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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 2009/10 and 2010/11 in Qalubia Governorate. The citrus mealybug *Planococcus citri* (Risso) nymphs had four peaks of abundance during the first season in 14th June 2009, 9th August 2009, 13rd December 2009 and 21st February 2010. Moreover, the insect adults had also four peaks of abundance in 17th May 2009, 28th June 2009, 9th August 2009 and 21st February 2010. While in the second season insect nymphs had five peaks of abundance in 18th April 2010, 25th July 2010, 3rd October 2010, 28th November 2010 and 20th March 2011. While the insect adults had also five peaks of abundance in 2nd May 2010, 3rd October 2010, 14th November 2010, 26th December 2010 and 3rd April 2011.

Six citrus species were screened during two seasons for susceptibility to citrus mealybug *P. citri* in Qalubia orchard. In the first season 2009/10 Clemantine mandarine and Balady mandarine were the least infested species by the insect with the mean numbers of 20.9±3 & 21.4±2.1 nymphs and 12.8±1.9 & 9±0.8 adults, respectively. While, Sour orange and Lemon were the heaviest attacked by the insect with the mean numbers of 152.3±17.5 & 150.3±8.8 nymphs and 84.3±10 & 76±4.7 adults, respectively. Navel orange and Persian agami were moderately infested by *P. citri* with the mean numbers of 58.1±6.7 & 38.7±5.8 nymphs and 33±4 & 23.7±3.8 adults, respectively. In the second season Lemon and Sour orange were the heaviest infested by the insect with the mean numbers of 172.2±21.1 & 119±8.3 nymphs and 104.1±13.8 & 67.7±5.4 adults, respectively. While, Persian agami and Navel orange were moderately susceptible to infestation where the recorded mean numbers were 32.8±2.1 & 52.5±6 nymphs and 18.5±1.6 & 27.9±2.5 adults, respectively. Clemantine mandarine and Balady mandarine were the lowest susceptible to infestation with the mean numbers of 23.2±4.9 & 32.3±6 nymphs and 11.4±2.2 & 18.4±3.4 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 20% SL., Vertimec 1.8% EC, Castor oil 30% and Mesrona oil 85% EC) against *P. citri* on 35 – years – old trees of Navel orange were evaluated. Mortalities were recorded after 3, 7, 14, 21 and 30 days of treatment. Confidor was the most effective compound followed by Vertimec, while Mesrona oil and Castor oil gave reductions in population rate after 30 days from application to 82.2 and 68.6% 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 2009/2010 amounted 800,000 tons, which is equivalent to about 440 million dollars (Guven and Sherif, 2010). The citrus mealybug *Planococcus citri* is globally distributed (Smith *et al*., 1997; Blumberg & Van Driesche, 2001; Mustu *et al*., 2008), highly polyphagous and generally the most destructive species of its family (Cadee and Van Alphen, 1997; Blumberg & Van Driesche, 2001). 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, 1996; Smith *et al*., 1997; Heinz *et al*., 2004). Black sooty mold fungi are detrimental to plants because they cover leaves, thus reducing photosynthesis and inducing plant stress (Malais and Ravensberg, 1992). The citrus mealybug is also known as a vector of some important plant viruses (Al-Ali, 1996; Bartelett, 1978; Rosciglione and Castellano, 1985; Lockhart and Olszewski, 1993; Su, 1998, 2000; Kubiriba *et al*., 2001; Watson and Kubiriba, 2005). 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 2004, Daane *et al*. 2006). 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, 1993 and Anonymous, 1997). 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

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

The present work was carried out during the two successive seasons 2009/2010 and 2010/2011 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 5 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.

2. 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 200g. (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 (1984). 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.,* 1984). The applied conditions were the following:

Apparatus: varian modle 3700 Gas chromatography.
Column: Material glass chormy WHP 80, 100.
Injection temperature: 220 ^{o}c.
Detector temperature: 240 ^{o}c.
Program: Initial temperature 70 ^{o}c, min 2.0, prog/ rate 70, final temperature 190 ^{o}c.

3. Chemical control:

This experiment was performed using thirty navel orange trees (*Citrus sinensis* L.) 35 years old grafted on sour orange root-stock, and were at 5x5 meter distance. The experiment comprised of five treatments (T1, T2, T3, T4 and T5) allocated in a randomized block design and each treatment consisted of six replicates (each included 5-infested branches/tree).

The applied treatments were as follows:

T1- Confidor (imidacloprid) 20% SL. A neonicotonid insecticide which applied at rate of 50ml/tree.

T2- Vertimec 1.8% 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 50ml/tree.

T3- Castor oil (30%) a natural oil extracted from castor seeds. It was applied at a rate of 30ml/tree, which was dissolved in 4 liters of the organic solvent triethylamine / feddan.

T4- Mesrona 85% EC, a local commercial oil. It was applied at a rate of 500 ml/tree.

T5- were untreated (control).

During the period of the experiment, random samples of 20 infested leaves per tree (120 / treatment) were picked up, one day pretreatment and at the following intervals: 3, 7, 21 and 30 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

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

Data arranged in fig. (1) showed that the nymphs of citrus mealybug *P. citri* during the first season 2009/10 has four peaks of abundance in 14th June

2009, 9th August 2009, 13th December 2009 and 21st February 2010 these peaks were represented by 94, 89.8, 58.5 and 81.4 nymphs/120 leaves, respectively. while the adults of citrus mealybug had also four peaks of abundance recorded in 17th May 2009, 28th June 2009, 9th August 2009 and 21st February 2010 were represented by 44.5, 57.4, 47.7 and 44.3 adults/120 leaves, respectively. The highest number of nymphs was recorded throughout the period from 19th April 2009 till 14th June 2009, while the lowest number of nymphs was recorded during 1st November 2009 to 29th November 2009. Data also showed that the highest number of adults was recorded throughout the period from 14th June 2009 till 12th July 2009, while the lowest number of adults was recorded during 1st November 2009 to 27th December 2009.

Data in fig. (2) showed that the nymphs of citrus mealybug during the second season has five peaks of abundance in 18th April 2010, 25th July 2010, 3rd October 2010, 28th November 2010 and 20th March 2011 these peaks were represented by 89.4, 65.1, 61.3, 61.8 and 119 nymphs/120 leaves, respectively. while the adults had also five peaks of abundance in 2nd May 2010, 3rd October 2010, 14th November 2010, 26th December 2010 and 3rd April 2011 these peaks were represented by 51.6, 36.5, 32.5, 34.5 and 71.8 adults/120 leaves, respectively. The highest number of nymphs was recorded throughout the period from 6th February 2011 till 20th March 2011, while the lowest number of nymphs was recorded during 8th August 2010 to 31st October 2010. Data also showed that the highest number of adults was recorded throughout the period from 20th March 2011 till 3rd April 2011 on all investigated citrus species, while the lowest number of adults was recorded during 22nd August 2010 to 31st October 2010.

2- Influence of different citrus species:

In the first season (2009/10), data illustrated in table (1) showed that Sour orange and Lemon were the heaviest infested by citrus mealybug nymphs with the mean numbers of 152.3±17.5 & 150.3±8.8 nymphs, respectively. While, Persian agami and Navel orange were moderately susceptible to infestation where the recorded mean numbers were 38.7±5.8 & 58.1±6.7 nymphs, respectively. However on contrary, Balady mandarine and Clemantine mandarine were the lowest susceptible to infestation with the mean numbers of 21.4±2.1 & 20.9±3 nymphs, respectively. Statistical analysis showed a significantly differences between the different citrus species for the insect nymphs.

Data arranged in table (2) showed that Sour orange and Lemon were the heaviest infested by citrus mealybug adults with the mean numbers of 84.3±10 & 76±4.7 adults, respectively. While, Persian agami and Navel orange were moderately susceptible to adults infestation where the recorded mean numbers were 23.7±3.8 & 33±4 adults, respectively. Clemantine mandarine and Balady mandarine were the lowest susceptible to adults infestation with the mean numbers of 12.8±1.9 & 9±0.8 adults, respectively. Statistical analysis showed a significantly differences between the different citrus species for the insect adults.

While in the second season (2010/11) data arranged in table (3) showed that Lemon and Sour orange were the heaviest infested by citrus mealybug nymphs with the mean numbers of 172.2±21.1 & 119±8.3 nymphs, respectively. While, Navel orange and Persian agami were moderately susceptible to nymphs infestation where the recorded mean numbers were 52.5±6 & 32.8±2.1 nymphs, respectively. However, Balady mandarine and Clemantine mandarine were the lowest susceptible to nymphs infestation with the mean numbers of 32.3±6 & 23.2±4.9 nymphs, respectively. Statistical analysis showed a significantly differences between the different citrus species for the insect nymphs.

The obtained data in table (4) showed that Lemon and Sour orange were the heaviest infested by insect adults with mean numbers of 104.1±13.8 & 67.7±5.4 adults, respectively. While, Navel orange and Persian agami were moderately susceptible to adults infestation where the recorded mean numbers were 27.9±2.5 & 18.5±1.6 adults, respectively. Balady mandarine and Clemantine mandarine were the lowest susceptible to adults infestation with the mean numbers of 18.4±3.4 & 11.4±2.2 adults, respectively. Statistical analysis showed a significantly differences between the different citrus species for the insect adults. El-Keiy (1964)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. (1): Population fluctuation of the citrus mealybug nymphs and adults in citrus orchard during 2009/10 season in Qalubia Governorate.

Fig. (2): Population fluctuation of the citrus mealybug nymphs and adults in citrus orchard during 2010/11 season in Qalubia Governorate.

Table (1): The monthly average number of the citrus mealybug nymphs at different citrus species during 2009/10 season in Qalubia governorate.

Months	Sour orange	Navel orange	Persian agami	Lemon	Balady mandarine	Clemantine mandarine
April 2009	221.1	60.2	20.8	108.9	20.6	21.3
May	215.5	91.8	18	195	15.7	9
June	221.7	99.6	20.5	169.7	11.6	16.7
July	196.5	92.7	21.4	177.5	16.9	5.4
August	196.9	80.3	28.2	166.6	20.7	14.9
September	223.4	52.4	31.4	119.1	26.3	21.6
October	189.5	33.4	34.2	98.1	25.2	19.8
November	57.7	38.3	35.7	119.2	11.7	12
December	91.1	26.2	32.6	156.7	9.7	11.4
January 2010	79.2	36	89.3	118.6	29.2	24.7
February	92.5	54	74.6	164.2	30.9	34
March	99.9	49.3	47.8	189.6	31.9	41.4
April	95.1	41.4	48.3	171.3	28	39.3
Total	1980.1	755.6	502.8	1954.5	278.4	271.5
Mean ± SE	**152.3^{a} ±17.5**	**58.1^{b} ±6.7**	**38.7^{bc} ±5.8**	**150.3^{a} ±8.8**	**21.4^{c} ±2.1**	**20.9^{c} ±3.0**

Means followed by the same letters are not significantly differences at 0.05 level of probability.

Table (2): The monthly average number of the citrus mealybug adults at different citrus species during 2009/10 season in Qalubia governorate.

Months	Sour orange	Navel orange	Persian agami	Lemon	Balady mandarine	Clemantine mandarine
April 2009	111.4	31.4	9.7	56.5	10.4	12.2
May	95.5	49.3	11	85.4	6.1	4.6
June	175.9	62.7	11.8	72.9	4.6	8.7
July	93.8	55.3	14.3	71.9	8.7	3.7
August	106.5	45.5	15.3	78.9	10	8.6
September	101.2	30.4	18.5	50.9	11.3	12.8
October	94.9	20.3	21.2	45.5	12	12.5
November	35.7	22	27.4	68.4	5.4	9.6
December	54.9	18.8	22	78.2	5.7	9.1
January 2010	73.3	22.3	61.4	83.5	7.2	13.4
February	57.3	24.6	41.2	99.9	10.5	21.2
March	53.7	28.4	28.2	103.7	13.3	28.3
April	41.4	18.3	26.4	93.4	12.4	22.3
Total	1095.5	429.3	308.4	989.1	117.6	167
Mean ± SE	**84.3^{a} ±10.0**	**33^{b} ±4.0**	**23.7^{bc} ±3.8**	**76^{a} ±4.7**	**9^{c} ±0.8**	**12.8^{c} ±1.9**

Means followed by the same letters are not significantly differences at 0.05 level of probability.

Table (3): The monthly average number of the citrus mealybug nymphs at different citrus species during 2010/11 season in Qalubia governorate.

Months	Sour orange	Navel orange	Persian agami	Lemon	Balady mandarine	Clemantine mandarine
April 2010	109.8	48.5	29.8	261.3	45.6	41.2
May	119.2	56.7	32.7	204.6	23.3	13.4
June	124	28.9	30.9	150.2	18	15.9
July	113.5	27.7	25.2	116.2	65.7	25.2
August	87.4	29.9	29	88.3	71	7.7
September	83	34.7	42.9	91.1	63.4	9.5
October	71.6	38.7	35.7	92	41.2	42.4
November	110	34.9	31.9	151.9	23.2	13.8
December	117.2	55.8	28.1	125	10.7	7.4
January 2011	124.4	75.9	44	114.7	9.5	7.5
February	139	84	16.2	244.5	7.2	8
March	187.5	91.3	37	286.1	15.1	59.8
April	161.3	75.7	42.9	312.3	25.8	49.2
Total	1547.9	682.7	426.3	2238.2	419.7	301
Mean ± SE	**119^{b} ±8.3**	**52.5^{c} ±6.0**	**32.8^{c} ±2.1**	**172.2^{a} ±21.1**	**32.3^{c} ±6.0**	**23.2^{c} ±4.9**

Means followed by the same letters are not significantly differences at 0.05 level of probability.

Table (4): The monthly average number of the citrus mealybug adults at different citrus species during 2010/11 season in Qalubia governorate.

Months	Sour orange	Navel orange	Persian agami	Lemon	Balady mandarine	Clemantine mandarine
April 2010	64.7	28.6	12.3	143.2	21.3	23.6
May	85.2	32.2	15.6	130.2	16.2	7.5
June	70.6	18.1	19.2	102.9	12.5	7.5
July	66.9	16.4	13.6	72.6	36.3	14.2
August	55.9	17	15.2	47.6	42	3.4
September	49.8	20.9	22.9	50.7	35	5.2
October	41.5	21.9	25.8	48.4	27.4	23.1
November	50	21.2	20.6	80	9.7	6.4
December	59	33.1	14.2	82.2	6.4	3.8
January 2011	56	27.5	22.5	67.6	7	4.7
February	73.4	43.3	8.2	157	5.7	4.2
March	90.7	41.7	20.3	159	8.7	24.8
April	116.9	40.2	30.2	212.3	11.6	19.8
Total	880.6	362.1	240.6	1353.7	239.8	148.2
Mean ± SE	**67.7^{b} ±5.4**	**27.9^{c} ±2.5**	**18.5^{c} ±1.6**	**104.1^{a} ±13.8**	**18.4^{c} ±3.4**	**11.4^{c} ±2.2**

Means followed by the same letters are not significantly differences at 0.05 level of probability.

3- 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 (5) shows that leaf volatile oil contents among investigated citrus species were as follows:

1- Champhor and Linalool, represented the major components of the volatile oils in sour orange trees (*Citrus sinensis* L.).
2- 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.
3- Leaves of Persian agami showed that Limonene was the most stable compound with a relative level, while Carvon and Myrcene shared two opposite trends.
4- Lemonene and Carvon, represented as the major components in the volatile oil of lemon leaves.
5- Eugenol is contained in a higher value in the volatile oil of Balady mandarine leaves.
6- 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 (1964) 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 (5): 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**

4- 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 (6) and fig. (3), indicated that Confidor gave a highest effect were the rates of insect population reduction after 7, 14, 21 and 30 days from application were 89.7, 88.7, 82.7 and 78.1% respectively, followed by Vertimec gave decrease of insect population after 7, 14, 21 and 30 days from application to 85, 89.8, 79.2 and 70.5% respectively. While mineral oil gave the lower mortality percentage than the two chemical insecticides, it decreased the rate of population after 7, 14, 21 and 30 days from application to 56.7, 69.7, 78 and 82.2% respectively. However, mineral oil exhibited more efficacy than castor oil whjch gave reduction of population rate after 7, 14, 21 and 30 days from application to 35.7, 55.5, 65.4 and 68.6% 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 3rd day after application to reach 82.2% 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. (3): Influence of the different insecticides on the average numbers of citrus mealybug *P. citri* after treatments.

Table (6): Effect of the tested insecticides on the population reduction.

Treatments	Percent of reduction after application (days)					General mean of reduction (%)
	3	7	14	21	30	
Confidor	44.9	89.7	88.7	82.7	78.1	76.82
Vertimec	53.5	85	89.8	79.2	70.5	75.6
Castor oil	15.9	35.7	55.5	65.4	68.6	48.22
Mesrona oil	29	56.7	69.7	78	82.2	63.12

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التفضيل العوائلي والمكافحة الكيماوية لحشرة بق الموالح الدقيقي علي أشجار الموالح

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أجريت هذه الدراسة خلال موسمي 10\2009 و 11\2010 في محافظة القليوبية. حوريات بق الموالح الدقيقي كان لها أربعة ذروات في التعداد خلال الموسم الأول في 14 يونيو و9 أغسطس و13 ديسمبر و21 فبراير 2010. بينما الحشرات الكاملة كان لها أيضا أربعة ذروات في 17 مايو 2009 و28 يونيو و9 أغسطس و21 فبراير. أما في الموسم الثاني فكانت حوريات الحشرة لها خمسة ذروات في التعداد خلال 18 أبريل 2010 و25 يوليو و3 أكتوبر و28 نوفمبر و20 مارس 2011 بينما الحشرة الكاملة كان لها أيضا خمسة ذروات تعداد في 2 مايو 2010 و3 أكتوبر و14 نوفمبر و26 ديسمبر و3 ابريل 2011.

تم اختبار حساسية ستة أصناف من الموالح للاصابة بحشرة بق الموالح الدقيقي. في الموسم الأول 10\2009 كان كل من اليوسفي كلمنتين واليوسفي البلدي من أقل الأصناف اصابة بالحشرة وذلك بمتوسط تعداد 20.9±3 & 21.4±2.1 للحوريات و12.8±1.9 & 9±0.8 للحشرات الكاملة علي التوالي. بينما النارنج والليمون الأضاليا كانا أشد الأصناف اصابة بالحشرة بمتوسط تعداد 152.3±17.5 & 150.3±8.8 للحوريات و84.3±10 & 76±4.7 للحشرات الكاملة علي التوالي. البرتقال أبوسرة والليمون العجمي كانا متوسطا الاصابة بالحشرة حيث سجلا متوسط تعداد 58.1±6.7 & 38.7±5.8 للحوريات و33±4 & 23.7±3.8 للحشرات الكاملة علي التوالي. في الموسم الثاني 11\2010 كان كل من الليمون الأضاليا والنارنج أكثر الأصناف اصابة حيث كان متوسط التعداد 172.2±21.1 & 119±8.3 للحوريات و104.1±13.8 & 67.7±5.4 للحشرات الكاملة علي التوالي. بينما كان الليمون العجمي والبرتقال أبوسرة متوسطا الحساسية للاصابة بالحشرة حيث كان متوسط التعداد 32.8±2.1 & 52.5±6 للحوريات و 18.5±1.6 & 27.9±2.5 للحشرات الكاملة علي التوالي. اليوسفي كلمنتين واليوسفي البلدي كانا أقل الأصناف حساسية للاصابة بمتوسط تعداد قدره 23.2±4.9 & 32.3±6 للحوريات و11.4±2.2 & 18.4±3.4 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 واللينالول 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 35 عام وتم حساب نسبة الخفض في تعداد الحشرة بعد 3, 7, 14, 21, 30 يوم بعد المعاملة. مبيد كونفيدور كان الأكثر تأثيرا علي الحشرة تلاه مبيد فيرتيمك بينم زيت مصرونا وزيت الخروع فقد خفضا تعداد الحشرة بعد 30 يوم من المعاملة بنسبة 82.2 و68.6% علي التوالي. تأثير كل من كونفيدور وفيرتيمك بدأ بقل 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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