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# *IV. SUMMARY*

The present work aimed to study four insect pests, (*Aphis gossypii, A. craccivora, Phyllocnistis citrella* and *Planococcus citri*) on four citrus kinds (navel orange, mandarin, Lime and Kumquat). It includes seasonal abundance and population distribution for these insects and biological studies, life table for *A. gossypii* and *A. craccivora*.

## 1. Ecological and population studies:

Population density of different citrus insect pests was determined on four citrus species in three localities in Menoufiya Governorate throughout two successive years, 1999 and 2000. In addition the population distribution at the cardinal directions and the central core of citrus tree was investigated.

## 1.1. Cotton aphid, *Aphis gossypii* Glover :

The population density of *A. gossypii* Fluctuated mostly during spring and summer, sometimes throughout early autumn

The highest population appeared on navel orange followed by mandarin, Lime and kumquat in the three concerned localities i.e. Shebin EL-Kom, Menouf and Talla in descending order.

The total average number in different Localities ranged between (884 and 2346) insects on navel orange, (567 and 2259) insects on mandarin, (253 and 464) insects on lime and (14 and 357) insects on Kumquat during 1999 season, whereas the total average of aphid during the second season of 2000 varied between 1065 and 1503, 664 and 918, 228 and 320, 21 and 225 insects on the four citrus species in the same previous order, respectively, it cleared that the first season was more dense than the second one.

## 1.2 Cowpea aphid, *Aphis craccivora* Koch :

The population fluctuated in both years of 1999 and 2000 occuping throughout March and April for the first period of activity, when the peak of activity took place during May. The second one appeared, mostly during the second year in summer (July and early August) and the maximum numbers was observed mostly during the second half of July indifferent cases. Little numbers during the first season were recorded throughout autumn (November on navel orange and mandarin in both Shebin EL-Kom and Menouf). The total population in the first season indicated that the highest density occurred on mandarin (4097, 3452 and 3012) followed by navel orange (1152, 1000 and 897) and on Lime (953, 821 and 712) and then on Kumquat (185, 167 and 138) in Shebin EL-Kom, Menouf and Talla regions, in descending order, respectively. During 2000 season total population density showed similar trend, except the aphid population on navel orange was in the alternately order before

mandarin. The total population recorded 1306, 848, 275 and 191 in Shebin EL-Kom, 524, 469, 208 and 149 in Menouf and 590, 325, 128 and 92 in Talla region on the leaves of navel orange, mandarin, Lime and Kumquat arranged in descending order, respectively.

## 1.3. Citrus mealy bug, *Planococcus citri* (Risso):

The total number of *P. citri* showed that the population density was more on navel orange Leaves and at Shebin EL-Kom than those of others, Also, the first season had high density rather than the second one. The total population density reached 176, 114, 57 and 52 insects/ 10 leaves at Shebin EL-Kom, 160, 109, 86 and 50 insects/ 10 leaves at Menouf and 134, 110, 66 and 69 insects /10 leaves at Talla during the first years of 1999, whereas the total numbers during 2000 season recorded 130, 106, 57 and 60 insects, 88, 62, 48 and 50 insects and 86, 56, 63 and 51 insects on navel orange, mandarin, Lime and Kumquat at three Localities arranged according to the above mentioned order, respectively.

## 1.4. Citrus Leaf miner, *Phyllocnistis citrella* Stainton:

The total population of *P. citrella* varied greatly on Kumquat Leaves at the three Localities, Shebin EL-Kom, Menouf and Talla. The total counts recorded in the first season amounting to 1093, 857 and 845 insects, while in the second season showed 233, 269 and 340

insects /10 leaves at the three Localities according to the previous order, respectively.

The population density at Shebin EL-Kom occupied the first order in the first season, whereas during the second season recorded the least total number comparing with the other two Localities. The total population was more dense in the first season than that of the second one. The population of CLM in 1999 year on the four citrus species tested at the three Localities indicated that navel orange received the highest population followed by mandarin, lime and then kumquat leaves harbored the least numbers, on the other hand Shebin EL-Kom was alternately Locality, while Menouf and Talla Localities were arranged according to the above mentioned after Shebin EL-Kom.

In 2000 year the level of CLM infestation differed greatly. So that, the highest amount was observed on mandarin trees followed by navel orange and kumquat then he population recorded Low counts on Lime, at Shebin EL-Kom. The other two localities followed the same order according to those of the first season, meaning navel orange, mandarin, Lime and kumquat, respectively. The population fluctuation of CLM showed number of peaks on the tested citrus species at the three localities. The common behavior were generally observed that this leaf miner was more abundant throughout summer and early autumn, while it disappeared completely during the remaining period of the year (most of autumn and spring and whole winter).

## 2. Population distribution of citrus insect pests:

### 2.1. Cotton aphid , *A.gossypii*:

The highest level of insect attack was recorded at the central core of citrus trees than north and west sides in the first season (Tab.9 and Fig.9) . The total population was 753, 583, 130 and 8 insects for central core of orange, mandarin, lime and kumquat, respectively. Population count was 281, 263, 226 and 225 individuals on east, south, west and north sites of orange, 220, 236, 176 and 200 individuals on mandarin , 77, 72, 37 and 70 on lime and only 4, 8, 4 and 3 on kumquat respectively.

In the second season (Tab.10 and Fig.10) the population maximum was observed on central core of tree followed by south, north, west and east sides of trees, population to these sites were 348, 284, 241, 214 and 204 individuals on orange, 296, 213, 155, 149 and 143 on mandarin,100, 80, 66, 60 and 54 on lime and 83, 68, 53, 49 and 45 on kumquat, respectively.

### 2.2. Cowpea aphid , *A.craccivora* :

The highest level of infestation was recorded for central core followed by south, north, west and east. The highest total of insects were 281, 959, 209 and 44 individuals on orange, mandarin, lime and kumquat respectively , 263, 228, 200 and 178 , 581, 780, 680 and 642 , 195, 184, 171 and 157 and 39, 36, 32 and 29 individuals for south, north, west and east sides of trees in the first season (Tab.11 and

Fig.11). The highest level was recorded on central core in the second season (Tab.12 and Fig.12) with 241, 173, 78 and 58 insects on orange, mandarin, lime and kumquat, respectively. The lowest and harbored population were recorded on east sides with 135, 82, 21 and 8 insects for the same hosts.

## 2.3. The citrus mealy bug, *Planococcus citri* :

The highest level observed on central core of citrus tree with 108, 79, 56 and 34 individuals on orange, mandarin, lime and kumquat for the first season (Tab.13 and fig 13), respectively. Also the highest level of insects with respect to the cardinal directions were reported from the south sides of tree and the lowest were mostly from the west ones. The population count were 80, 56, 37 and 32 and 62, 48, 26 and 22 individuals for the hosts on two sides respectively.

The highest population in the second season (Tab.14 and fig 14) was being 68, 52, 44 and 41 on orange, mandarin, lime and kumquat respectively. Population of east and south were higher than those of west and north sides of trees. Population counts ranged from 29-57, 46-24, 22-43 and 19-39 insects on the different hosts for the above mentioned directions, respectively.

## 2.4. The citrus leafminer, *Phyllocnistis citrella* :

The maximum population occurred on the east side. The population counts being 358, 336, 252 and 234 insects on east of

orange, mandarin, lime and kumquat respectively, followed by north side for the first two host and 335, 331, 253 and 229 individuals for the last two ones on west. The least level infestation occurred on south sides being 325, 311, 236 and 216 insects on the above mentioned hosts. The minimum counts recorded from central core of these plants amounting to 277, 255, 198 and 184 insects in 1999 (Tab.15 and Fig.15). During 2000(Tab.16 and Fig.16) different sites of trees could be arranged in order of magnitude to east, west, north, south and central core of tree respectively. The total number of insects for these sites were 160, 136, 110, 87 and 59 on orange , 159, 135, 111, 82 and 55 on mandarin, 109, 94, 76, 56 and 32 on lime and 94, 83, 65, 53 and 31 on kumquat, respectively.

The population density of the four insects on the different citrus kinds as clearly that *A. gossypii*, *A. craccivora* and *P. citri* population preferred the core of citrus trees, while east direction was the least preferred for aphid and the north direction harbored the lowest numbers of mealy bug. CLM population exhibited opposite behavior, since the highest numbers were observed, at all on the leaves of the east direction, while the lowest population was recorded in core of the citrus tree. These results cleared that aphid and mealy bug may be preferred the core of tree to escape from the intensive light and higher temperature to the more suitable area in the core leaves, whereas CLM preferred relatively higher temperature and more intensive light area.

## 3. Biological studies :

To study the biology of two aphid species *(A.gossypii* and *A.craccivora*), three citrus varieties seedlings were potted (navel orange, mandarin and lime).

### 3.1. Effect of the different host plants on the different stages for insect pests :

a- Nymphal stage of *A.gossypii* :

1st instar , it ranged between 1.33 ± 0.49 to 1.43 ± 0.51,1.69 ± 0.50 to 2.47 ± 0.52 and 2.14 ± 0.95 to 2.36 ± 0.75 days on the three citrus varieties (navel orange, mandarin and lime) during three periods of rearing.

2nd instar , the shortest period of 1.33 ± 0.49 days on navel orange during July, while the longest period occurred on lime during the same month (July) with 2.93 ± 0.27 days.

3rd instar , the lowest period of 2.0 ± 0.0 days during May - June and July on both navel orange and mandarin . The highest mean period on lime attained to 3.29 ± 0.47during July.

4th instar , this period ranged between 2.0 ± 0.0 and 2.86 ± 0.54 days during May and July , respectively.

Generation time , on navel orange ranged between 10.17 ± 0.98 to 10.37 ± 0.74 days during July and June respectively, whereas on mandarin differed from 10.63 ± 0.81 to 12.30 ± 1.57 days during May and June. It ranged between 13.29 ± 2.64 to 15.14 ± 0.45 days during June and July on lime, respectively.

Life span , the minimum period 23.40 ± 1.06 and 24.38 ± 1.20 days occurred on navel orange and mandarin, the shortest duration was observed on lime during June reached 24.93 ± 2.37 days. The maximum mean period of 28.33 ± 1.45 days was recorded during June on mandarin, while on lime showed 25.71 ± 1.94 days during May. The maximum period appeared on orange during June lasting 23.87 ± 1.55 days.

Adult longevity :

Preparturition period , the short period of mature aphid females recorded the lowest duration of 2.06 ± 0.25 days on mandarin during July , while the longest duration among the short duration attained 2.93 ± 0.48 days during July , whereas the longest period was observed on mandarin during June.

Parturition period, it ranged between 12.13 ± 0.74 and 12.47 ± 1.46 days on navel orange. The shortest period observed on lime varying between 9.36 ± 1.28 and 10.36 ± 1.01 days. On mandarin it ranged between 12.00 ± 1.27 to 14.73 ± 1.71 days.

Postparturition period , it ranged between 1.43 ± 0.76 to 1.88 ± 0.50 days on tested citrus varieties except on lime reached 2.14 ± 0.77 days.

Whole period, on orange ranged between 15.80±0.86 to16.33 ± 1.50 days , on mandarin it ranged between 15.94 ± 1.00 to 18.67±0.63 days during July and June and on lime differed between 13.71 ± 1.27 to 14.93 ± 0.92 days during July and May. The longest period on

mandarin 18.67 ± 0.63 during June while the lowest period on lime during July 13.71 ± 1.27 days.

b-Nymphal stage of *A.craccivora* :

1st instar , it ranged between 1.79 ± 0.47 and 2.27 ± 0.83 days on orange , while on mandarin varying from 1.97 ± 0.64 to 2.70 ± 0.78 days and on lime showed the longest period varied between 2.50 ± 0.73 to 2.94 ± 0.50 days during the three generations.

2nd instar , on orange lived about two days or more slightly reaching to 2.12 ± 0.33 days , also the seam trend on mandarin when the duration ranged between 2.50 ± 0.52 and 2.60 ± 0.51 days, on lime the duration ranged between 3.19 ± 0.40 and 3.93 ± 0.48 days.

3rd instar , the longest period reached 2.29 ± 0.47 , 2.56 ± 0.51 and 3.71 ± 0.47 days on orange, mandarin and lime, respectively, whereas the shortest duration appeared on the same varieties reaching 2.12 ± 0.33 , 2.27 ± 0.46 and 3.06 ± 0.25 days, respectively.

4th instar , it showed the same trend when the duration ranged between 2.0 ± 0.0 , 2.29 ± 0.47 on orange , 2.53 ± 0.52 , 2.67 ± 0.62 on mandarin and on lime the longest duration ranging between 3.0 ± 0.0 and 3.64 ± 0.63 days .

Generation time , the highest duration of 10.68 ± 1.51 and 12.97 ± 2.48 days recorded on orange and mandarin , respectively, whereas the lowest period was observed on the same varieties attained 10.50 ± 0.87 and 11.90 ± 1.45 days, respectively. The longest value observed

on lime reaching the maximum of 18.07 ± 1.34 days, while the minimum decreased to 15.75 ± 1.00 days.

Life span , it ranged between 22.71 ± 0.92 and 23.36 ± 1.39 days on orange followed by mandarin varying between 22.73 ± 2.19 and 24.93 ± 1.49 and reached the longest period of 28.50 ± 0.86 on lime , while the shortest period 26.31 ± 1.40 days.

Adult longevity :

Preparturition period , its varied between 2.12 ± 0.33 and 2.21 ± 0.43 days on orange , ranged between 2.40 ± 0.51 and 2.67 ± 0.49 days on mandarin . The longest period of 3.13 ± 0.34 days observed on lime , whereas the lowest period of 2.86 ± 0.36 days .

Parturition period , on orange ranged between 10.59 ± 0.94 and 10.79 ± 0.48 days. The shortest period observed on lime varying between 8.56 ± 0.81 and 9.63 ± 1.20 days .On mandarin differed between the preceding periods 8.47 ± o.83 , 10.87 ± 0.35 days.

Postparturition period , short period appeared on lime showing mean period of 1.50 ± 0,52 days in both October and November, while in September it reached 1.57 ± 0.51 days .On mandarin recorded the highest value ranging between 1.80 ± 0.41 and 2.40 ± 0.51 days .The longest period on orange was 2.36 ± 0.50 days whereas the lowest occurred with 2.18 ± 0.53 days during September and November, respectively.

Whole period , the lowest value of duration occurred with mean period of 12.93 ± 0.88 days during November on mandarin , whereas

the longest period was observed on orange reaching 15.21 ± 1.25 days during September.

The results mentioned that the mean durations in different cases attained the lowest value among the aphid insects reared on navel orange seedlings followed by mandarin and then lime for *A. gossypii*. But for *A. craccivora* the generation and life span recorded the longest periods on lime seedlings followed with mandarin and than navel oranges while the results revealed the opposite for adult longevity.

Both aphid species behave similar trend in general with slight deals differences.

## 3.2. Life table parameters:

That showing the generation time (GT), net reproductive rate (Ro), intrinsic rate (rm) and finite rate of increase (rm/ time). These items give a good idea about the expected population of two studied aphid species (*A. gossypii* and *A. craccivora*).

Orange seedling was considered the most suitable host plant to give good biology of both *A. gossypii* and *A. craccivora*, followed by mandarin and lime seedlings. The generation doubling time was estimated ($In_2$/ rm), so that the shortest values were observed on orange seedlings .