J. Plant Prot. and Path., Mansoura Univ., Vol. ٤ (٤): ٣٨٥ - ٣٩٦, ٢٠١٣

HOST PREFERENCE AND CHEMICAL CONTROL OF CITRUS MEALYBUG, *Planococcus citri* RISSO (HOMOPTERA, PSEUDOCOCCIDAE) ON CITRUS TREES

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ABSTRACT

The present study were carried out during seasons ٢٠٠٩/١٠ and ٢٠١٠/١١ in Qalubia Governorate. The citrus mealybug *Planococcus citri* (Risso) nymphs had four peaks of abundance during the first season in ١٤th June ٢٠٠٩, ٩th August ٢٠٠٩, ١٣rd December ٢٠٠٩ and ٢١st February ٢٠١٠. Moreover, the insect adults had also four peaks of abundance in ١٧th May ٢٠٠٩, ٢٨th June ٢٠٠٩, ٩th August ٢٠٠٩ and ٢١st February ٢٠١٠. While in the second season insect nymphs had five peaks of abundance in ١٨th April ٢٠١٠, ٢٥th July ٢٠١٠, ٣rd October ٢٠١٠, ٢٨th November ٢٠١٠ and ٢٠th March ٢٠١١. While the insect adults had also five peaks of abundance in ٢nd May ٢٠١٠, ٣rd October ٢٠١٠, ١٤th November ٢٠١٠, ٢٦th December ٢٠١٠ and ٣rd April ٢٠١١.

Six citrus species were screened during two seasons for susceptibility to citrus mealybug *P. citri* in Qalubia orchard. In the first season ٢٠٠٩/١٠ Clemantine mandarine and Balady mandarine were the least infested species by the insect with the mean numbers of ٢٠,٩±٣ & ٢١,٤±٢,١ nymphs and ١٢,٨±١,٩ & ٩±٠,٨ adults, respectively. While, Sour orange and Lemon were the heaviest attacked by the insect with the mean numbers of ١٥٢,٣±١٧,٥ & ١٥٠,٣±٨,٨ nymphs and ٨٤,٣±١٠ & ٧٦±٤,٧ adults, respectively. Navel orange and Persian agami were moderately infested by *P. citri* with the mean numbers of ٥٨,١±٦,٧ & ٣٨,٧±٥,٨ nymphs and ٣٣±٤ & ٢٣,٧±٣,٨ adults, respectively. In the second season Lemon and Sour orange were the heaviest infested by the insect with the mean numbers of ١٧٢,٢±٢١,١ & ١١٩±٨,٣ nymphs and ١٠٤,١±١٣,٨ & ٦٧,٧±٥,٤ adults, respectively. While, Persian agami and Navel orange were moderately susceptible to infestation where the recorded mean numbers were ٣٢,٨±٢,١ & ٥٢,٥±٦ nymphs and ١٨,٥±١,٦ & ٢٧,٩±٢,٥ adults, respectively. Clemantine mandarine and Balady mandarine were the lowest susceptible to infestation with the mean numbers of ٢٣,٢±٤,٩ & ٣٢,٣±٦ nymphs and ١١,٤±٢,٢ & ١٨,٤±٣,٤ adults, respectively.

Volatile oils were analyzed in tested citrus species so that different levels of susceptibility in citrus species to *P. citri* infestation may be correlated to different kinds and percentage of components of volatile oils. Sour orange which was the heaviest infested was characterized by the highest rates of Champhor and Linalool, and Lemon which came the next after Sour orange showed highest rate of Carvon and d-limonene.

The efficacies of four insecticides (Confidor ٢٠٪ SL., Vertimec ١,٨٪ EC, Castor oil ٣٠٪ and Mesrona oil ٨٥٪ EC) against *P. citri* on ٣٥ – years – old trees of Navel orange were evaluated. Mortalities were recorded after ٣, ٧, ١٤, ٢١ and ٣٠ days of treatment. Confidor was the most effective compound followed by Vertimec, while Mesrona oil and Castor oil gave reductions in population rate after ٣٠ days from application to ٨٢,٢ and ٦٨,٦٪ respectively. Three weeks later, the activity of both Confidor and Vertimec had decreased rapidly, however mineral oil had longer residual effect and less harmful to natural enemies.

INTRODUCTION

Citrus is a major export product of Egypt, as the country ranks ninth in the international trade, exports of orange in ٢٠٠٩/٢٠١٠ amounted ٨٠٠،٠٠٠ tons, which is equivalent to about ٤٤٠ million dollars (Guven and Sherif, ٢٠١٠). The citrus mealybug *Planococcus citri* is globally distributed (Smith *et al*., ١٩٩٧; Blumberg & Van Driesche, ٢٠٠١; Mustu *et al*., ٢٠٠٨), highly polyphagous and generally the most destructive species of its family (Cadee and Van Alphen, ١٩٩٧; Blumberg & Van Driesche, ٢٠٠١). The nymphs and females cause damage to host plants with their piercing-sucking mouthparts, which they use to suck sap and remove nutrients. As a result, the plants often become stunted, distorted, or yellowed and show reduced vigor. They excrete honeydew, which provides a medium for the growth of black sooty mold fungi (Al-Ali, ١٩٩٦; Smith *et al*., ١٩٩٧; Heinz *et al*., ٢٠٠٤). Black sooty mold fungi are detrimental to plants because they cover leaves, thus reducing photosynthesis and inducing plant stress (Malais and Ravensberg, ١٩٩٢). The citrus mealybug is also known as a vector of some important plant viruses (Al-Ali, ١٩٩٦; Bartelett, ١٩٧٨; Rosciglione and Castellano, ١٩٨٥; Lockhart and Olszewski, ١٩٩٣; Su, ١٩٩٨, ٢٠٠٠; Kubiriba *et al*., ٢٠٠١; Watson and Kubiriba, ٢٠٠٥). Detection and control of citrus mealybug is difficult, as for other mealybugs, due to its particular cryptic behavior and to its wax cover that protects these insects from pesticide applications (Walton and Pringle ٢٠٠٤, Daane *et al*. ٢٠٠٦). Extensive uses of chemical toxicants for pest control caused many problems, such as acute and chronic human and animal toxicity, development of insect resistance to chemicals and environmental pollution. So, alternative effective and environmental safe insecticides such as mineral oils are urgently needed (Abdel Salam, ١٩٩٣ and Anonymous, ١٩٩٧). The object of the present work is to determine the host preferences of *P. citri* on six citrus species and its chemical control in a citrus orchard in Qalubia governorate.

MATERIALS AND METHODS

١. Host preference of *P. citri* to different citrus species:

The present work was carried out during the two successive seasons ٢٠٠٩/٢٠١٠ and ٢٠١٠/٢٠١١ on various citrus species in the citrus orchard in the farm of the Faculty of Agriculture, Benha University. The citrus species and varieties used were; Sour orange *Citrus aurantium* (L), Washington navel orange *Citrus sinensis* (L) var Egyptian, Persian agami lime *Citrus aurantifolia* Swingle, Lemon *Citrus Limon* Burman, Balady mandarin *Citrus reticulata* Blanco and Clemantine mandarin *Citrus reticulata* Blanco. Six trees of each species were chosen in this work and kept free from any pesticides treatment for ٥ years before and during this work. Biweekly samples of twenty leaves from each tree were picked from terminal branches and central core, at random, from different species of citrus trees. Samples were placed in plastic bags which were labeled and transported to the laboratory to be

microscopically examined and both nymphs and adult females were counted and recorded.

٢. Chemical analysis of volatile oils:

Leaf samples of six different species of citrus trees were collected from spring flushes developed shoots. Contaminating materials were removed from the leaves and each sample weighed approximately ٢٠٠g. (fresh weight) of leaves. Essential oils were extracted from the fresh leaves by steam distillation method using special apparatus with general features as devised by Clevenger and Guenther (١٩٨٤). The essential oils distilled from the leaves were analyzed by gas liquid chromatography to identify the volatile constituents of the extracted oil for each species of citrus trees (Sun *et al.,* ١٩٨٤). The applied conditions were the following:

Apparatus: varian modle ٣٧٠٠ Gas chromatography.
Column: Material glass chormy WHP ٨٠, ١٠٠.
Injection temperature: ٢٢٠ ^{o}c.
Detector temperature: ٢٤٠ ^{o}c.
Program: Initial temperature ٧٠ ^{o}c, min ٢,٠, prog/ rate ٧٠, final temperature ١٩٠ ^{o}c.

٣. Chemical control:

This experiment was performed using thirty navel orange trees (*Citrus sinensis* L.) ٣٥ years old grafted on sour orange root-stock, and were at ٥x٥ meter distance. The experiment comprised of five treatments (T١, T٢, T٣, T٤ and T٥) allocated in a randomized block design and each treatment consisted of six replicates (each included ٥-infested branches/tree).

The applied treatments were as follows:

T١- Confidor (imidacloprid) ٢٠٪ SL. A neonicotonid insecticide which applied at rate of ٥٠ml/tree.

T٢- Vertimec ١,٨٪ EC, a natural commercial acaricide product, contains the effective material Abamectin, which is produced in nature by certain organisms that live in soil. It was applied at a rate of ٥٠ml/tree.

T٣- Castor oil (٣٠٪) a natural oil extracted from castor seeds. It was applied at a rate of ٣٠ml/tree, which was dissolved in ٤ liters of the organic solvent triethylamine / feddan.

T٤- Mesrona ٨٥٪ EC, a local commercial oil. It was applied at a rate of ٥٠٠ ml/tree.

T٥- were untreated (control).

During the period of the experiment, random samples of ٢٠ infested leaves per tree (١٢٠ / treatment) were picked up, one day pretreatment and at the following intervals: ٣, ٧, ٢١ and ٣٠ days post treatment. The evaluation of insecticides was based on the reduction in the population density of live individuals of the citrus mealybug, in relation to the pretreatment count.

RESULTS AND DISCUSSION

١- Population fluctuation of *Planococcus citri* on citrus orchard:

Data arranged in fig. (١) showed that the nymphs of citrus mealybug *P. citri* during the first season ٢٠٠٩/١٠ has four peaks of abundance in ١٤th June

٢٠٠٩, ٩th August ٢٠٠٩, ١٣th December ٢٠٠٩ and ٢١st February ٢٠١٠ these peaks were represented by ٩٤, ٨٩,٨, ٥٨,٥ and ٨١,٤ nymphs/١٢٠ leaves, respectively. while the adults of citrus mealybug had also four peaks of abundance recorded in ١٧th May ٢٠٠٩, ٢٨th June ٢٠٠٩, ٩th August ٢٠٠٩ and ٢١st February ٢٠١٠ were represented by ٤٤,٥, ٥٧,٤, ٤٧,٧ and ٤٤,٣ adults/١٢٠ leaves, respectively. The highest number of nymphs was recorded throughout the period from ١٩th April ٢٠٠٩ till ١٤th June ٢٠٠٩, while the lowest number of nymphs was recorded during ١st November ٢٠٠٩ to ٢٩th November ٢٠٠٩. Data also showed that the highest number of adults was recorded throughout the period from ١٤th June ٢٠٠٩ till ١٢th July ٢٠٠٩, while the lowest number of adults was recorded during ١st November ٢٠٠٩ to ٢٧th December ٢٠٠٩.

Data in fig. (٢) showed that the nymphs of citrus mealybug during the second season has five peaks of abundance in ١٨th April ٢٠١٠, ٢٥th July ٢٠١٠, ٣rd October ٢٠١٠, ٢٨th November ٢٠١٠ and ٢٠th March ٢٠١١ these peaks were represented by ٨٩,٤, ٦٥,١, ٦١,٣, ٦١,٨ and ١١٩ nymphs/١٢٠ leaves, respectively. while the adults had also five peaks of abundance in ٢nd May ٢٠١٠, ٣rd October ٢٠١٠, ١٤th November ٢٠١٠, ٢٦th December ٢٠١٠ and ٣rd April ٢٠١١ these peaks were represented by ٥١,٦, ٣٦,٥, ٣٢,٥, ٣٤,٥ and ٧١,٨ adults/١٢٠ leaves, respectively. The highest number of nymphs was recorded throughout the period from ٦th February ٢٠١١ till ٢٠th March ٢٠١١, while the lowest number of nymphs was recorded during ٨th August ٢٠١٠ to ٣١st October ٢٠١٠. Data also showed that the highest number of adults was recorded throughout the period from ٢٠th March ٢٠١١ till ٣rd April ٢٠١١ on all investigated citrus species, while the lowest number of adults was recorded during ٢٢nd August ٢٠١٠ to ٣١st October ٢٠١٠.

٢- Influence of different citrus species:

In the first season (٢٠٠٩/١٠), data illustrated in table (١) showed that Sour orange and Lemon were the heaviest infested by citrus mealybug nymphs with the mean numbers of ١٥٢,٣±١٧,٥ & ١٥٠,٣±٨,٨ nymphs, respectively. While, Persian agami and Navel orange were moderately susceptible to infestation where the recorded mean numbers were ٣٨,٧±٥,٨ & ٥٨,١±٦,٧ nymphs, respectively. However on contrary, Balady mandarine and Clemantine mandarine were the lowest susceptible to infestation with the mean numbers of ٢١,٤±٢,١ & ٢٠,٩±٣ nymphs, respectively. Statistical analysis showed a significantly differences between the different citrus species for the insect nymphs.

Data arranged in table (٢) showed that Sour orange and Lemon were the heaviest infested by citrus mealybug adults with the mean numbers of ٨٤,٣±١٠ & ٧٦±٤,٧ adults, respectively. While, Persian agami and Navel orange were moderately susceptible to adults infestation where the recorded mean numbers were ٢٣,٧±٣,٨ & ٣٣±٤ adults, respectively. Clemantine mandarine and Balady mandarine were the lowest susceptible to adults infestation with the mean numbers of ١٢,٨±١,٩ & ٩±٠,٨ adults, respectively. Statistical analysis showed a significantly differences between the different citrus species for the insect adults.

While in the second season (٢٠١٠/١١) data arranged in table (٣) showed that Lemon and Sour orange were the heaviest infested by citrus mealybug nymphs with the mean numbers of ١٧٢,٢±٢١,١ & ١١٩±٨,٣ nymphs, respectively. While, Navel orange and Persian agami were moderately susceptible to nymphs infestation where the recorded mean numbers were ٥٢,٥±٦ & ٣٢,٨±٢,١ nymphs, respectively. However, Balady mandarine and Clemantine mandarine were the lowest susceptible to nymphs infestation with the mean numbers of ٣٢,٣±٦ & ٢٣,٢±٤,٩ nymphs, respectively. Statistical analysis showed a significantly differences between the different citrus species for the insect nymphs.

The obtained data in table (٤) showed that Lemon and Sour orange were the heaviest infested by insect adults with mean numbers of ١٠٤,١±١٣,٨ & ٦٧,٧±٥,٤ adults, respectively. While, Navel orange and Persian agami were moderately susceptible to adults infestation where the recorded mean numbers were ٢٧,٩±٢,٥ & ١٨,٥±١,٦ adults, respectively. Balady mandarine and Clemantine mandarine were the lowest susceptible to adults infestation with the mean numbers of ١٨,٤±٣,٤ & ١١,٤±٢,٢ adults, respectively. Statistical analysis showed a significantly differences between the different citrus species for the insect adults. El-Keiy (١٩٦٤)also found that lemon balady was the most immune to infestation by *C. ficus*, while navel orange, sweet orange and orange balady were highly susceptibile.

Fig. (١): Population fluctuation of the citrus mealybug nymphs and adults in citrus orchard during ٢٠٠٩/١٠ season in Qalubia Governorate.

Fig. (٢): Population fluctuation of the citrus mealybug nymphs and adults in citrus orchard during ٢٠١٠/١١ season in Qalubia Governorate.

Table (١): The monthly average number of the citrus mealybug nymphs at different citrus species during ٢٠٠٩/١٠ season in Qalubia governorate.

Months	Sour orange	Navel orange	Persian agami	Lemon	Balady mandarine	Clemantine mandarine
April ٢٠٠٩	٢٢١,١	٦٠,٢	٢٠,٨	١٠٨,٩	٢٠,٦	٢١,٣
May	٢١٥,٥	٩١,٨	١٨	١٩٥	١٥,٧	٩
June	٢٢١,٧	٩٩,٦	٢٠,٥	١٦٩,٧	١١,٦	١٦,٧
July	١٩٦,٥	٩٢,٧	٢١,٤	١٧٧,٥	١٦,٩	٥,٤
August	١٩٦,٩	٨٠,٣	٢٨,٢	١٦٦,٦	٢٠,٧	١٤,٩
September	٢٢٣,٤	٥٢,٤	٣١,٤	١١٩,١	٢٦,٣	٢١,٦
October	١٨٩,٥	٣٣,٤	٣٤,٢	٩٨,١	٢٥,٢	١٩,٨
November	٥٧,٧	٣٨,٣	٣٥,٧	١١٩,٢	١١,٧	١٢
December	٩١,١	٢٦,٢	٣٢,٦	١٥٦,٧	٩,٧	١١,٤
January ٢٠١٠	٧٩,٢	٣٦	٨٩,٣	١١٨,٦	٢٩,٢	٢٤,٧
February	٩٢,٥	٥٤	٧٤,٦	١٦٤,٢	٣٠,٩	٣٤
March	٩٩,٩	٤٩,٣	٤٧,٨	١٨٩,٦	٣١,٩	٤١,٤
April	٩٥,١	٤١,٤	٤٨,٣	١٧١,٣	٢٨	٣٩,٣
Total	١٩٨٠,١	٧٥٥,٦	٥٠٢,٨	١٩٥٤,٥	٢٧٨,٤	٢٧١,٥
Mean ± SE	١٥٢,٣[a] ±١٧.٥	٥٨,١[b] ±٦,٧	٣٨,٧[bc] ±٥,٨	١٥٠,٣[a] ±٨,٨	٢١,٤[c] ±٢,١	٢٠,٩[c] ±٣,٠

Means followed by the same letters are not significantly differences at ٠,٠٥ level of probability.

Table (٢): The monthly average number of the citrus mealybug adults at different citrus species during ٢٠٠٩/١٠ season in Qalubia governorate.

Months	Sour orange	Navel orange	Persian agami	Lemon	Balady mandarine	Clemantine mandarine
April ٢٠٠٩	١١١,٤	٣١,٤	٩,٧	٥٦,٥	١٠,٤	١٢,٢
May	٩٥,٥	٤٩,٣	١١	٨٥,٤	٦,١	٤,٦
June	١٧٥,٩	٦٢,٧	١١,٨	٧٢,٩	٤,٦	٨,٧
July	٩٣,٨	٥٥,٣	١٤,٣	٧١,٩	٨,٧	٣,٧
August	١٠٦,٥	٤٥,٥	١٥,٣	٧٨,٩	١٠	٨,٦
September	١٠١,٢	٣٠,٤	١٨,٥	٥٠,٩	١١,٣	١٢,٨
October	٩٤,٩	٢٠,٣	٢١,٢	٤٥,٥	١٢	١٢,٥
November	٣٥,٧	٢٢	٢٧,٤	٦٨,٤	٥,٤	٩,٦
December	٥٤,٩	١٨,٨	٢٢	٧٨,٢	٥,٧	٩,١
January ٢٠١٠	٧٣,٣	٢٢,٣	٦١,٤	٨٣,٥	٧,٢	١٣,٤
February	٥٧,٣	٢٤,٦	٤١,٢	٩٩,٩	١٠,٥	٢١,٢
March	٥٣,٧	٢٨,٤	٢٨,٢	١٠٣,٧	١٣,٣	٢٨,٣
April	٤١,٤	١٨,٣	٢٦,٤	٩٣,٤	١٢,٤	٢٢,٣
Total	١٠٩٥,٥	٤٢٩,٣	٣٠٨,٤	٩٨٩,١	١١٧,٦	١٦٧
Mean	٨٤,٣[a]	٣٣[b]	٢٣,٧[bc]	٧٦[a]	٩[c]	١٢,٨[c]
± SE	±١٠,٠	±٤,٠	±٣,٨	±٤,٧	±٠,٨	±١,٩

Means followed by the same letters are not significantly differences at ٠,٠٥ level of probability.

Table (٣): The monthly average number of the citrus mealybug nymphs at different citrus species during ٢٠١٠/١١ season in Qalubia governorate.

Months	Sour orange	Navel orange	Persian agami	Lemon	Balady mandarine	Clemantine mandarine
April ٢٠١٠	١٠٩,٨	٤٨,٥	٢٩,٨	٢٦١,٣	٤٥,٦	٤١,٢
May	١١٩,٢	٥٦,٧	٣٢,٧	٢٠٤,٦	٢٣,٣	١٣,٤
June	١٢٤	٢٨,٩	٣٠,٩	١٥٠,٢	١٨	١٥,٩
July	١١٣,٥	٢٧,٧	٢٥,٢	١١٦,٢	٦٥,٧	٢٥,٢
August	٨٧,٤	٢٩,٩	٢٩	٨٨,٣	٧١	٧,٧
September	٨٣	٣٤,٧	٤٢,٩	٩١,١	٦٣,٤	٩,٥
October	٧١,٦	٣٨,٧	٣٥,٧	٩٢	٤١,٢	٤٢,٤
November	١١٠	٣٤,٩	٣١,٩	١٥١,٩	٢٣,٢	١٣,٨
December	١١٧,٢	٥٥,٨	٢٨,١	١٢٥	١٠,٧	٧,٤
January ٢٠١١	١٢٤,٤	٧٥,٩	٤٤	١١٤,٧	٩,٥	٧,٥
February	١٣٩	٨٤	١٦,٢	٢٤٤,٥	٧,٢	٨
March	١٨٧,٥	٩١,٣	٣٧	٢٨٦,١	١٥,١	٥٩,٨
April	١٦١,٣	٧٥,٧	٤٢,٩	٣١٢,٣	٢٥,٨	٤٩,٢
Total	١٥٤٧,٩	٦٨٢,٧	٤٢٦,٣	٢٢٣٨,٢	٤١٩,٧	٣٠١
Mean	١١٩[b]	٥٢,٥[c]	٣٢,٨[c]	١٧٢,٢[a]	٣٢,٣[c]	٢٣,٢[c]
± SE	±٨,٣	±٦,٠	±٢,١	±٢١,١	±٦,٠	±٤,٩

Means followed by the same letters are not significantly differences at ٠,٠٥ level of probability.

Table (٤): The monthly average number of the citrus mealybug adults at different citrus species during ٢٠١٠/١١ season in Qalubia governorate.

Months	Sour orange	Navel orange	Persian agami	Lemon	Balady mandarine	Clemantine mandarine
April ٢٠١٠	٦٤,٧	٢٨,٦	١٢,٣	١٤٣,٢	٢١,٣	٢٣,٦
May	٨٥,٢	٣٢,٢	١٥,٦	١٣٠,٢	١٦,٢	٧,٥
June	٧٠,٦	١٨,١	١٩,٢	١٠٢,٩	١٢,٥	٧,٥
July	٦٦,٩	١٦,٤	١٣,٦	٧٢,٦	٣٦,٣	١٤,٢
August	٥٥,٩	١٧	١٥,٢	٤٧,٦	٤٢	٣,٤
September	٤٩,٨	٢٠,٩	٢٢,٩	٥٠,٧	٣٥	٥,٢
October	٤١,٥	٢١,٩	٢٥,٨	٤٨,٤	٢٧,٤	٢٣,١
November	٥٠	٢١,٢	٢٠,٦	٨٠	٩,٧	٦,٤
December	٥٩	٣٣,١	١٤,٢	٨٢,٢	٦,٤	٣,٨
January ٢٠١١	٥٦	٢٧,٥	٢٢,٥	٦٧,٦	٧	٤,٧
February	٧٣,٤	٤٣,٣	٨,٢	١٥٧	٥,٧	٤,٢
March	٩٠,٧	٤١,٧	٢٠,٣	١٥٩	٨,٧	٢٤,٨
April	١١٦,٩	٤٠,٢	٣٠,٢	٢١٢,٣	١١,٦	١٩,٨
Total	٨٨٠,٦	٣٦٢,١	٢٤٠,٦	١٣٥٣,٧	٢٣٩,٨	١٤٨,٢
Mean ± SE	٦٧,٧^{b} ±٥,٤	٢٧,٩^{c} ±٢,٥	١٨,٥^{c} ±١,٦	١٠٤,١^{a} ±١٣,٨	١٨,٤^{c} ±٣,٤	١١,٤^{c} ±٢,٢

Means followed by the same letters are not significantly differences at ٠,٠٥ level of probability.

٣- The relationship between the susceptibility of citrus species to citrus mealybug *P. citri* and their leaves contents of volatile oils:

The essential oils were extracted from fresh young leaves and analyzed by gas chromatography to identify the volatile oil constituents of the extracted oil from each species. Table (٥) shows that leaf volatile oil contents among investigated citrus species were as follows:

١- Champhor and Linalool, represented the major components of the volatile oils in sour orange trees (*Citrus sinensis* L.).
٢- β-pinene and Linalool, represented as the major components of the volatile oils in navel orange leaves but Geraneol and Eugenol were found in lower percentages.
٣- Leaves of Persian agami showed that Limonene was the most stable compound with a relative level, while Carvon and Myrcene shared two opposite trends.
٤- Lemonene and Carvon, represented as the major components in the volatile oil of lemon leaves.
٥- Eugenol is contained in a higher value in the volatile oil of Balady mandarine leaves.
٦- Clementine mandarine leaves had higher values of β-pinene and Linalool in the volatile oil.

The variation between different species of citrus in their susceptibility to citrus mealybug *P. citri* infestation, may be due to the variations in leaf volatile oil values and the components of volatile oil. Sour orange which was the heaviest infested was characterized by the highest rates of Champhor and Linalool, and Lemon which came the next after Sour orange showed highest rate of Carvon and d-limonene. El-Keiy (١٩٦٤) found a negative correlation

between the number of oil glands of different varieties of citrus and the degree of infestation by the black scale insect.

Table (٥): Qualitative analysis of leaf volatile oils contents among citrus species.

	Sour orange	Navel orange	Persian agami	Lemon	Balady mandarine	Clemantine mandarine
Champhor	***					
Linalool	***	***				**
Myrcene	*		*			
Limonene	*		***			
B-pinene		***				***
Eugenol		*			***	
Carvon			*	***		
d-limonene				***		
Geraneal		*				

***** high percentage** **** medium percentage** *** low percentage**

٤- Chemical control:

Field trial for testing the effect of four insecticides for controlling citrus mealybug *P. citri* in Navel orange trees (*Citrus sinensis* L.) has been carried out. Data in table (٦) and fig. (٣), indicated that Confidor gave a highest effect were the rates of insect population reduction after ٧, ١٤, ٢١ and ٣٠ days from application were ٨٩,٧, ٨٨,٧, ٨٢,٧ and ٧٨,١٪ respectively, followed by Vertimec gave decrease of insect population after ٧, ١٤, ٢١ and ٣٠ days from application to ٨٥, ٨٩,٨, ٧٩,٢ and ٧٠,٥٪ respectively. While mineral oil gave the lower mortality percentage than the two chemical insecticides, it decreased the rate of population after ٧, ١٤, ٢١ and ٣٠ days from application to ٥٦,٧, ٦٩,٧, ٧٨ and ٨٢,٢٪ respectively. However, mineral oil exhibited more efficacy than castor oil whjch gave reduction of population rate after ٧, ١٤, ٢١ and ٣٠ days from application to ٣٥,٧, ٥٥,٥, ٦٥,٤ and ٦٨,٦٪ respectively.

Both Confidor and Vertimec have proved effective against citrus mealybug *P. citri* but not for long time because the insect started to build up its population after three weeks from application, while mineral oil caused reduction in the population gradually from the ٣rd day after application to reach ٨٢,٢٪ after one month from application, the trunk application with mineral oil has given a prolonged control effect for at least one month, so it could be recommended to use the mineral oil for controlling citrus mealybug because of its long time effect, it is also less harmful to natural enemies and has lower price.

Fig. (٣): Influence of the different insecticides on the average numbers of citrus mealybug *P. citri* after treatments.

Table (٦): Effect of the tested insecticides on the population reduction.

Treatments	Percent of reduction after application (days)					General mean of reduction (%)
	٣	٧	١٤	٢١	٣٠	
Confidor	٤٤,٩	٨٩,٧	٨٨,٧	٨٢,٧	٧٨,١	٧٦,٨٢
Vertimec	٥٣,٥	٨٥	٨٩,٨	٧٩,٢	٧٠,٥	٧٥,٦
Castor oil	١٥,٩	٣٥,٧	٥٥,٥	٦٥,٤	٦٨,٦	٤٨,٢٢
Mesrona oil	٢٩	٥٦,٧	٦٩,٧	٧٨	٨٢,٢	٦٣,١٢

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التفضيل العوائلي والمكافحة الكيماوية لحشرة بق الموالح الدقيقي علي أشجار الموالح

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أجريت هذه الدراسة خلال موسمي ٢٠٠٩\١٠ و ٢٠١٠\١١ في محافظة القليوبية. حوريات بق الموالح الدقيقي كان لها أربعة ذروات في التعداد خلال الموسم الأول في ١٤ يونيو و٩ أغسطس و١٣ ديسمبر و٢١ فبراير ٢٠١٠. بينما الحشرات الكاملة كان لها أيضا أربعة ذروات في ١٧ مايو ٢٠٠٩ و٢٨ يونيو و٩ أغسطس و٢١ فبراير. أما في الموسم الثاني فكانت حوريات الحشرة لها خمسة ذروات في التعداد خلال ١٨ أبريل ٢٠١٠ و٢٥ يوليو و٣ أكتوبر و٢٨ نوفمبر و٢٠ مارس ٢٠١١ بينما الحشرة الكاملة كان لها أيضا خمسة ذروات تعداد في ٢ مايو ٢٠١٠ و٣ أكتوبر و١٤ نوفمبر و٢٦ ديسمبر و٣ ابريل ٢٠١١.

تم اختبار حساسية ستة أصناف من الموالح للاصابة بحشرة بق الموالح الدقيقي. في الموسم الأول ٢٠٠٩\١٠ كان كل من اليوسفي كلمنتين واليوسفي البلدي من أقل الأصناف اصابة بالحشرة وذلك بمتوسط تعداد ٢٠,٩±٣ & ٢١,٤±٢,١ للحوريات و١٢,٨±١,٩ & ٩±٠,٨ للحشرات الكاملة علي التوالي. بينما النارنج والليمون الأضاليا كانا أشد الأصناف اصابة بالحشرة بمتوسط تعداد ١٥٢,٣±١٧,٥ & ١٥٠,٣±٨,٨ للحوريات و٨٤,٣±١٠ & ٧٦±٤,٧ للحشرات الكاملة علي التوالي. البرتقال أبوسرة والليمون العجمي كانا متوسطا الاصابة بالحشرة حيث سجلا متوسط تعداد ٥٨,١±٦,٧ & ٣٨,٧±٥,٨ للحوريات و٣٣±٤ & ٢٣,٧±٣,٨ للحشرات الكاملة علي التوالي. في الموسم الثاني ٢٠١٠\١١ كان كل من الليمون الأضاليا والنارنج أكثر الأصناف اصابة حيث كان متوسط التعداد ١٧٢,٢±٢١,١ & ١١٩±٨,٣ للحوريات و١٠٤,١±١٣,٨ & ٦٧,٧±٥,٤ للحشرات الكاملة علي التوالي. بينما كان الليمون العجمي والبرتقال أبوسرة متوسطا الحساسية للاصابة بالحشرة حيث كان متوسط التعداد ٣٢,٨±٢,١ & ٥٢,٥±٦ للحوريات و ١٨,٥±١,٦ & ٢٧,٩±٢,٥ للحشرات الكاملة علي التوالي. اليوسفي كلمنتين واليوسفي البلدي كانا أقل الأصناف حساسية للاصابة بمتوسط تعداد قدره ٢٣,٢±٤,٩ & ٣٢,٣±٦ للحوريات و١١,٤±٢,٢ & ١٨,٤±٣,٤ للحشرات الكاملة علي التوالي.

تم تحليل الزيوت الطيارة لاصناف الموالح المختبرة لذلك فان الاختلاف في حساسية أصناف الموالح المختلفة للاصابة بالحشرة ربما يرجع الي اختلاف كمية ومكونات الزيت الطيار الموجود في أوراق الموالح، حيث كان النارنج الأكثر اصابة بالحشرة احتوت أوراقه علي نسبة عالية من الكامفور والليناليول أما الليمون الأضاليا الذي تلي النارنج في الأعلي حساسية للاصبة بالحشرة فقد احتوت أوراقه علي د-ليمونين والكارفون كمكونات أساسية.

تم دراسة تأثير أربعة مبيدات وهي: كونفيدور، فيرتيمك، زيت الخروع، زيت مصرونا علي حشرة بق المالح الدقيقي التي تصيب أشجار البرتقال أبو سرة عمرها ٣٥ عام وتم حساب نسبة الخفض في تعداد الحشرة بعد ٣، ٧، ١٤، ٢١، ٣٠ يوم بعد المعاملة. مبيد كونفيدور كان الأكثر تأثيرا علي الحشرة تلاه مبيد فيرتيمك بينم زيت مصرونا وزيت الخروع فقد خفضا تعداد الحشرة بعد ٣٠ يوم من المعاملة بنسبة ٨٢,٢ و٦٨,٦% علي التوالي. تأثير كل من كونفيدور وفيرتيمك بدأ يقل تدريجيا بعد ثلاثة أسابيع من المعاملة بينما الزيت المعدني مصرونا ظل تأثيره لمدة طويلة بعد المعاملة كما أنه أقل المركبات ضررا علي الأعداء الحيوية.

قام بتحكيم البحث

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