

SUMMARY AND CONCLUSION

The present investigation was carried out during 1985, 1986 and 1987 seasons, in order to study the effect of cross-pollination and some growth regulators on yield and fruit quality of some citrus species and varieties (Washington navel orange, Jaffa orange, Mazizy orange, Clementine tangarine and Agami lime). The pollination and growth regulators treatments used in this study were as follows:-

- 1 - Open pollination (control).
- 2 - Bagging only.
- 3 - Emasculation and bagging.
- 4 - Cross pollination with Balady lime pollen.
- 5 - Cross pollination with Marsh grapefruit pollen.
- 6 - Cross pollination with Balady mandarin pollen.
- 7 - Cross pollination with Suckarry orange pollen.
- 8 - Dipping emasculated flowers in a solution of GA_3 at 1000 p.p.m.
- 9 - Dipping emasculated flowers in a solution of GA_3 at 2000 p.p.m.
- 10 - Dipping emasculated flowers in a solution of N.A.A. at 25 p.p.m.
- 11 - Dipping emasculated flowers in a solution of N.A.A. at 50 p.p.m.
- 12 - Dipping emasculated flowers in a solution of GA_3 at 1000 p.p.m. + N.A.A. at 25 p.p.m.
- 13 - Dipping emasculated flowers in a solution of GA_3 at 1000 p.p.m. + N.A.A. at 50 p.p.m.

- 14 - Dipping emasculated flowers in a solution of GA_3 at 2000 p.p.m. + N.A.A. at 25 p.p.m.
- 15 - Dipping emasculated flowers in a solution of GA_3 at 2000 p.p.m. + N.A.A. at 50 p.p.m.

The cytology of chromosomal behaviour and pollen formation and the histology of ovules fertilization and embryo development were also studied among some citrus species and varieties to correlate these variations to fertility of each.

The results of these studies could be summarized as follows ;-

- 1 - In Washington navel orange, it was found that, Cross-pollination with Balady mandarin and Cross-pollination with Suckarry orange caused significant increase in fruit set, remaining fruits after June drop, mature fruits, fruit weight, fruit height, fruit diameter, juice weight and the number of well developed seeds per fruit. On the other hand, Cross-pollination with different pollinators caused significant decrease in T.S.S/acid ratio of fruit juice.

GA_3 at 1000 p.p.m, GA_3 at 2000 p.p.m. and the combinations between GA_3 and N.A.A. treatments had resulted in a considerable increase in fruit set, remaining fruits after June drop,

fruits remained to maturity (yield), fruit weight, fruit height and fruit shape index. However, T.S.S of fruit Juice and T.S.S / acid ratio were significantly decreased.

The ascorbic acid content in fruit juice was significantly increased by GA_3 at 1000 p.p.m. GA_3 at 2000 p.p.m. and GA_3 2000 p.p.m. + N.A.A. at 50 p.p.m. treatments .

- 2 - In the Jaffa orange , Cross-pollination with Balady mandarin and Cross-pollination with Suckarry orange increased fruit set, yield, fruit weight, fruit diameter, Juice weight and number of well developed seeds per fruit. The two treatments resulted in decreasing fruit shape index and did not affect T.S.S, acidity, T.S.S/ acid ratio or ascorbic acid content. On the other hand, GA_3 at 1000 p.p.m. , GA_3 at 2000 p.p.m. and GA_3 2000 p.p.m. + N.A.A. 50 p.p.m. treatments significantly increased fruit set and yield, while N.A.A. at 25 p.p.m. and N.A.A. at 50 p.p.m. caused significantly decreased in fruit set and yield . The treatments of GA_3 at 1000 p.p.m., GA_3 at 2000 p.p.m. and N.A.A. at 25 p.p.m. treatments caused in significant increased of fruit weight, fruit height, fruit shape index, peel thickness, Juice weight, T.S.S, total acidity T.S.S/acid ratio.

- 3 - In the Mazizy orange, Cross-pollination with Balady mandarin and Cross-pollination with Suckarry orange caused significant increase in fruit set, yield, fruit weight, fruit height, peel thickness , juice weight and well developed seeds per fruit.

The treatments of GA_3 1000 p.p.m. , GA_3 at 2000 p.p.m. and GA_3 2000 p.p.m. + N.A.A. at 50 p.p.m. increased fruit weight, fruit height, fruit diameter, fruit shape index, peel thickness and juice weight but decreased T.S.S/acid ratio. On the other hand, treatments of N.A.A. at 25 p.p.m. , N.A.A. at 50 p.p.m. fruit juice increased fruit set and yield but decreased fruit weight, and fruit juice acidity.

- 4 - In the Clementine tangarine, bagging only treatment gave low percentages of fruit set and mature fruits than Cross-pollination treatments. This result may indicate that the Clementine tangarine is partial self-incompatibility .
- Cross-pollination with Balady mandarin and cross-pollination with Suckarry orange caused significant increase in fruit set and yield. All pollinizers used caused significant increase in fruit weight and T.S.S. Cross-pollination with

Marsh grapefruit and Cross-pollination with Balady mandarin caused in increasing fruit diameter, peel thickness and fruit juice weight.

The treatments of GA_3 at 1000 p.p.m. and GA_3 at 2000 p.p.m. were significantly increased fruit set, yield, fruit weight, fruit height, peel thickness and total acidity of fruit Juice. On the other hand, GA_3 at 2000 p.p.m. + N.A.A. at 50 p.p.m. and N.A.A. at 25 p.p.m. caused in decreasing fruit set and yield.

- 5 - In the Agami lime, All Cross-pollination treatments resulted in increasing fruit set, yield, fruit weight, fruit diameter and the fruits resulting from these treatments seem to be more flattend. Cross-pollination with Balady lime and Cross-pollination with Balady mandarin caused in significant increase in peel thickness, Juice weight and well developed seeds per fruit.

The treatments of GA_3 at 1000 p.p.m. , GA_3 2000 p.p.m. and GA_3 1000 p.p.m. + N.A.A. at 50 p.p.m. caused significant increase in fruit set, yield, fruit weight, fruit diameter, peel thickness, juice weight and total acidity. Only, GA_3 at 1000 p.p.m. treatment resulted in significant increase of ascorbic acid content in fruit Juice.

6 - Generally, it was found that, the emasculation and bagging treatment did not give any mature fruit in Jaff orange, Mazizy orange, Clementine tangarine and Agami lime. This result indicate that these species and varieties are need of pollination and fertilization to produce yield. On the other hand, mature fruits which produced from emasculation and bagging treatment in the Washington navel orange is evidintly due to the ability of this variety to set fruits parthenocarpically without pollination and fertilization.

7 - The mitotic investigations showed that, the chromosome number in Washington navel orange, Jaffa orange, Mazizy orange, Clementine tangarine and Agami lime was $2n=18$. Thus, these citrus species and varieties are normal diploids.

8 - In meiotic studies, it was found that, the haploid number of chromosomes in Balady lime, Marsh grapefruit, Balady mandarin, Suckarry orange, Jaffa orange, Mazizy orange, Clementine tangarine and Agami lime was 9, while the diploid number was 18 chromosomes.

9 - The chromosome behaviour at meiosis in each of these citrus species and varieties showed 9 bivalents at late diakinesis and metaphase I

stages. There were univalent chromosomes beside the bivalents in some PMC's in different proportions. More PMC's with univalents were observed in the Agami lime and Marsh grapefruit than those in the other citrus species and varieties.

- 10- Clementine tangarine, Balady mandarin and Suckarry orange showed the maximum percentages of pollen fertility, while Agami lime and Marsh grapefruit showed the minimum percentages of pollen fertility.
- 11- A positive correlation was found between the percentages of stainable pollen and the percentages of pollen germination.
- 12- A negative correlation was found between the percentages of PMC's with univalents on one hand and the percentages of stainable pollen and pollen germination on the other hand,
- 13- A negative correlation was found between the percentages of PMC's with univalents and the number of well developed seeds per fruit.
- 14- A positive correlation was found between the number of well developed seeds per fruit on one

hand and the percentage of stainable pollen and the percentage of pollen germination on the other hand.

- 15- As a result of these cytological studies, one might conclude that, the Balady mandarin, Suckarry orange, Mazizy orange and Clementine tangarine were nearly cytologically stable, Therefore, these species and varieties can be safely used in breeding programs for citrus improvement.
- 16- Histological studies showed that, the embryo sac was completely differentiated within 3 days after pollination. The fecundation occurred within 7-13 days after pollination of the citrus species and varieties under this study.
- 17- Within 13-20 days after pollination, the free nuclear endosperm divisions occurred and become more visible.
- 18- The degeneration of ovules in all citrus species and varieties under this investigation was not observed within the first 3 days after treatments with the exception of Clementine tangarine and Agami lime when their flowers were emasculated and bagged.

- 19- The percentage of deteriorated ovules increased for all treatments within 7 to 30 days and reached to the maximum at 45 and 60 days after pollination treatments.
- 20- Cross-pollination with Balady mandarin pollen gave the lowest percentage of deteriorated ovules and the highest dimensions of well developed ones.
- 21- At 60 days after pollination, the adventitious embryos were appeared.
- 22- At 60-85 days after pollination, the successive divisions of both sexual and adventitious embryos developed to the main body with globular shape and the nuclear endosperm developed to form cellular endosperm.
- 23- At 100 days after pollination, the embryos had reached to the cotyledonary stage and the cellular endosperm began to disappear.
- 24- At 120 days after pollination, the various parts of the complete embryo were formed (hypocotyle, radicle, cotyledons and plumule) and the seed coats were completely differentiated.