A	2.46A	1.65A	1.74A	4.28A	4.19A	61.4A	58.7A
2000 p.p.m	111.2A	113.9A	7.8A	7.8A	6.0A	5.8A	1.31A	1.34A	2.25A	2.22A	5.5A	5.3A	2.70A	2.53A	1.61A	1.70A	4.31A	4.23A	62.5A	59.8A

E- Interaction effect of (growth retardants x concentrations x spraying dates).

Gro.ret. / Spr.dat. & Con.	Fruit weight (gm)		Fruit height (cm)(H)		Fruit diameter (cm)(D)		Fruit shape index (H/D)		Thickness of false pulp (cm)		Fruit firmness (Kg/cm^2)		Number of developed seeds per fruit: Well developed seeds		Shrivelled seeds		Total number of seeds		Well developed seeds (%)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
Control	119.3A	119.3A	8.0A	8.0A	5.6A	5.6A	1.43A	1.43A	2.18A	2.18A	4.8A	4.8A	2.25A	2.25A	1.98A	1.98A	4.23A	4.23A	54.5A	54.5A
Full bloom																				
1000 p.p.m	110.9A	114.2A	7.7A	7.9A	6.0A	5.8A	1.29A	1.35A	2.26A	2.20A	5.7A	5.1A	2.75A	2.50A	1.53A	1.78A	4.28A	4.28A	64.3A	58.4A
2000 p.p.m	109.2A	113.3A	7.7A	7.9A	6.1A	5.9A	1.26A	1.36A	2.28A	2.22A	5.8A	5.2A	2.90A	2.50A	1.50A	1.73A	4.40A	4.23A	65.9A	59.2A
Mid -June																				
1000 p.p.m	113.2A	116.8A	7.8A	7.9A	5.9A	5.7A	1.32A	1.40A	2.23A	2.19A	5.3A	4.8A	2.58A	2.35A	1.60A	1.88A	4.15A	4.23A	61.7A	55.6A
2000 p.p.m	112.0A	115.8A	7.8A	7.9A	6.0A	5.7A	1.30A	1.38A	2.24A	2.20A	5.6A	5.0A	2.65A	2.40A	1.55A	1.85A	4.20A	4.25A	63.1A	56.5A

** Values with the same letters within the same column are not significantly different.*

Table (14): Fruit physical properties of "Anna" apple trees as affected by PP_{333} & CCC foliar sprays at various concentrations and dates during (1997 season).

A- Specific effect of growth retardants, concentrations and spraying dates.

Investigated factors		Fruit weight (gm)	Fruit height (cm) (H)	Fruit diameter (cm) (D)	Fruit shape index (H/D)	Thickness of false pulp (cm)	Fruit firmness (kg/cm^2)	Number of developed seeds per fruit			Well developed seeds (%)
								Well developed Seeds	Shrivelled seeds	Total number of seeds	
Growth retardants	PP_{333}	112.2B	7.9A	5.8A	1.35B	2.22A	5.4A	2.52A	1.78B	4.29A	58.6A
	CCC	115.2A	7.9A	5.7B	1.39A	2.18B	5.2B	2.31B	1.92A	4.23A	54.6B
concentrations	Control	119.6A	8.0A	5.7C	1.42A	2.16B	4.8B	2.23C	2.0A	4.23A	52.7B
	1000 p.p.m	111.7B	7.8B	5.8B	1.36B	2.21A	5.5A	2.46B	1.79B	4.26A	57.8A
	2000 p.p.m	109.8B	7.8B	5.9A	1.33B	2.23A	5.6A	2.55A	1.74B	4.29A	59.4A
Spraying dates	F.B	112.7A	7.9A	5.8A	1.36A	2.21A	5.4A	2.48A	1.81A	4.29A	57.7A
	M.J	114.7A	7.9A	5.7B	1.38A	2.19A	5.1B	2.35B	1.88A	4.23A	55.6B

B-Interaction effect of (growth retardants x spraying dates).

Gro.ret. / Spr.dat.	Fruit weight (gm)		Fruit height (cm)(H)		Fruit diameter (cm)(D)		Fruit shape index (H/D)		Thickness of false pulp (cm)		Fruit firmness (Kg/cm^2)		Number of developed seeds per fruit						Well developed seeds (%)	
													Well developed seeds		Shrivelled seeds		Total number of seeds			
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
F.B	111.0A	114.5A	7.8A	7.9A	5.9A	5.7A	1.33A	1.38A	2.22A	2.19A	5.5A	5.4A	2.58A	2.38A	1.75A	1.88A	4.33A	4.25A	59.5A	55.9A
M.J	113.4A	115.9A	7.9A	7.9A	5.8A	5.7A	1.36A	1.40A	2.21A	2.17A	5.3A	5.0A	2.46A	2.24A	1.80A	1.96A	4.26A	4.20A	57.8A	53.4A

C-Interaction effect of (growth retardants x concentrations).

Gro.ret. / Con.	Fruit weight (gm)		Fruit height (cm)(H)		Fruit diameter (cm)(D)		Fruit shape index (H/D)		Thickness of false pulp (cm)		Fruit firmness (Kg/cm^2)		Number of developed seeds per fruit						Well developed seeds (%)	
													Well developed seeds		Shrivelled seeds		Total number of seeds			
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
Control	119.6A	119.6A	8.0A	8.0A	5.7C	5.7C	1.42A	1.42A	2.16B	2.16B	4.8B	4.8B	2.23D	2.23D	2.0A	2.0A	4.23A	4.23A	52.7C	52.7C
1000 p.p.m	109.6A	113.8A	7.8A	7.9A	5.9AB	5.7C	1.33A	1.39A	2.24A	2.18B	5.8A	5.2A	2.60B	2.33CD	1.69B	1.90A	4.29A	4.23A	60.6A	55.0BC
2000 p.p.m	107.3A	112.3A	7.8A	7.9A	6.0A	5.8BC	1.30A	1.37A	2.26A	2.20B	5.7A	5.5A	2.73A	2.38C	1.64B	1.85A	4.36A	4.23A	62.5A	56.2B

* *Values with the same letters within the same column are not significantly different.*

Continued Table (14) ...

D- Interaction effect of (spraying dates x concentrations).

Spr. dat. / Con.	Fruit weight (gm)		Fruit height (cm)(H)		Fruit diameter (cm)(D)		Fruit shape index (H/D)		Thickness of false pulp (cm)		Fruit firmness (Kg/cm^2)		Number of developed seeds per fruit: Well developed seeds		Shrivelled seeds		Total number of seeds		Well developed seeds (%)	
	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J	F.B	M.J
Control	119.6A	119.6A	8.0A	8.0A	5.7A	5.7A	1.42A	1.42A	2.16A	2.61A	4.8A	4.8A	2.23D	2.23D	2.0A	2.0A	4.23A	4.23A	52.7A	52.7A
1000 p.p.m	110.3A	113.1A	7.8A	7.9A	5.8A	5.7A	1.34A	1.38A	2.22A	2.20A	5.8A	5.2A	2.55AB	2.38C	1.75A	1.84A	4.30A	4.21A	59.3A	56.4A
2000 p.p.m	108.3A	111.3A	7.8A	7.8A	6.0A	5.8A	1.31A	1.36A	2.24A	2.22A	5.7A	5.4A	2.65A	2.45BC	1.69A	1.80A	4.34A	4.25A	61.1A	57.6A

E- Interaction effect of (growth retardants x concentrations x spraying dates).

Gro.ret. / Spr.dat. & Con.	Fruit weight (gm)		Fruit height (cm)(H)		Fruit diameter (cm)(D)		Fruit shape index (H/D)		Thickness of false pulp (cm)		Fruit firmness (Kg/cm^2)		Number of developed seeds per fruit: Well developed seeds		Shrivelled seeds		Total number of seeds		Well developed seeds (%)	
	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC	PP_{333}	CCC
Control	119.6A	119.6A	8.0A	8.0A	5.7A	5.7A	1.42A	1.42A	2.16A	2.16A	4.8A	4.8A	2.23A	2.23A	2.0A	2.0A	4.23A	4.23A	52.7A	52.7A
Full bloom																				
1000 p.p.m	108.5A	112.3A	7. 8A	7.9A	5.9A	5.8A	1.32A	1.37A	2.25A	2.19A	5.9A	5.6A	2.70A	2.40A	1.65A	1.85A	4.35A	4.25A	62.1A	56.5A
2000 p.p.m	105.0A	111.6A	7.7A	7.9A	6.2A	5.8A	1.26A	1.36A	2.26A	2.21A	5.7A	5.7A	2.80A	2.50A	1.60A	1.78A	4.40A	4.28A	63.6A	58.5A
Mid -June																				
1000 p.p.m	110.9A	115.2A	7.9A	7.9A	5.9A	5.6A	1.34A	1.41A	2.23A	2.18A	5.6A	4.9A	2.50A	2.25A	1.73A	1.95A	4.23A	4.20A	59.2A	53.6A
2000 p.p.m	109.7A	113.0A	7.8A	7.9A	5.9A	5.7A	1.33A	1.38A	2.25A	2.18A	5.6A	5.3A	2.65A	2.25A	1.68A	1.93A	4.33A	4.18A	61.3A	53.9A

* *Values with the same letters within the same column are not significantly different.*

4-**Steffens <u>et</u> <u>al.</u> (1993); Ben and Poniedzialek (1994); Mei <u>et</u> <u>al.</u> (1995); Lipecki and Wieniarska (1995)** on fruit weight.

III..4.b. Fruit chemical properties:

Starch percentage total sugars percentage, total soluble solids percentage (T.S.S %), titratable acidity percentage and T.S.S /acid ratio of Anna apple fruits in response to the specific and interaction effects of the three investigated factors (growth retardants, concentrations and spraying dates) and their combinations, respectively were the evaluated fruit chemical properties in this concern. Data obtained during both 1996 and 1997 seasons are tabulated in Table 15 (A,B,C,D and E).

A-Specific effect of investigated factors:

With regard to the specific effect of kind of growth retardant (PP_{333} & CCC), Table 15 (A) reveals obviously that PP_{333} resulted in increasing significantly all fruit chemical properties than CCC during both seasons except total acidity whereas the reverse was found.

As for the specific effect of concentrations of growth retardant, it is quite clear that both 1000 & 2000 p.p.m concentrations increased all studied fruit chemical characteristics except acidity percentage as compared to control (0.0 p.p.m). Such trend was true and differences were significant during both seasons.

Regarding the response to specific effect of spraying dates, data in Table 15 (A) showed that it was so slight to be significant in most cases and it was less pronounced as compared to those of both kind of growth retardant and concentrations. However, there was a general tendency that full bloom spray increased slightly most fruit chemical properties except acidity percentage.

B-Interaction effect of (growth retardants x spraying dates):

Table 15 (B) clears that the variances in all studied fruit chemical properties of Anna apple fruits were so few to reach level of significance as their response to the interaction effect of various combinations between growth retardants and spraying dates during both 1996 & 1997 seasons was concerned. However, the full bloom sprays with PP_{333} resulted in a relative increase in most chemical characteristics except fruit juice acidity percentage which was not affected.

C-Interaction effect of (growth retardants x concentrations):

Concerning the response to the interaction effect of both growth retardants as combined with the three applied concentrations (0.0 , 1000 and 2000 p.p.m), data in Table 15 (C) displayed that four combinations of PP_{333} and CCC both at either 2000 or 1000 p.p.m resulted in increasing all fruit chemical properties of Anna apple fruits except fruit juice acidity as compared to control (0.0 p.p.m). Such trend was true during both seasons of study, however, the 2000 p.p.m PP_{333} and to great extent the 1000 p.p.m PP_{333} were significantly the superior in most cases.

D-Interaction effect of (spraying dates x concentrations):

Table 15 (D) shows that the combinations of both 1000 & 2000 p.p.m concentrations from one side and the spraying dates at either full bloom or mid-June from the other resulted in a relative increase in most chemical properties of Anna apple fruits as compared to control except fruit juice acidity which did not influence. However, differences were not significant in most cases except with T.S.S percentage and T.S.S / acid ratio during both seasons. Moreover, the rate of increase in the T.S.S / acid ratio was more pronounced than the other investigated chemical properties of Anna apple fruits. This could be logically explained depending upon the unparallelled response of both T.S.S percentage and

Table (15): Fruit chemical properties of "Anna" apple trees as affected by PP_{333} & CCC foliar sprays at various concentrations and dates (during 1996 & 1997seasons).

A- Specific effect of growth retardants, concentrations and spraying dates.

Investigated factors		Starch (%) 1996	Starch (%) 1997	Total sugars (%) 1996	Total sugars (%) 1997	T. S. S (%) 1996	T. S. S (%) 1997	Acidity (%) 1996	Acidity (%) 1997	T.S.S./acid ratio 1996	T.S.S./acid ratio 1997
Growth retardants	PP_{333}	13.6A	13.5A	6.7A	6.9A	11.4A	11.6A	0.67B	0.67B	17.0A	17.4A
	CCC	12.8B	13.0B	6.5B	6.7B	11.2B	11.2B	0.68A	0.69A	16.4B	16.3B
Concentrations	Control	12.6B	12.8B	6.3B	6.6B	10.7B	11.2B	0.69A	0.70A	15.5B	16.0B
	1000 p.p.m	13.4A	13.4A	6.7A	6.9A	11.5A	11.5A	0.68B	0.68B	17.1A	17.1A
	2000 p.p.m	13.7A	13.6A	6.8A	7.0A	11.7A	11.6A	0.67C	0.67C	17.5A	17.5A
Spraying dates	F.B	13.3A	13.4A	6.7A	6.8A	11.4A	11.5A	0.67A	0.67B	16.9A	17.2A
	M.J	13.1A	13.1A	6.5A	6.8A	11.2A	11.3B	0.68A	0.69A	16.5A	16.6B

B- Interaction effect of (growth retardants x spraying dates).

Spr.dat. \ Gro. ret.	Starch (%) PP_{333}	Starch (%) CCC	Total sugars (%) PP_{333}	Total sugars (%) CCC	T. S. S (%) PP_{333}	T. S. S (%) CCC	Acidity (%) PP_{333}	Acidity (%) CCC	T.S.S/acid ratio PP_{333}	T.S.S/acid ratio CCC
1996										
F.B	13.7A	12.9A	6.8A	6.5A	11.5A	11.2A	0.67A	0.68A	17.3A	16.5A
M.J	13.6A	12.7A	6.7A	6.4A	11.3A	11.1A	0.67A	0.69A	16.8A	16.2A
1997										
F.B	13.6A	13.1A	6.9A	6.8A	11.8A	11.3A	0.66A	0.68A	17.8A	16.6A
M.J	13.3A	12.9A	6.8A	6.7A	11.5A	11.2A	0.68A	0.70A	17.0A	16.1A

C-Interaction effect of (growth retardants x concentrations).

Con. \ Gro. ret.	Starch (%) PP_{333}	Starch (%) CCC	Total sugars (%) PP_{333}	Total sugars (%) CCC	T. S. S (%) PP_{333}	T. S. S (%) CCC	Acidity (%) PP_{333}	Acidity (%) CCC	T.S.S/acid ratio PP_{333}	T.S.S/acid ratio CCC
1996										
Control	12.6C	12.6C	6.3C	6.3C	10.7B	10.7B	0.69A	0.69A	15.5B	15.5B
1000 p.p.m	14.1A	12.8BC	6.9A	6.5B	11.6A	11.4A	0.67A	0.69A	17.5A	16.6B
2000 p.p.m	14.2A	13.1B	7.0A	6.6B	11.8A	11.5A	0.66A	0.68A	18.1A	17.0A
1997										
Control	12.8B	12.8B	6.6A	6.6A	11.2C	11.2C	0.70A	0.70A	16.0C	16.0C
1000 p.p.m	13.7A	13.1B	7.0A	6.8A	11.9A	11.2BC	0.66A	0.69A	18.0A	16.2BC
2000 p.p.m	13.9A	13.2B	7.1A	6.8A	11.9A	11.4B	0.65A	0.68 A	18.3A	16.8B

** Values with the same letters within the same column are not significantly different.*

Continued Table (15).....

D- Interaction effect of (spraying dates x concentrations).

Spr.dat. / Con.	Starch (%) F.B	Starch (%) M.J	Total sugars (%) F.B	Total sugars (%) M.J	T. S. S (%) F.B	T. S. S (%) M.J	Acidity (%) F.B	Acidity (%) M.J	T.S.S/acid ratio F.B	T.S.S/acid ratio M.J
					1996					
Control	12.6A	12.6A	6.3A	6.3A	10.7B	10.7B	0.69A	0.69A	15.5B	15.5B
1000 p.p.m	13.6A	13.3A	6.8A	6.6A	11.6A	11.4A	0.67A	0.68A	17.4A	16.7A
2000 p.p.m	13.8A	13.5A	6.9A	6.7A	11.8A	11.5A	0.66A	0.67A	17.8A	17.2A
					1997					
Control	12.8A	12.8A	6.6A	6.6A	11.2C	11.2C	0.70A	0.70A	16.0B	16.0B
1000 p.p.m	13.5A	13.2A	6.9A	6.8A	11.7A	11.4B	0.67A	0.69A	17.5A	16.7B
2000 p.p.m	13.8A	13.3A	7.0A	6.9A	11.8A	11.5B	0.66A	0.68A	18.0A	17.1A

E- Interaction effect of (growth retardants x concentrations x spraying dates).

Gro. ret. / Spr. dat. & Con.	Starch (%) PP_{333}	Starch (%) CCC	Total sugars (%) PP_{333}	Total sugars (%) CCC	T. S. S (%) PP_{333}	T. S. S (%) CCC	Acidity (%) PP_{333}	Acidity (%) CCC	T.S.S/acid ratio PP_{333}	T.S.S/acid ratio CCC
					1996					
Control	12.6A	12.6A	6.3A	6.3A	10.7A	10.7A	0.69A	0.69A	15.5A	15.5A
Full bloom										
1000.p.pm	14.2A	13.0A	7.0A	6.6A	11.8A	11.4A	0.66A	0.68A	18.0A	16.8A
2000 p.p.m	14.3A	13.3A	7.2A	6.7A	12.0A	11.5A	0.65A	0.67A	18.4A	17.2A
Mid- June										
1000 p.p.m	14.0A	12.7A	6.8A	6.4A	11.5A	11.3A	0.67A	0.69A	17.1A	16.4A
2000 p.p.m	14.1A	12.9A	6.9A	6.5A	11.7A	11.4A	0.66A	0.68A	17.7A	16.8A
					1997					
Control	12.8A	12.8A	6.6A	6.6A	11.2A	11.2A	0.70A	0.70A	16.0A	16.0A
Full bloom										
1000 p.p.m	13.8A	13.3A	7.0A	6.8A	12.1A	11.3A	0.65A	0.68A	18.6A	16.5A
2000 p.p.m	14.2A	13.4A	7.1A	6.9A	12.1A	11.5A	0.64A	0.67A	18.8A	17.2A
Mid- June										
1000 p.p.m	13.6A	12.9A	6.9A	6.7A	11.7A	11.2A	0.67A	0.70A	17.4A	16.0A
2000 p.p.m	13.6A	13.0A	7.0A	6.8A	11.7A	11.2A	0.66A	0.69A	17.7A	16.4A

* *Values with the same letters within the same column are not significantly different.*

acidity percentage to various combinations between the spraying dates and concentrations of the applied growth retardants, whereas each measurement followed it's own trend which was conflicted with that of the other measurement. Consequently, differences were clearly wider in T.S.S / acid ration rather than in T.S.S percentage.

E-Interaction effect of (growth retardants x concentrations x spraying dates):

Data in Table 15 (E) pointed out that different fruit chemical properties of Anna apple cv. were influenced slightly by the interaction effect resulted by various combinations between (growth retardants x concentrations x spraying dates). Since the full bloom sprays with PP_{333} at either 1000 or 2000 p.p.m (especially higher concentration) were the superior followed by those of the same growth retardants at the same concentrations when sprayed in mid-June, however, the analogous ones of CCC came third. Such trend was true during both seasons for all examined fruit chemical characteristics except fruit juice acidity percentage which was not influenced and showed the least variation in this respect.

These results go in line with the findings of **Helail (1986); Othman (1991); Atawia and Helail (1992); El-Mahdy and Abdalla (1995); Hassan and Atawia (1995) and Khurshid et al. (1997).**

III. 5. Anatomical examination:

Regarding the time of "Anna" apple and "Le-Conte" pear flower bud differentiation as affected by full bloom sprays with PP_{333} and CCC, data reported in Tables (16) and (17) show clearly that floral bud differentiation was not obviously noticed till April, 22 nd. and May , 1st. 1996 in the unsprayed trees (control) of both studied pome species i.e.

Anna apple and Le-Conte pear, respectively. The microscopical examination showed that eight stages could be detected throughout the course of both "Anna" apple and " Le-Conte" pear flower bud development starting from April, 1 st. 1996 till January, 1st. 1997.These stages are as follows:

Stage I :

In this stage, initiation of flower bud differentiation was not yet started. The bud was generally characterized by its convex shaped apex. Figs: 17 (A) and 18 (A).

Stage II:

In this stage, bud was distinguished by its dome shaped apex which surrounded by a primary leaves and scales. The apex consisted of a central mass of meristematic cell, named (corpus) covered by a thick layer of cells, named (tunica). Floral parts development could not be detected yet. Figs : 17 (B) and 18 (B).

Stage III:

During this stage, the sepals primordia showed rapid upward growth giving the cup shape as shown in Figs : 17 (C) and 18 (C).

Stage IV:

In this stage, further increase in length of sepals occurred and their edges were bent centripetaly towards each other forming a central cavity. The initiation of petals primordia appeared from the apexial part of the sepals as shown in Figs : 17 (D) and 18 (D).

Stage V:

The occurrence of stamens to be noticed first was the main character of this stage as shown in Figs : 17 (E) and 18 (E).

Stage VI:

This stage is considered as the stage of stamens development that shows the anthers as stated in Figs : 17 (F) and 18 (F).

Stage VII:

In this stage, The first sign of carpels primordia could be detected as illustrated in Figs: 17 (G) and 18 (G).

Stage VIII:

The main feature of this stage is the continuity of floral parts till full development. Anthers and pistils became well developed, also the pollen grains and ovules completed their development. This stage is considered as the final stage of flower bud differentiation and thus the bud completed its course of development as shown in Figs: 17 (H) and 18 (H).

Concerning the effect of full bloom sprays with "CCC" and "PP_{333}", each at 1000 & 2000 p.p.m on flower bud differentiation, data clearly show that the first visible sign of flower bud differentiation (stage II) was recorded on April, 22 nd. 1996 and May, 1st. 1996 at which the buds were in dome-shape for treated Anna apple and Le-Conte pear trees, respectively, while the buds of untreated trees of both Anna apple and Le-Conte pear were still in stage I. Buds of untreated Anna apple and Le-Conte pear trees reached a dome - shape (stage II) on May, 1 st. and May, 15 th. In other words, 1000 p.p.m "CCC" & PP_{333}" and 2000 p.p.m "PP_{333}" sprays accelerated initiation of flower bud differentiation i.e. occurrence of stage II by two weeks in Anna apple and Le-Conte pear trees. Other stages, III, IV, V, VI, VII, and VIII were recorded during the period from April, 22 nd. 1996 till September, 1 st. in treated buds of Anna apple, and from May, 1st., 1996 till September, 1st. in treated buds of Le-Conte pear. On the other hand, stage VIII of bud differentiation tookplace on January, 1 st. of the following year (1997) for control trees, while in "CCC" & "PP_{333} sprayed trees, it occurred on September, 1 st. in both studied pome species.

These results are in partial agreement with that reported by **Drinkard (1911); Zeller (1955); Nesterov (1959); El-Azzouni et al. (1967); Tromp (1968) and Ghosh (1970); Al-Doori (1977); Buban and Faust (1980); Stino et al. (1985); Hassaballa et al. (1987) and Fouad et al. (1995).**

It could be safely concluded that full bloom sprays with PP_{333}& CCC at either 1000 &2000 p.p.m not only accelerated the first step of flower bud differentiation (stage II) to be started two weeks earlier than control in both Anna apple and Le-Conte pear trees but also compressed (shortened) the duration required for attaining the final stage (VIII) by about four months i.e. on September, 1st. for the treated trees instead of January, 1st. for untreated ones of both Anna apple and Le-Conte pear cultivars. Moreover, spraying with both growth retardants increased also the rate of flower bud differentiation as the number of differentiated buds at each examination date of the PP_{333} & CCC treated trees was compared to the analogous ones of the untreated trees in both Anna apple and Le-Conte pear cultivars.

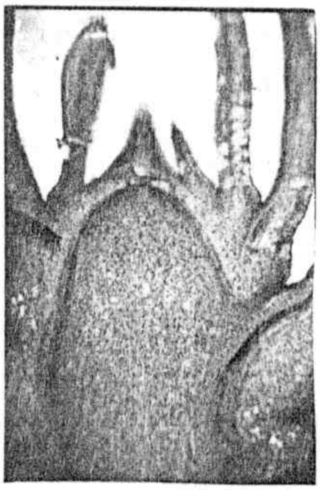
Table (16): Number of flower buds developed per 10 Anna apple sampled buds at various stages as affected by fullbloom sprays with CCC&PP_{333}

Examination dates	Stages of flower bud differentiation															
	I	II	III	IV	V	VI	VII	VIII	I	II	III	IV	V	VI	VII	VIII
	Control (Tap water)								1000 p.p.m CCC (Fullbloom spray)							
April 1st , 1996	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
7th	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
15th	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
22 nd	10			-					9	1	-	-	-	-	-	-
May 1st	9	1	-	-	-	-	-	-	8	1	1	-	-	-	-	-
15 th	9	1	-	-	-	-	-	-	8	-	1	1	-	-	-	-
June 1st	8	1	1	-	-	-	-	-	7	-	1	1	1	-	-	-
July 1st	7	-	1	1	1	-	-	-	6	-	-	1	2	1	-	-
August 1st	6	-	-	-	2	1	1	-	5	-	-	1	1	2	1	-
September 1st	6	-	-	-	1	1	2	-	5	-	-	-	-	2	2	1
January1st.1997	5	-	-	-	-	2	1	2								
	2000 p.p.m CCC (Fullbloom spray)								1000 p.p.m pp_{333} (Fullbloom spray)							
April 1st., 1996	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
7th	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
15th	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
22 nd	9	-	1	-	-	-	-	-	8	1	1	-	-	-	-	-
May 1st	8	1	1	-	-	-	-	-	8	-	1	1	-	-	-	-
15 th	7	1	1	1	-	-	-	-	7	-	1	2	-	-	-	-
June 1st	7	-	-	1	1	1	-	-	6	-	-	1	2	1	-	-
July 1st	7	-	-	-	1	2	-	-	6	-	-	-	1	2	1	-
August 1st	6	-	-	-	1	1	2	-	5	-	-	-	2	1	2	-
September 1st	4	-	-	-	1	2	2	1	5	-	-	-	-	2	2	1
	2000 p.p.m pp_{333} (Fullbloom spray)															
April 1 st , 1995	10	-	-	-	-	-	-	-								
7 th	10	-	-	-	-	-	-	-								
15 th	10	-	-	-	-	-	-	-								
22 nd	7	2	1	-	-	-	-	-								
May 1 st	7	1	1	1	-	-	-	-								
15 th	7	-	1	1	1	-	-	-								
June 1st	6	-	-	1	1	2	-	-								
July 1 st	6	-	-	-	2	1	1	-								
August 1st	5	-	-	-	1	2	2	-								
September 1st	5	-	-	-	1	1	2	1								

Table (17): Number of flower buds developed per 10 Le-Conte pear sampled buds at various stages as affected by full boom sprays with CCC & PP_{333}.

Examination dates	Stages of flower bud differentiation															
	I	II	III	IV	V	VI	VII	VIII	I	II	III	IV	V	VI	VII	VIII
	Control (Tap water)								1000 p.p.m CCC (Fullbloom spray)							
April 1st , 1996	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
7th	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
15th	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
22 nd	10			-					10	-	-	-	-	-	-	-
May 1st	10	-	-	-	-	-	-	-	9	1	-	-	-	-	-	-
15 th	9	1	-	-	-	-	-	-	8	1	1	-	-	-	-	-
June 1st	9	-	1	-	-	-	-	-	8	-	1	1	-	-	-	-
July 1st	8	-	1	1	-	-	-	-	7	-	-	2	1	-	-	-
August 1st	7	-	-	1	1	1	-	-	6	-	-	-	1	2	1	-
September 1st	7	-	-	-	1	2	-	-	6	-	-	-	-	2	1	1
January1st.1997	5	-	-	-	-	2	2	1								
	2000 p.p.m CCC (Fullbloom spray)								1000 p.p.m pp_{333} (Fullbloom spray)							
April 1st., 1996	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
7th	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
15th	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
22 nd	10	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
May 1st	8	2	-	-	-	-	-	-	9	-	1	-	-	-	-	-
15 th	8	1	1	-	-	-	-	-	8	-	2	-	-	-	-	-
June 1st	7	-	1	1	1	-	-	-	8	-	-	1	1	-	-	-
July 1st	6	-	-	1	1	2	-	-	7	-	-	-	2	1	-	-
August 1st	6	-	-	-	2	1	1	-	6	-	-	-	1	2	1	-
September 1st	5	-	-	-	1	2	1	1	5	-	-	-	1	1	2	1
	2000 p.p.m pp_{333} (Fullbloom spray)															
April 1 st , 1995	10	-	-	-	-	-	-	-								
7 th	10	-	-	-	-	-	-	-								
15 th	10	-	-	-	-	-	-	-								
22 nd	10	-	-	-	-	-	-	-								
May 1 st	8	-	2	-	-	-	-	-								
15 th	7	-	2	1	-	-	-	-								
June 1st	7	-	-	1	2	-	-	-								
July 1 st	7	-	-	-	1	2	-	-								
August 1st	6	-	-	-	1	1	2	-								
September 1st	6	-	-	-	1	-	2	1								

Fig. (17): Stages of floral bud differentiation in Anna apple cv.: A, B, C, D, E, F, G and H:



(Stage I):

(A):Initiation of floral bud differentiation.

(convex apex) (X = 4 x 6)

(Stage II):

(B):A dome shaped apex.

(X = 4 x 6)

(Stage III):

(C): A cup shape of sepals primordia.

(X = 4 x 6)

(Stage IV):

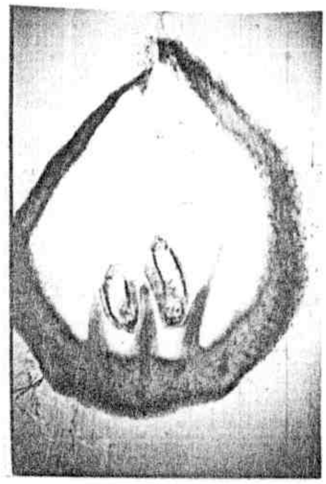
(D): Development of petals primordia.

(X = 4 x 6)

(Stage V):

(E): Initiation of stamens primordia.

(X = 4 x 6)



(Stage VI):

(F): Development of stamens primordia

(X = 4 x 6)

(Stage VII):

(G): Development of carpels primordia

(X = 4 x 6)

(Stage VIII):

(H): full development of floral parts

includes: (X = 4 x 6)

a- Formation of pollen grains.

b- Completed development of ovules.

Fig. (18): Stages of floral bud differentiation in Le-Conte pear cv.: A, B, C, D, E, F, G and H:

(Stage I):

(A):Initiation of floral bud differentiation.

(convex apex) (X = 4 x 6)

(Stage II):

(B):A dome shaped apex.

(X = 4 x 6)

(Stage III):

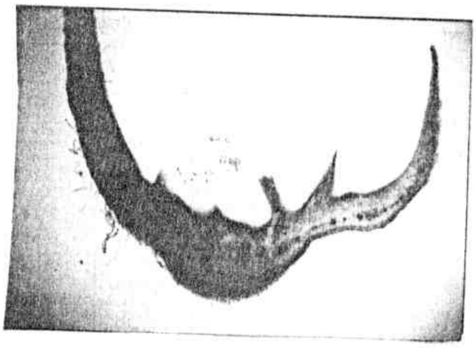
(C): A cup shape of sepals primordia.

(X = 4 x 6)

(Stage IV):

(D): Development of petals primordia.

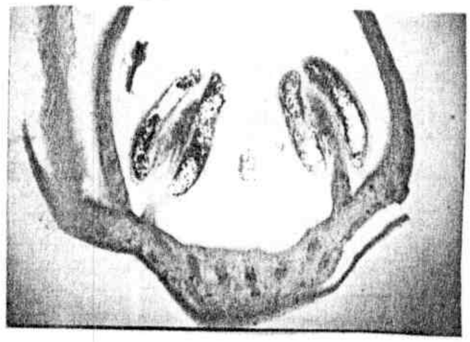
(X = 4 x 6)



(Stage V):

(E): Initiation of stamens primordia.

(X = 4 x 6)



(Stage VI):

(F): Development of stamens primordia

(X = 4 x 6)

(Stage VII):

(G): Development of carpels primordia

(X = 4 x 6)

(Stage VIII):

(H): full development of floral parts

includes: (X = 4 x 6)

a- Formation of pollen grains.

b- Completed development of ovules.

SUMMARY AND CONCLUSION

The present investigation was carried out during two successive seasons of 1995/ 96 and 1996/97 on fruitful trees of both Le-Conte pear and Anna apple "commercial cultivars" of about 18 and 10- year-old and grown at 4x4 and 5x5 meters apart, respectively in clay loamy soil of the Experimental Station of the Faculty of Agriculture at Mosh-tohor, Zagazig University. Moreover, Ein Shamer apple, Dorsett Golden apple, Bartlett pear, Calleryana pear and Balady quince were also included as a plant material.

The main purpose was aimed to throw some light on the real reasons or causes of the most important problem usually meets producers of such pome species / cultivars i.e., the light yield with lower fruit quality which is closely related to the few number or absent of developed seeds per fruit and certainly could be considered as a direct reflection of unsufficient pollination and fertilization.

Also, this problem is related to the growth nature of these species/ cultivars.

Moreover, how to eliminate such problem practically was also aimed. Therefore, the experiments included in this investigation were dealing with the following three fields of study as follows:

I. Cytological studies :

In this regard the relationship between the chromosomal behaviour and pollen grains viability of either the mother plants (commercial/ cultivated cultivars) i.e. Anna apple and Le-Conte pear or the investigated pollinizers " Ein Shamer apple; Dorsett Golden apple; Bartlett pear; Calleryana pear and Balady quince" were studied.

I.1. Chromosomal behaviour:

Chromosomal behaviour at various stages of meiosis was cytologically examined in the pollen mother cells " PMC's" taken from anthers of floral buds collected from each pome species /cultivar at different stages of development. The number of pollen mother cells "PMC's microscopically examined at either Diakinesis or Metaphase I were counted. The number of examined mother cells showed the complete pairing (17 bivalents only) and those exhibited the presence of both bivalent and univalent chromosomes together at various proportions were counted separately and their percentage were estimated.

I.2. Pollen grains viability :

Pollen grains viability of the differential investigated pome species and cultivars was studied through the two following ways:

I.2.a. Pollen grains stainability :

Freshly collected dry pollens of each investigated pome member were microscopically examined (5 fields per each slide) regarding their shape, size and stainability to aceto-carmine solution. The deeply stained pollens with normal size and shape were classified as fertile, while smaller, shrivelled or weakly stained ones considered as sterile .

I.2.b. Germination percentage:

Germination percentage was estimated by dusting a small amount of pollens on Petri dish containing 15% sucrose + agar medium, then left under room temperature for 24 hours.

Thereafter, germinated and ungerminated pollens were counted through 5 microscopic fields each containing 50-100 pollens.

II. Pollination studies :

Two experiments were conducted during 1995 and 1996 years for studying the response of Anna apple and Le-Conte pear each individually to the following pollination treatments :

1-Open pollination (control).

2-Naturally self pollination (bagging only).

3-Emasculation and bagging (parthenocarpic fruiting).

4- Self pollination.

5- Cross pollination with Ein Shamer apple pollens.

6-Cross pollination with Dorsett Golden apple pollens.

7-Cross pollination with Bartlett pear pollens.

8-Cross pollination with Calleryana pear pollens.

9-Cross pollination with Balady quince pollens.

Twelve healthy trees from each pome species i.e. Le-Conte pear and Anna apple were carefully selected and classified according to their vigour into four categories (blocks),3 trees per each. The randomized complete blocks design with four replications was used for arranging the 9 investigated pollination treatments, whereas the three trees of each block were subjected randomly to the 9 investigated treatments i.e. 3 pollination treatments per each tree. The number of treated flowers with each pollination treatment per every replicate was counted, then developed fruits were also counted three times viz 1st. one month later from applying pollination (for both Le-Conte pear and Anna apple) while 2nd. and 3rd. for Anna apple at the last week of June and harvesting date. Thus the following fruiting measurements in response to the nine investigated treatments were determined:

1-Fruit set and fruit retention (after June drop and at harvesting).

2-Fruit quality (physical and chemical properties): fruit weight, dimensions (height & diameter), shape index (H:D), false pulp thickness, flesh firmness and number of seeds per fruit were the determined physical properties. However, T.S.S %, titratable acidity%, T.S.S / acid ratio and both starch & sugars contents were the chemical properties .

3-Histological Examination.

It aimed to follow the differentiation, development and deterioration of ovules, as well as the embryo sac formation, fecundation and seed development in response to various investigated pollination treatments were periodically done at 3,7,21,30, 45 and 60 days from pollination.

III. Physiological studies :

Two factorial experiments were conducted on fruitful Anna apple and Le-Conte pear trees during two successive seasons of 1995/96,1996/97 to investigate the response of their growth, flowering, fruiting measurements and fruit quality as well as some histological examinations of their flower bud differentiation in response to some growth retardants sprayed at various concentrations and dates. Hence, an experiment was devoted for trees of each pome species from one side and dealing with studying the specific effects of three factors namely: a) kind of growth retardants (PP_{333} & CCC) ; b) applied concentrations (1000 & 2000 p.p.m) and c) spraying date (at full bloom and mid-June), as well as the interaction effect of their combinations from the other. Thus, the combinations between the 3 investigated factors (2 growth retardants x 2 concentrations x 2 spraying dates) and tap water spray as control were the 9 treatments included in each experiment:

1- Tap water spray (control).
2- Full bloom spray with 1000 p.p.m PP_{333}.
3- Full bloom spray with 2000 p.p.m PP_{333}.
4- Full bloom spray with 1000 p.p.m CCC.
5- Full bloom spray with 2000 p.p.m CCC.
6- Mid- June spray with 1000 p.p.m PP_{333}.
7- Mid- June spray with 2000 p.p.m PP_{333}.
8- Mid- June spray with 1000 p.p.m CCC.
9- Mid- June spray with 2000 p.p.m CCC.

Taking into consideration that full bloom sprays were done on (February 16th. &5th.) for Anna apple and (March 30th & 23 th.) for Le-Conte pear during 1995 & 1996 years, respectively. Triton at 0.5% was used as a surfactant with all spray treatments.

Data obtained during both experimental seasons regarding the response of various growth, flowering, fruiting and fruit quality to the different treatments were recorded during the next year of growth retardants application (second year of each season) as follows :

III.1. Growth measurements:

In early September of each season when growth was ceased, average shoot length, number of leaves per shoot, leaf dimensions (length & width), leaf area, leaf index (length : width) and leaf dry weight were determined .

III.2. Flowering measurements:

Number of spurs and inflorescences per tree were counted in the following spring of applying growth retardants treatments.

III.3. Fruiting measurements:

Fruit set %, fruit retention %, number of fruits /spur and yield per tree, as well as fruit physical and chemical properties as previously mentioned with pollination studies were determined in the next year of sprays.

III.4. Anatomical examination:

Floral bud differentiation of Anna apple and Le-Conte pear in response to PP_{333} and CCC sprays was studied during second season (1996/97). Terminal buds from non bearing spurs of the full bloom sprayed trees with PP_{333} and CCC and non sprayed ones were randomly sampled for anatomical examination at various intervals throughout specified durations of examination (April, 1st. 1996 until Jan.1st. 1997).

Obtained data during both seasons of study could be summarized as follows :

I. Cytological studies :

I.1. Chromosomal behaviour :

From cytological examination at both Diakinesis and Metaphase I during meiosis in pollen mother cells of Anna apple, Dorsett Golden apple, Ein Shamer apple, Le-Conte pear, Bartlett pear, Calleryana pear and Balady quince it could be concluded that:

1- The absent of any multivalent chromosomes from one side and the present of 17 bivalent chromosomes in most examined PMC's of these 7 pome species and cultivars from the other proved that they are diploids with $2x = 34$ and haploid chromosomal number of 17.

2- Some of the examined PMC's exhibited 17 bivalent chromosomes beside some univalent ones at different proportions. The most frequently observed chromosomal configuration of such aberration was the presence of (16 bivalents + 2 univalents) followed by the (15 bivalents + 4 univalents) while that pattern of (14 bivalents + 6 univalents) showed the least proportion.

3- Percentage of such aberration in chromosomal pariring was varied from one species / cultivar to another and reflected the cytological stability of each. Whereas, Bartlett pear and Dorsett Golden apple were cytologically the most stable ones i.e. showed the highest percentage of PMC's with 17 bivalents only, followed by both Calleryana pear and Ein Shamer apple. The reverse was true with Balady quince (least percentage of chromosomal pairing) followed by Le-Conte pear and Anna apple.

I.2. Pollen grains viability:

Viability of examined pollen grains were evaluated through stainability and germination methods. Data obtained during both seasons revealed obviously that the 7 investigated pome species and cultivars followed the same trend, regardless of the employed method of evaluation. Since, Bartlett pear was the superior followed in a descending order by Dorsett Golden apple, Ein Shamer apple, Calleryana pear, Anna apple, Le-Conte pear and Balady quince.

However, the values of germination % were relatively lower as compared with the analogous ones of stainability percentage.

Generally it could be noticed that cytological behaviour of the studied pome species /cultivars was coincident with that of pollen grains viability. Since,both Bartlett pear and Dorsett Golden apple were cytologically the most stable (having the lowest % of univalents) from one hand, and induced the most viable pollens from the other. The reverse was true with Balady quince.

II. Pollination studies :

Data obtained concerning the effect of differential pollination treatments on some fruiting and fruit quality measurements, as well as histological examination of the developing ovaries of Le-Conte pear and Anna apple cultivars could be summarized as follows :

II.1. Fruit set :

A. Le-Conte pear :

The maximum fruit set percentage in Le-Conte pear was achieved by the hand cross pollination with Bartlett pear pollens , followed in descending order by cross pollination treatments with pollens of Calleryana pear, Dorsett Golden apple and Ein Shamer apple. The reverse was detected with (emasculation and bagging) followed in an increasing order by bagging only; cross pollination with Balady quince pollens; open pollination and hand self pollination.

B. Anna apple :

Hand cross pollination treatment with pollens of Dorsett Golden apple and to some extent Ein Shamer apple pollens were the superior treatments followed by cross pollination with Bartlett and Calleryana pear pollens. The reverse was true with parthenocarpic fruiting treatment, while other treatments were in between.

II.2. Fruit retention of Anna apple:

Fruit retention measurements expressed as percentage of remained fruits at either late June or harvesting date typically followed the same trend of response previously detected with fruit set percentage. Hence, the highest percentage of retained fruits at both measuring dates was always concomitant to the hand cross pollination with pollens of Dorsett Golden apple and Ein Shamer apple, while the reverse was true with the emasculation and bagging treatment.

II.3. Fruit quality:

A.Fruit physical properties:

A.1. Fruit weight :

The heaviest fruits were closely related to such ones induced by hand cross pollinated flowers with pollens of Dorsett Golden apple and Ein Shamer apple, while the opposite was found with the parthenocarpic fruits.

A.2.Fruit dimensions (height & diameter):

Data obtained during 1995 & 1996 seasons revealed that both fruit dimensions did not respond equally to the various pollination treatments. Hence, variations in fruit diameter were less pronounced than those exhibited with fruit height. Moreover, fruit height was responded positively to the self pollination treatments (bagging only and hand self pollination) and the hand cross pollination treatments with pollens of both Bartlett and Calleryana pear, while with diameter, the hand cross pollination with pollens of either Dorsett Golden apple or Ein Shamer apple cultivars were the superior. On the other hand, emasculation and bagging and cross pollination with Balady quince pollens reduced both fruit dimensions.

A.3.Fruit shape index:

Due to the variable responses of both fruit dimensions to each pollination treatment, data obtained revealed that two opposite trends were detected. In The first, fruits tended to be of round shape (the hand cross pollination with pollens of Dorsett Golden apple, Ein Shamer apple or Balady quince. Second represented the effect of the six other pollination treatments, whereas fruits tended to be oblonged in shape.

A.4. False pulp thickness :

The thickest false pulp was exhibited by those fruits of hand cross pollinated flowers with pollens of Dorsett Golden apple and Ein Shamer apple, difference was significant during 1st. season only.

A.5. Fruit firmness :

The same trend previously found with false pulp thickness was also detected with firmness.

A.6. Fruit seediness :

The number of well developed and total seeds per fruit as well as percentage of well nourished seeds followed the same trend of response, whereas the hand cross pollination with pollens of Dorsett Golden apple induced fruits having significantly the highest values of these seed measurements, while emasculation and bagging induced completely seedless fruits.

B. Fruit chemical properties :

Data obtained during both 1995 & 1996 seasons revealed obviously that the percentage of both starch and total sugars in flesh of

Anna apple fruits as well as the fruit juice T.S.S% followed nearly the same trend of response, whereas the hand cross pollination with pollens of Dorsett Golden apple and Ein Shamer apple resulted in significant increases than other pollination treatments. Moreover, emasculation and bagging was the inferior, however, the differences were not significant in most cases as compared to the other pollination treatments except the aforesaid two treatments. As for fruit juice acidity %, trend of response to the investigated treatments took the other way around, whereas the least acidity %was in closed relationship to the hand cross pollination with pollens of either Dorsett Golden apple or Ein Shamer apple cultivars. Accordingly the highest value of T.S.S/ acid ratio was always concomitant to the Anna apple fruits induced by cross pollination with pollens of Dorsett Golden apple and Ein Shamer apple cultivars.

II.4. Histological studies:

Histological examinations displayed the following points:

1- Ovary of both Anna apple and Le-Conte pear usually contains five regular and symmetric carpels, each with two similar ovules. However, the abnormal ovary contains less than five well developed carples either associated with or without other undeveloped carpels, each containing only ovule or completely empty.
2- In some cases aborted ovules were observed after 3 or 7 days from applying some pollination treatments with both pome species / cultivar.

3- After 21 days from fecundation, the fertilized ovules showed progressive increase (integuments, embryo sac) and zygotic division and endosperm nuclei were observed.

4- After 30, 45 and 60 days from carring out the various pollination treatments, number of shrivelled or well developed ovules and seeds per each fruit were varied from one treatment to another. Hence, the highest number of both well developed ovules after 30 days and consequently number of well developed seeds after 45 and 60 days in Anna apple were obtained by hand cross pollination with pollens of Dorsett Golden apple followed by pollens of Ein Shamer apple and Bartlett pear. The reverse was true with emasculation and bagging, whereas the ten ovules were completely shrivelled followed by treatment of bagging only (naturally self pollination) which showed the least number of well developed seeds.

III. Physiological studies :

Growth, flowering and fruiting measurements, besides anatomical examination of flower bud differentiation in Anna apple and Le-Conte pear trees as influenced by the PP_{333} and CCC sprays at various concentrations and dates were investigated in this concern through conducting two factorial experiments.

III.1. Vegetative growth measurements :

Experiment, I " Anna apple cultivar":

A.Specific effect of investigated factors:

Regarding the specific effect of type of growth retardants, data obtained displayed that PP_{333} was statistically more effective than CCC in reducing most growth measurements. i.e. (shoot length, number of leaves per each, leaf length, shape index and area of leaf),while the reverse was found with leaf width and its dry weight.

As for the specific effect of concentrations, both 1000 & 2000p.p.m restricted all growth measurements than control(0.0 p.p.m), however, the higher concentration was statistically more effective. In addition, full bloom exceeded significantly the mid- June spraying in reducing most growth measurements except leaf width and dry weight.

B.Interaction effect of (growth retardants x spraying dates) :

Full bloom sprays of PP_{333} exhibited statistically the severest reduction in shoot length, number of leaves per shoot and leaf length, while mid-June CCC sprays showed the lightest depression. Other growth measurements did not response to the interaction effect of combinations between growth retardants and spraying dates.

C.Interaction effect of (growth retardants x concentrations) :

Spraying PP_{333} at 2000 p.p.m resulted significantly in the shortest shoots with the fewest number of leaves per each and the least values of leaf length, leaf index and leaf area, while 1000 p.p.m CCC spray was the inferior and ranked last just before control (0.0 p.p.m) Leaf dry weight followed an opposite trend whereas PP_{333} either at 1000 or 2000 p.p.m induced the heaviest ones.

D. Interaction effect of (spraying dates x concentrations):

It could be concluded that the full bloom sprays at 2000 p.p.m induced significantly the severest reduction in shoot length, number of leaves per shoot, leaf length and shape index, while the reverse was found with leaf dry weight. The response of leaf width and its area was of minor importance .

E.Interaction effect of (growth retardants x concentrations x spraying dates):

Full bloom sprays of PP_{333} at either 1000 or 2000 p.p.m were significantly the most restrictive combinations i.e. treatments for most growth measurements (shoot length, number of leaves per shoot, leaf length and its shape index).Leaf area showed the same trend but differences were not significant. On the contrary all combinations of both PP_{333} & CCC slightly increased leaf dry weight than control (water spray).

Experiment, II" Le-Conte pear cultivar":

Data obtained during both 1995/96 and 1996/97 seasons displayed that Le-Conte pear trees typically exhibited the same trends previously detected with Anna apple pertaining the response to the specific and interaction effects of the kind, concentration and date of spraying two investigated growth retardants.

III.2. Flowering measurements:

Number of fruiting spurs and inflorescences per tree in response to the various treatments of PP_{333} and CCC sprays were the investigated flowering measurements of both Anna apple and Le-Conte pear cultivars. Data obtained revealed that both cultivars followed typically the same trends of response to either specific or interaction effects of the investigated three factors (2 growth retardants, 3 concentrations and 2 spraying dates).

A. Specific effect of investigated factors:

Trees of both pome species /cultivars responded specifically to kind of growth retardant, concentration and spraying date, however, the response was more pronounced with concentration rather than kind of growth retardant, while spraying date came last.

B. Interaction effect of various combinations:

The specific effect of each studied factor was certainly reflected on the interaction effect of their various combinations. Hence, both flowering measurements varied greatly in their response to the interaction effect of combinations between growth retardants and concentrations (the paclobutrazol sprayed trees at 2000 p.p.m was the superior). Meanwhile, the response to interaction effect of (growth retardants x spraying dates) was less pronounced and not significant.

In addition, the interaction effect of combinations between spraying dates and concentrations was in between.

III.3. Fruiting measurements:

Fruit set percentage of both Anna apple and Le-Conte pear cultivars, as well as fruit retention (at last week of June and harvesting date), number of mature fruits per inflorescence and yield in (kg) per tree of Anna apple cv. were the investigated fruiting measurements.

Obtained data revealed that all followed the same trends of response to either specific effect of each investigated factor or the interaction effect of their various combinations.

Specific effect of investigated factors:

Regarding the specific effect of the three factors, data obtained showed that all fruiting measurements were significantly increased with the PP_{333}, 2000 p.p.m and the full bloom sprays as compared to CCC, 1000 p.p.m and mid-June sprays, respectively.

Interaction effect of various combinations:

Data obtained during both seasons declared that the response of all fruiting measurements to interaction effect of (growth retardants x spraying dates) was so slight to be significant, while with the combinations of (growth retardants x concentrations) variations were more pronounced whereas spraying of PP_{333} at 1000 or 2000 p.p.m were significantly the most effective. Meanwhile, the interaction effect of (spraying dates x concentrations) was intermediate where the full bloom spray at either 1000 or 2000 p.p.m was the superior, however, differences were significant during second season only.

In addition, in spite of the differences due to various combinations between (growth retardants x concentrations x spraying dates) were not significant , but it could be noticed that full bloom spray of PP_{333} regardless of concentration resulted in a considerable increase in all fruiting measurements.

III.4.Fruit quality:

III.4.a.Fruit physical properties:

Specific effect of investigated factors:

Referring the specific effect of growth retardants, obtained data showed that PP_{333} resulted in a significant reduction in fruit weight, fruit height, fruit shape index and number of shrivelled seeds per fruit as compared to CCC during 1996 & 1997 seasons, respectively. The reverse was true with the fruit diameter, thickness of false pulp, fruit firmness, number and percentage of well developed seeds per fruit. In addition, the total number of seeds per fruit. was not affected by the kind of the growth retardants.

Regarding the specific effect of the growth retardant concentration, tabulated data revealed that both 1000& 2000 p.p.m significantly decreased fruit weight, fruit height, fruit shape index and number of shrivelled seeds as compared to control (0.0p.p.m).

On the contrary, fruit diameter, thickness of false pulp, fruit firmness, number and percentage of well developed seeds were significantly increased by both concentrations of 1000 & 2000 p.p.m as compared to the water spray (control). Anyhow, total number of seeds per fruit did not respond to the applied concentrations.

As for the specific effect of spraying date, data displayed that full bloom sprays significantly increased fruit diameter, fruit firmness, number and percentage of well developed seeds per fruit, while the other measurements of Anna fruit physical properties did not specifically respond.

Interaction effect of various combinations:

Data obtained showed that the response of all measurements of fruit physical properties of Anna apple cv. to interaction effect of (growth retardants x spraying dates) was so little to be significant, while with the combinations of (growth retardants x concentrations), fruit weight, fruit height, fruit shape index and number of shrivelled seeds per fruit were decreased as compared to control, however, the PP_{333}at 2000 p.p.m was more restrictive in this respect. Moreover the fruit diameter, thickness of false pulp, fruit firmness, number and percentage of well developed seeds were increased as compared to control.

Regarding the interaction effect of (spraying dates x concentrations), there was a slight increase with fruit diameter, thickness of false pulp, fruit firmness, number and percentage of well developed seeds, however, the fruit weight, fruit height, fruit shape index and number of shrivelled seeds per fruit were restricted.

Referring the interaction effect of (growth retardants x concentrations x spraying dates), fruit weight, fruit height, fruit shape index and number of shrivelled seeds per fruit, they tended to be decreased below control, while fruit diameter, thickness of false pulp, fruit firmness, number and percentage of well developed seeds followed an opposite trend (a relative increase) as compared to control.

III.4.b. Fruit chemical properties:

Starch percentage, total sugars percentage, total soluble solids percentage (T.S.S %), titratable acidity percentage and T.S.S / acid ratio of Anna apple fruits in response to the specific and interation effects of the three investigated factors were the evaluated fruit chemical properties in this concern.

Specific effect of investigated factors:

Concerning the specific effect of kind of growth retardants, data reveals that PP_{333} significantly increased all fruit chemical properties than CCC except total acidity whereas the reverse was found.

As for the specific effect of concentrations, it is clear that both 1000 &2000 p.p.m increased all studied fruit chemical properties except acidity percentage as compared to control.

Regarding the response to specific effect of spraying dates, data showed that full bloom spray increased slightly most fruit chemical properties except acidity percentage.

Interaction effect of various combinations:

With regard to the interaction effect of (growth retardants x spraying dates), PP_{333} at full bloom resulted in a relative increase in most chemical properties except acidity % which was not effected.

Referring the interaction effect of (growth retardants x concentrations), combinations of PP_{333} & CCC both at either 2000 or 1000 p.p.m resulted in increasing all fruit chemical properties except acidity %, however, the 2000 p.p.m PP_{333} and to great extent the 1000 p.p.m PP_{333} were significantly the superior in most cases.

Considering the interaction effect of (spraying dates x concentrations), full bloom or mid-June sprays resulted in a relative increase in most chemical properties of Anna apple fruits as compared to control except acidity % which did not influence.

Regarding the interaction effect of (growth retardnts x concentrations x spraying dates), the full bloom sprays with PP_{333} at either 1000 or 2000 p.p.m (especially higher concentration) were the superior followed by those of the same growth retardant at the same concentrations when sprayed in mid-June, however, the analogous ones of CCC came third.

Such trend was true during both seasons for all examined fruit chemical characteristics except acidity % which was not influenced and showed the least variation in this respect.

III.5. Anatomical examination:

It could be safely concluded that full bloom sprays with PP_{333} & CCC at either 1000 or 2000 p.p.m not only accelerated the first step of flower bud differentiation (stage II) to be started two weeks earlier than control in both Anna apple and Le-Conte pear trees but also compressed (shortened) the duration required for attaining the final stage (VIII) by about four months i.e on September,1 st. for the treated trees instead of January, 1st. for untreated ones of both Anna apple and Le-Conte pear cultivars.

Moreover, spraying with both growth retardants increased also the rate of flower bud differentiation as the number of differentiated buds at each examination date of the PP_{333} or CCC treated trees was compared to the analogous ones of the untreated trees in both Anna apple and Le-Conte pear cultivars.