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HOST PREFERENCE AND CHEMICAL CONTROL OF *Phyllocnistis citrella* STAINTON (LEPIDOPTERA : GRACILARIIDAE) IN QALUBIA GOVERNORATE.

BY

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ABSTRACT

The citrus leaf miner, *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillaridae) has become an important pest in citrus orchards in Egypt. Six citrus varieties were screened during 2003/2004 for susceptibility to *P. citrella* in Qalubia orchard. Balady mandarine and Clemantine mandarine were the least infested, Persian agami and Lemon were the heaviest attacked, while Sour orange and Navel orange were moderately infested by *P. citrella.* Volatile oils were analyzed in tested citrus varieties so that different levels of susceptibility in citrus varieties to *P. citrella* attack may be correlated to different kinds and percentages of components of volatile oil.

The efficacies of four insecticides (Confidor 20% SL, Vertimec 1.8% EC, Castor oil 30% and Mesrona oil 85% EC) against *P. citrella* on 30-years-old trees of Navel orange were evaluated. Mortalities were recorded after 1, 3, 7, 14 and 21 days of treatment. Confidor was the most effective compound followed by Vertimec, Mesrona oil and Castor oil, they gave reductions in infestation rate after 21 days from application to 15%, 20%, 22% and 35.2%, respectively. 20 days 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

The citrus leafminer (CLM), *Phyllocnistis citrella* (Lepidoptera: Gracillariidae, Phyllocnistinae) is a major pest of citrus causing severe damage to new leaf flush. CLM is native of subtropical and tropical Asia (CAB 1986) and is a serious pest of citrus in China (Zhang *et al.*, 1994) and increasingly in many other regions of the world (Beattie *et al.*, 1995). The pest was detected in Egypt in summer of 1994 in almost all of the citrus growing areas (Eid, 1998). The CLM has its origin in South Asia, where it was observed in Calcuta, India, for the first time in 1865 (Sponagel and Diaz 1994). In this century, the pest has spread to many countries through shipments of plant materials and by migration. This insect damages the young tender leaves of all species of the genus *Citrus*. CLM reduces possibly the photosynthetically active leaf area of its host both by destroying mesophyll cells and by rolling the leaves during pupation. The pest is most destructive in young plantations, where it may cause total defoliation if it is not controlled. CLM attacks even young fruits (Heppner 1995).the object of the present

work is to determine the host preferences of *P citrella* on six citrus species and its chemical control in a citrus orchard in Qalubia governorate

MATERIAL AND METHODS

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

The present work was carried out during the period from 1/5/2003 to 1/5/2004 on various citrus species, in the citrus orchard in the farm of the Faculty of Agriculture at Moshtohor, Zagazig 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, Clemantine mandarin *Citrus reticulata* Blanco.

Six trees of each species were chosen in this work, and kept free from any pesticidal treatment for 5 years before and during this work.

Biweekly samples of twenty new leaves were randomly picked from each tree. Samples were placed in plastic bags which were labeled and transported to the laboratory to be microscopically examined and both larvae and pupae 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 (1948). 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 condition were the following:
Apparatus: varian model 3700 Gas chromatography.
Column: Material glass chormy WHP 80, 100.
Injection temperature: 220°C.
Detector temperature: 240°C.
Program: Initial temperature 70°C, min 2.0, prog/ rate 70, final temperature 190°C

3. Chemical control:

This experiment was performed using fifteen navel orange trees (*Citrus sinensis* L.) 30 years old grafted on sour orange root-stock, and were at 5x5 meter, distances. The experiment comprised of five treatments (T1, T2, T3, T4 and T5) allocated in a randomised block design and each treatment consisted of three 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 mineral oil. It was applied at a rate of 500 ml / tree.

Trees of T5 were untreated (control).

During the period of the experiment, the numbers of alive larvae and pupae in infested leaves from different treatments were recorded at one day pretreatment and at the following intervals, 1, 3, 7, 14 and 21 days post treatment. Pupal cases (as an indicator for emerged adult moths) were also recorded. The collected data were in terms of alive larvae, alive pupae, and pupal cases for each treatment.

RESULTS AND DISCUSSION

1. Population fluctuation of *Phyllocnistis citrella* on different citrus varieties:

Data in table (1) and figs. (1 & 2), showed that the citrus leaf miner *P. citrella* has nine peaks of abundance recorded from the 1st May 2003 to 30th April 2004, the most distinct ones were recorded on 30th August, 15th September and 30th November 2003. These peaks were represented by 432.8, 335.6 and 204.6 larvae/120 leaves from 6 varieties. The highest number of larvae was recorded throughout the period from 1st May till 30th September 2003 on all investigated citrus varieties. The lowest number of larvae was recorded during 15th December 2003 to 30th March 2004.

Data showed that Lemon and Persian agami were the heaviest infested by citrus leaf miner with the total mean numbers of 1901.6 and 1602.7 larvae, respectively. While Navel orange and Sour orange were moderately susceptible to infestation where the recorded total mean numbers of larvae were 475.8 and 586.4 respectively, however on contrary, Clemantine mandarine and Balady mandarine were the lowest susceptible to infestation with the total mean numbers of 329.4 and 392.3 larvae, respectively. These results agree with Singh (1984); Singh and Azam (1986) and Badawy (1967) who reported that *mandarine* plants had lower percentage of infestation by *P. citrella* and they attributed their results to the relatively smaller size and leathery tissues of its leaves.

2. The relationship between the susceptibility of citrus varieties to citrus leaf miner *P. citrella* 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 variety. Table (2) shows that leaf volatile oil contents among investigated citrus varieties 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 higher 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.

Table (1): Biweekly mean counts of *P. citrella* larvae & pupae recorded from six citrus varieties during 2003/2004 season.

Date	Larvae						Pupae					
	Sour orange	Navel orange	Persian agami	Lemon	Balady mandarine	Clemantine mandarine	Sour orange	Navel orange	Persian agami	Lemon	Balady mandarine	Clemantine mandarine
1/5/2003	60.3	46.2	73.3	32.3	63.6	15.6	16.0	20.5	21.5	17.3	20.3	8.2
15/5	38.1	42.8	69.0	38.4	61.3	22.3	11.2	17.8	23.3	18.6	28.8	11.8
30/5	52.5	36.3	88.6	40.0	42.5	19.5	15.3	12.3	30.0	18.5	18.6	8.6
15/6	63.2	41.0	107.3	56.6	27.1	18.8	18.8	16.0	44.6	23.3	11.3	8.3
30/6	51.3	29.8	122.5	58.6	26.0	19.3	16.3	11.2	42.8	21.0	12.0	9.0
15/7	53.4	33.6	134.0	112.3	22.6	32.3	18.0	13.6	58.1	43.3	11.6	13.5
30/7	60.1	38.3	141.6	109.5	21.8	30.8	22.6	17.3	56.3	42.8	10.8	14.3
15/8	33.2	40.1	163.2	148.3	18.3	22.4	12.3	19.1	63.0	67.2	9.0	9.6
30/8	36.1	31.5	176.3	152.6	16.0	20.3	14.0	11.8	69.6	65.3	8.3	9.0
15/9	23.5	26.6	68.1	169.8	11.3	36.3	9.3	11.0	24.6	74.5	3.6	15.8
30/9	25.3	28.3	59.0	150.3	9.6	34.8	11.0	13.3	22.8	63.8	3.0	15.3
15/10	13.3	22.6	98.3	86.6	23.1	16.8	4.3	8.2	37.3	39.3	8.5	5.8
30/10	15.4	24.3	82.6	91.8	21.5	13.3	3.8	9.1	34.5	36.6	7.6	1.0
15/11	10.3	8.6	52.3	116.6	6.3	5.3	3.0	2.0	26.1	41.0	2.0	1.0
30/11	12.3	9.8	48.0	123.2	6.8	4.5	3.3	3.2	21.3	46.8	2.3	0
15/12	5.0	3.0	19.3	49.6	2.3	1.0	1.5	1.0	11.6	19.2	0	0
30/12	3.3	2.3	10.6	41.3	2.0	0.3	0.6	0	6.5	17.3	0	0
15/1/2004	6.3	3.6	5.1	45.0	0.2	0.6	1.3	0.2	0	18.6	0	0
30/1	6.0	3.3	3.3	31.3	0.2	0.3	1.0	0.3	0	13.5	0	0
15/2	5.6	2.0	4.8	22.6	0	0	2.3	0	0.3	9.8	0	0
30/2	6.3	1.8	4.3	20.0	0	0	2.0	0	0	9.3	0	0
15/3	1.3	0	21.0	42.3	0	0	0	0	3.6	15.6	0	0
30/3	1.0	0	28.3	39.8	0	0	0	0	5.8	16.3	0	0
15/4	0.3	0	12.1	53.3	0	6.3	0	0	3.0	20.5	0	0
30/4	3.0	0	9.8	69.5	9.8	8.6	0.6	0	0	28.8	1.8	0.8
total	**596.4**	**475.8**	**1602.7**	**1901.6**	**392.3**	**329.4**	**188.5**	**187.9**	**606.6**	**788.2**	**159.5**	**132.0**
mean	**23.5**	**19.0**	**64.1**	**76.0**	**15.7**	**13.2**	**7.5**	**7.5**	**24.3**	**31.5**	**6.4**	**5.3**

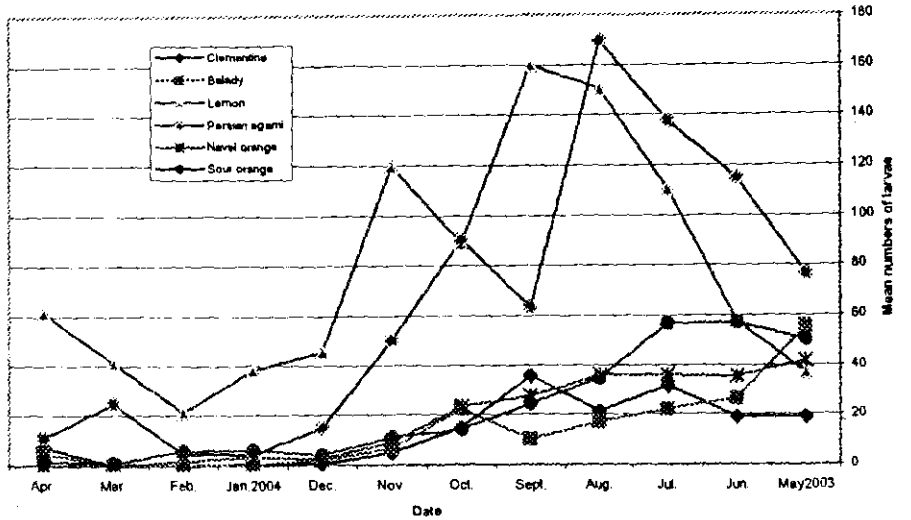

Fig.(1): population fluctuations of *P. citrella* larvae on six citrus varieties during 2003/2004 season.

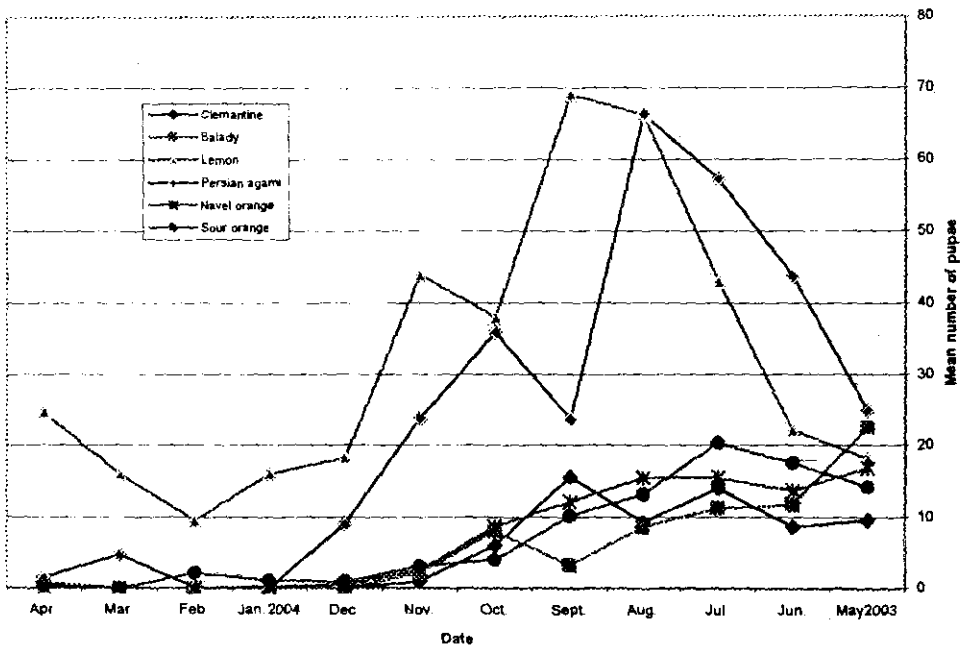

Fig.(2): population fluctuations of *P. citrella* pupae on six citrus varieties during 2003/2004 season.

Table (2): Qualitative analysis of leaf volatile oil contents among citrus varieties.

	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

The variation between different varieties of citrus in their susceptibility to *P. citrella* infestation, may be due to the variations in leaf volatile oil values and the components of volatile oil. Lemon which was the heaviest infested was characterized by the highest rates of Carvon and d-limonene, and Persian agami which came the next after Lemon showed highest rate of Limonene. Limonene may be a factor causing increase in infestation by *P. citrella.*

2. Chemical control:

Field trial for testing the effect of four insecticides for controlling *P. citrella* in Navel orange trees (*Citrus sinensis* L.) has been carried out.

Data in table (3) and fig. (3), indicated that Confidor gave a highest effect, where the rates of infestation after 7, 14 and 21 days from application were 9, 10 and 15% respectively, followed by Vertimec gave decrease of infestation rate after 7, 14 and 21 days from application to 15.4, 9 and 20% respectively. While mineral oil gave the lower mortality percentages than the two chemical insecticides, it decreased the rate of infestation after 7, 14 and 21 days from application to 44.7, 26.5 and 22.3% respectively. However, mineral oil exhibited more efficacy than castor oil which gave reduction of infestation rate after 7, 14 and 21 days from application to 64.6, 43.4 and 35.2% respectively.

Both Confidor and Vertimec have proved effective against *P. citrella* 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 first day after application to reach 22.3% after three weeks 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 controling *P. citrella* because of its long time effect, it is also less harmful to natural enemies and has lower price.

The present results agree with Rae *et al.* (1996); Mustafa and Ateyyat (1997); Ujiye (2000) and Villanueva-Jimenez *et al.* (2000).

Table (3): Field population management of *P. citrella* using four insecticides in Qalubia governorate during 2004 season.

Treatments >		Confidor	Vertimec	Castor oil	Mesrona oil	Control
Pre spraying	Larvae	81	98	85	96	71
	Pupae	105	83	61	66	44
	Ruptured pupae	92	86	48	63	39
	% infestation	93%	90.6%	97.3%	95.2%	93.4%
After 1 day	Larvae	76	82	81	82	79
	Pupae	91	69	60	63	45
	Ruptured pupae	85	77	47	54	41
	% infestation	83.5%	75.3%	94%	85.2%	93.8%
After 3 days	Larvae	24	41	68	42	93
	Pupae	71	39	51	61	68
	Ruptured pupae	45	42	46	40	61
	% infestation	47.5%	40%	79.3	60.5%	95.2%
After 7 days	Larvae	0	12	51	26	142
	Pupae	18	19	46	50	96
	Ruptured pupae	15	18	37	23	78
	% infestation	9%	15.4%	64.6%	44.7%	97.4%
After 14 days	Larvae	6	7	32	12	167
	Pupae	14	11	33	33	95
	Ruptured pupae	9	6	21	17	116
	% infestation	10%	9%	43.4%	26.5%	96.2%
After 21 days	Larvae	12	19	25	13	172
	Pupae	18	21	28	21	113
	Ruptured pupae	11	15	18	16	137
	% infestation	15%	20%	35.2%	22.3%	94.5%

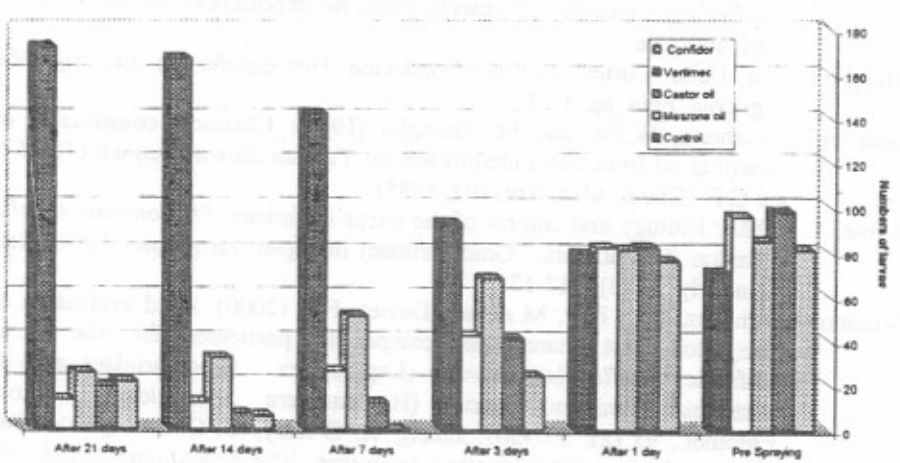

Fig.(3): Effects of tested insecticides on the population density of *P. cetrilla* infesting Navel orange trees.

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التفضيل العوائلي والمكافحة الكيماوية لحشرة صانعة أنفاق أوراق الموالح في محافظة القليوبية

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أجريت هذه الدراسة بغرض تقييم حساسية بعض أصناف الموالح للإصابة بحشرة صانعة أنفاق أوراق الموالح وعلاقتها بمحتوي هذه الأصناف من الزيوت الطيارة , كذلك مدي استجابة حشرة صانعة أنفاق أوراق الموالح لبعض المبيدات ,وقد أوضحت النتائج ما يلي:

أولا :حساسية بعض أصناف الموالح للإصابة بحشرة صانعة أنفاق أوراق الموالح:

تم اختبار حساسية ستة أصناف من الموالح للإصابة بحشرة صانعة أنفاق أوراق الموالح وهي النارنج -البرتقال أبوسرة -الليمون العجمي -الليمون الأضاليا -اليوسفي البلدي -اليوسفي كلمنتين ,حيث أظهرت النتائج أن أكثر الأصناف حساسية للإصابة كانت الليمون العجمي والليمون الأضاليا أما كلا من النارنج والبرتقال أبو سرة فقد كانا متوسطا الحساسية بينما كانت أصناف اليوسفي البلدي واليوسفي كلمنتين أقل الأصناف حساسية للإصابة بحشرة صانعة أنفاق أوراق الموالح.

ثانيا :تحليل الزيوت الطيارة في أوراق أصناف الموالح المختلفة:

أشارت النتائج إلي أن الاختلاف في حساسية أصناف الموالح المختلفة للإصابة بالحشرة ربما يرجع إلي اختلاف كمية ومكونات الزيت الطيار الموجود في أوراق الموالح ,حيث تم تحديد مكونات وكميات الزيوت الطيارة الأساسية المستخلصة من أوراق أصناف الموالح المختلفة وكانت النتائج كالأتي

١- احتوت أوراق النارنج علي نسبة عالية من الكامفور واللينالول.
٢- أوراق البرتقال أبو سرة احتوت علي البيتابنين واللينالول بكميات مناسبة.
٣- أوراق الليمون العجمي احتوت علي الليمونين كمكون أساسي.
٤- احتوت أوراق الليمون الأضاليا علي د-ليمونين والكارفون كمكونات أساسية للزيت الطيار
٥- الايجينول كان المكون الأساسي للزيت الطيار في أوراق اليوسفي البلدي.
٦- اليوسفي كلمنتين احتوت أوراقه علي بيتابنين واللينالول كمكونات أساسية

ثالثا :تأثير بعض المبيدات علي حشرة صانعة أنفاق أوراق الموالح التي تصيب أشجار البرتقال أبوسرة:

تم استخدام أربعة مبيدات لمكافحة حشرة صانعة أنفاق أوراق الموالح علي أشجار البرتقال ابوسرة وهي :كونفيدور ، فيرتيميك، زيت الخروع ، زيت مصرونا .حيث أظهرت النتائج أن مبيد الكونفيدور كان الأكثر تأثيرا علي الحشرة تلاه مبيد الفيرتيميك ثم زيت المصرونا ثم زيت الخروع، حيث قلت نسبة الإصابة بعد 21يوم من المعاملة إلي 15%, 20%, 22%, 35% علي التوالي

كما أوضحت النتائج أن تأثير كل من الكونفيدور والفيرتيميك بدأ يقـل تـدريجيا بعد ثلاثة أسابيع من المعاملة بينما الزيت المعدني مصرونا ظل تأثيره لفترة طويلة بعـد المعاملة كما انه اقل المركبات ضررا علي النبات وعلي الأعداء الحيوية كذلك أرخصـها سعرا.