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## 5- SUMMARY AND CONCLUSION

This study was carried out during two successive seasons of 98-1999 and 99-2000 on 12 year old Washington navel orange trees budded on sour orange rootstock and grown in a loamy clay soil at the orchard in Tokh, El Kaliobia Governorate.

This investigation was aimed to study the abscission problem of Navel orange trees (Reasons, Times, Ratio); Also the treatments which caused to reduce the fruitlets as follows:

### 1-Physiological studies :

1-1 studying the level of endogenous hormones in plants by Determination of endogenous hormones for IAA, GA<sub>3</sub> , ABA and ethylene periodically every two weeks from fruit set at 11/4 to mature of fruits (Late August) in both fixed and dropped fruits.

1-2 studying the level nutrition in plants by measurements of peel firmness, determination of total pectin, total carbohydrates and calcium periodically every two weeks in both fixed and dropped fruits.

2- Study the effects of ecostress and its possible role in abscission.

3-Anatomical studies: to notice changes in the anatomical structure of separation zone.

4-treatments to state prevent or reduce the drop of fruit .

4-1 By spraying growth regulators as follows:

4-1-1 Gibberellin at 25 & 50 ppm .

4-1-2 Promalain at 22.5 & 45 ppm .

4-1-3 2,4-D at 10 & 20 ppm .

4-2 By spraying mineral nutrition .

4-2-1 Calcium sulfate at 1000 & 2000 ppm .

4-2-2 Potassium sulfate at 1000& 2000 ppm .

**Times of spraying for trees :** each tree sprayed with 10 liters in two experiments three times :

- 1- At 75% of fully opened flowers at least.
- 2- Diameter fruitlets from 0.5 upto 1.0 cm.
- 3- Diameter fruitlets from 1.5 upto 2.5 cm.

In addition to control sprayed with only water .

**The obtained results could be summarized as follows:**

I- Study the abscission reasons :

1- Results of this study revealed that the abscission occurred in double single waves.

The first fruitlets wave drop about (38%) after 30 days from full bloom was on April 25<sup>th</sup> and on May 5<sup>th</sup> in both two seasons 98-1999 and 99 - 2000, respectively.

- The second fruitlets wave drop about (80%) after 75 days from full bloom was on June 10<sup>th</sup> and 18<sup>th</sup> respectively in 1998-99 and 1999- 2000 seasons. The total amount of fruit drop reached to 97.72% in the end of fruit development stage.

2- Results were clear that high endogenous level of gibberellic acid (GA<sub>3</sub>) 1.6 ppm. and low levels 0.21 ppm. of abscisic acid (ABA) in the fixed fruits on the trees, while the opposite was true which GA<sub>3</sub> was significantly low 0.21 ppm. & 0.53 ppm. beside the high concentration 1.4 ppm. & 1.64 ppm. of ABA in drop fruitlets in two waves after 30 and 75 days from full bloom.

3- Also, it was revealed that the increasing ratio of IAA 0.92 ppm. to ethylene 159.77ppm. level in fruitlets Navel orange abscission zone after 30 and 60 days from full bloom, some time before the second wave by few days to two weeks. But the endogenous ethylene concentration was associated the two distinctive wave for fruitlets drop.

Results can be concluded that auxin has double effect, the first one it delays abscission during its first stages, when ethylene does not induce any phytoeromtomological effects; and the second, it enhances abscission at later stages via the induction of ethylene formation.

- 4- Results appeared that the total pectin and carbohydrates percentage had low values in the abscission zone of Navel orange dropped fruitlets than those in the same zone in fixed fruitlets. Hence, peel firmness in fixed fruits was bigger 12 kg./ cm<sup>2</sup> than that in dropped ones 10 kg./ cm<sup>2</sup>. It seems, therefore that the nutrition level in plant may eventually become a limiting factor for increasing of fruit set of Navel orange trees and improved the yield.
- 5- Results in this study showed that a significant decrease in Ca ion content was observed in the abscission zone with dropped fruitlets of Navel orange during the two waves of fruit drop at 30 and 75 days from full bloom. Ca percentage increament proportionally with decreased of fruit drop percentage. This attain Ca ion had a positive effect on decreased in the total fruit drop and improved fruit set and yield.
- 6- These results indicated that high air temperature and solar radiation during double single waves which recorded 29°C and 33°C on 25 April and 10 June respectively were caused for increasing of fruitlets abscission.
- 7- These results revealed that increasing air temperature and solar radiation caused increasing ethylene production. Consequently, increasing fruitlets abscission after 30 and 75 days from full bloom.
- 8- **The anatomical study** showed that lignified cells were found at the separation zone. Moreover, it was that both fibers of xylem and phloem tissues were absent at such zone. This could lead to the conclusion that

the above mentioned changes in the anatomical structure of separation zone can make it very weakened.

**II- Reducing fruit drop of fruitlets Navel orange by plant growth regulators: GA<sub>3</sub>, promalin and 2,4-D and its combinations:**

- 1- Results showed that the GA<sub>3</sub> at 50 ppm was superior treatment in the effect by increasing fruit set significantly about (77%) through two successive seasons. Moreover, the other treatments: promalin at (45 ppm.) and 2,4-D at 20 ppm were increased percentage of fruit set significantly about (76 and 74%) compared with control trees (72%).
- 2- All treatments by regulators substances caused significant decrease in fruitlets drop. In this respect GA<sub>3</sub> at 50 ppm reducing fruit drop by 26% approximately and had a high superior in the first wave of fruitlets drop which occurred after 30 days from full bloom, promalin at (45ppm) reducing fruit drop of fruitlets Navel orange by 18 %. While, 2,4-D at 20 ppm reducing fruit drop by 7% comparing with control. In the same direction, in second peak which occurred in June (June drop) or after 75 days from full bloom GA<sub>3</sub> at 50 ppm reduce fruit drop by 9.75%. While, Promalin at (45 ppm) reduce fruit drop by 7.35% and 2,4-D at 20 ppm reduce fruit drop by 4.65% approximately comparing with the control.
- 3- Concerning the effect of interaction between the three growth regulator substances. These results disclosed that the best combination was 2,4-D at (20 ppm) with GA<sub>3</sub> at (50 ppm.) which recorded the highest significant value 77.34% of fruit set followed by 2,4-D at (20 ppm) with promalin at (45 ppm) gave 74.66% compared with fruit set percentage of control (72.31%).
- 4- Consequently, the combination between 2,4-D at (20 ppm) with GA<sub>3</sub> at 50 ppm had a promotive effect on reducing fruit drop through the

two distinct fruit drop periods. It was superior than 2,4-D with promalin.

- 5- The results revealed that the high concentration of GA<sub>3</sub> at (50 ppm) didn't effective on fruit weight but gave the highest fruit number per tree.

Consequently, the total yield significant increased by 48% comparing with the control.

- 6- Also, promalin at (45 ppm) had a positive effect on yield by gaving the highest number of fruits per tree. But, gave less average of fruit weight (220 gm) comparing with the rest treatments.

- 7- Whatever, promalin increasing significantly in the total yield by 39% approximately compared with control treatment.

Meanwhile, the low concentration of 2,4-D at (10 ppm) caused the highest average weight of fruit (about 250 gm./ fruit) and less left fruits on the tree. 2,4-D treatment caused significant increasing in the total yield by 28% with neglecting the concentration compared with the control in both two seasons.

- 8- These results declared that GA<sub>3</sub> at (50 ppm.) plus 2,4-D at (20 ppm.) was the superior combination than others. This treatment was significantly increase of fruit weight by about 55 gm. which equal to 30% compared to control. While the number of fruit per tree increasing by 20 to 28 fruit per tree. This the application give increasing of total yield reached 41.5% compared with control.

Generally, it could be concluded that increasing of yield is probably due to increase in fruit weight and number of fruit per tree.

- 9- The results illustrated that the best combination was between promalin (45 ppm) with 2,4-D at (20 ppm) which cause significantly increasing on fruit weight by about 71 gm. which equal by 38% compared with



control. Also, this treatment gave significantly increased on total yield about 34.5% compared with control. In general, it could be mentioned that increasing yield is probably due to increase in fruit weight and size of fruit which reached to the highest values in two seasons compared to control.

- 10- These results declared that 2,4-D treatments at 20 & 10 ppm induced the largest increased values of fruit size for Navel orange fruits in two seasons 98-1999 & 1999-2000. While GA<sub>3</sub> at (50 ppm.) and promalin at (45 ppm) produced the lightest fruits of fruit size in comparison with the control in both seasons.
- 11- Data indicated that the 2,4-D treatment with neglecting the concentrations caused the largest significant dimension of Navel orange fruits. Also, the interaction between 2,4-D (20 & 10 ppm) with promalin (45 ppm.) produced the largest increased values for dimension fruits in both two seasons. While, the lowest increased values were on 2,4-D with GA<sub>3</sub> with neglecting concentrations compared with the control in two seasons of study.
- 12- These results showed that GA<sub>3</sub> gave the highest significant level as peel firmness (kg/cm<sup>2</sup>) for Navel orange fruits with neglecting concentrations. While, 2,4-D produced the lowest increased in comparison with control. The interaction between GA<sub>3</sub> at (50 ppm.) with 2,4-D at (10 & 20 ppm) recorded the highest significant values on peel firmness for Navel orange fruits in two seasons.
- 13- Data indicated that GA<sub>3</sub> treatment at 50 ppm caused the highest significant increased in peel thickness of Navel orange fruits followed by 2,4-D treatment in both two seasons.

Regarding the interaction , the highest significant values in peel thickness of Navel orange fruits were on 2,4-D at (20 ppm.) with promalin at (45 ppm) compared with the control.

- 14- These results illustrated that spray promalin at (45ppm.) on Navel orange trees caused the highest significant (49.54%) increase in Juice weight percentage and followed by the control in two seasons. But 2,4-D induced the lowest decrease values (43.91%) on juice weight percentage of Navel orange fruits in two seasons. However, GA<sub>3</sub> had no significant effect on juice weight percentage.

Concerning the effect of combination these results declared that the control recorded the highest significant values (48.64%) on juice weight percentage of Navel orange compared with the other treatments in two seasons.

- 15 - The results showed that GA<sub>3</sub> caused a significantly increased in T.S.S. of Navel orange fruits in comparison with control in the first season. However, 2,4-D at 10 ppm had a slight increase than those in control and other treatments in the second one.

Regarding the interaction on T.S.S.%, the results clearly that GA<sub>3</sub> at 50 ppm with 2,4-D (10 & 20 ppm) induced a significant increase on T.S.S. of Navel orange fruits compared with the control.

- 16- Promalin at (22.5 ppm.) gave the highest significant of total acidity percentage than control and other treatments.
- 17- Considering the interaction, the results indicated that the lowest decreased values on acidity % were with GA<sub>3</sub> with 2,4-D with neglecting concentrations. Also, promalin (22.5 ppm.) with 2,4-D at 10 ppm.

### **III- Effect of Mineral nutrition (Calcium and Potassium) on, Fruit**

**set, Fruit drop, Yield for Navel orange trees as follows:**

- 1- Foliar applications of potassium and calcium sulfate at (2000 ppm) on Navel orange trees were superior significant (76.24% & 76.11%) in their effect on fruit set percentage.
- 2- Spraying applications of calcium sulfate, also potassium sulfate at (2000 ppm) on Navel orange trees were effective significantly, (28.29% & 72.53%), (28.31% & 73.90%) respectively to reduce the fruit drop through the two fruitlets drop waves after 30 and 75 days from full bloom.
- 3- The highest yield was obtained by applying calcium and potassium sulfate at (2000 ppm) by about (49.14 and 33.28%) respectively compared with the control through two successive seasons of 98-1999 and 1999-2000.
- 4- Data revealed that calcium and potassium treatments increased significantly fruit size and rind firmness of peel. While, non-significantly on the percentage of juice. On the other hand, the control induced the highest significant (0.41 cm.) in peel thickness compared with all treatments.
- 5- Juice acid content and total soluble solids were increased significantly by spray calcium and potassium sulphate. While, the ratio of soluble solids to acids was decreased.

#### **General evaluation:**

The general evaluation of growth regulators treatments used in the experiment show the superiority of GA<sub>3</sub> at 50 ppm. Followed by Promalin at 45 ppm. (2.5 cm<sup>3</sup>/L. ) treatments as compared to the other treatments concerning increased fruit set % , yield and fruit quality.

Taking into consideration evaluation of calcium and potassium treatments used in this study showed that the superiority calcium sulfate with neglecting concentrations as compared to potassium sulfate and control treatments concerning increased fruit set, yield and fruit quality.

### **Conclusion**

Results of this study revealed that the abscission occurred in double single waves. The first fruitlets wave drop after 30 days from full bloom ( at 75% petal fall ) and the second one after 75 days from full bloom (June drop). The total amount of fruit drop reached to 97.7% in the end of fruit at 205 days from full bloom.

#### **The recommendation as follows:**

Spraying of Navel orange trees by GA<sub>3</sub> at 50 ppm twice. The first spray at full bloom ( at 75% of fully opened flowers at least ). The second one at reach the diameter of fruitlets from 1.5 up to 2.5 cm. Thus, GA<sub>3</sub> at 50 ppm increasing the fruit set percentage, reduced fruit drop, hence, increasing yield and improving fruit quality. Also spraying of navel orange trees by Promalin at 45 ppm (2.5 cm<sup>3</sup>/L.), followed GA<sub>3</sub> . But GA<sub>3</sub> in the priority because it was gave the least economically cost and gave the highest profit per feddan.

Likewise, spraying of Navel orange trees by calcium sulfate at 2000 ppm twice. The first spray at full bloom ( at 75% of fully opened flowers at least ). The second one at reach the diameter of fruitlets from 1.5 up to 2.5 cm. Thus, Calcium sulfate at 2000 ppm induced increasing of fruit set percentage and yield, also improving fruit quality followed by Calcium sulfate at 1000 ppm.