

*Annals Of Agric. Sc., Moshtohor,*  
*Vol. 43(2): 895-901, (2005).*

**HOST PREFERENCE AND SEASONAL FLUCTUATION OF CITRUS  
LEAF MINER, *Phyllocnistis citrella* STAINTON, POPULATION ON THE  
PREFERRED HOST IN RELATION TO ITS PARASITIDS AND  
WEATHER FACTORS.**

**BY**

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**ABSTRACT**

Ecological studies about citrus leaf miner (CLM) *P. citrella* were carried out on citrus orchards at El-Kanater El-Khairia, Qalyubiya Governorate. The results showed that, all citrus spp. were infested variously by this pest, the sour orange seemed to be the most susceptible one among the tested citrus plants. The other citrus spp. (lime, orange and grape fruit) ranked differently as moderate infested group, while the mandarin spp. represented the least preferred one. Generally the infestation in the first tested year (2000), was higher than the second one (2001). The insect infestation, started at mid-May, during the first year then the population fluctuated to record 5 peaks. The highest peak was represented by 195 insects / 50 leaves at the end of July. In the second year, the infestation started one week earlier and the insect population represented also by 5 peaks. The number of the highest peak was 187 insects / 50 leaves at the end of July. The partial regression analysis showed that the parasitoids of the tested insect had a negative significant effect. But the combined effect of the weather factors and the parasitoids had shown positive and significant effect on the insect population during the two tested years.

**INTRODUCTION**

The citrus leaf miner (CLM) *P. citrella* was simultaneously observed in most countries of the world (Heppner 1993). Infestation was common in all citrus orchards and was abundant enough in last years to cause serious damage. Citrus leaf miner larvae mine tender foliage and stems of citrus trees, killing leaf tissue and causing leaf drop (Knapp *et al.* 1994). In Egypt, it was discovered first during the summer of 1994 at El-Sharkia and Ismailia Governorates (Abdel-Aziz, 1995 and Abo-Sheaasha, 1997). Then, it spread and distributed rapidly throughout most of the citrus growing areas. Its population had increased rapidly and within the last ten years it became the most important pest of citrus in Egypt. The most infested sp. of citrus was sour orange with high mean number of mines, while lime tree leaves was the most preferable citrus host for egg-laying (Abdel-Rhman 1998). Species belonging to genus citrus and related ones of the family Rutaceae, appear to be the principal host plants of this insect pest, *P. citrella*. The present study aimed to investigate the susceptibility different citrus hosts to infestation with this

insect pest the seasonal fluctuation, of insect population and in relation to its parasitoids and weather factors.

## MATERIALS AND METHODS

Weekly samples consists of fifty newly leaves were chosen at the four cardinalin addition to the middle position of citrus tree. The investigated citrus spp., were sour orange, lime, Grape fruit, orange and mandarin trees (about 25 years old). These samples were taken to study the susceptibility and population fluctuation of *P. citrella*. The leaves of citrus species were examined in an area of about one feddan for each species except the sour orange trees which located on the edges and in the middle of the tested area of the citrus orchards during the investigated two successive seasons 2000 and 2001 at El-Kanater El-Khairia Qalyubiya Governorate. The samples were collected, put in a plastic sac and examined in the laboratory for insect larvae and their parasitoids. For identifying and counting the parasitoids of insect larvae, the leaves of each group were put singly in a petri-dishes (11 and 15 cm in diameter.) contains moist filter paper. The dishes were kept under laboratory conditions and examined daily for recording the parasitoids.

The effectiveness of climatic factors (daily means of air max. temperature (in °C), daily mean of air min. temp., daily air mean temp., daily mean range of temp., daily mean R.H.% and the means of daily sunshine duration) on the population density of *P. citrella* was estimated during the two successive seasons 2000 & 2001. Records of these factors were supplied by the Meteorological Administration, at Kobry El-Kobba, Cairo.

The data were statistically analyzed by the aid of computer, (SAS) program to determine the differences between the citrus species in the infestation and to clarify the correlation and the effect of climatic factors and parasitoids on the population density of *P. citrella* and some data were analyzed by Duncan multiple range test and multiple F-test Duncan, (1955).

## RESULTS AND DISCUSSION

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

During such course of investigation, it is observable that the citrus leaf miner (CLM), preferred some citrus species than others. Such phenomenon could be coincide the numbers of detected larvae, through out the investigation period. As shown in Tables (1, 2) in which the citrus species are presented in descending order, according to infestation level by *P. citrella*. Concerning the mean number of larvae, for each citrus species, it was shown that, the permanent bearing sour orange, was significantly the most preferred one with an average of insect density of 122.5 & 105.2 insects / 50 leaves during 2000 & 2001, respectively, to this insect pest, compared to other species. The moderate group was represented by lime, orange and grape fruit durig the first and second year. The least one was mandarin with an average of 43.6 & 36.7 insects / 50 leaves in 2000 & 2001, respectively. The

variances between the insect infestation data were statistically significant (see "F" and L.S.D values under the 1<sup>st</sup> and 2<sup>nd</sup> Tables).

**Table (1): Monthly mean numbers of *P. citrella* larvae/50 leaves of five species of citrus at El-Kanater El-Khairia, Qalyubiya Governorate during the season of 2000.**

Species Months	Sour orange	Lime	Orange	Grape fruit	Mandarin	Total	Mean
May.2000	122.67	97.33	95.10	124.00	43.00	482.10	<b>96.42</b>
Jun.2000	127.25	106.50	104.75	117.25	55.00	510.75	<b>102.15</b>
Jul.2000	153.00	117.80	145.70	132.20	53.00	601.70	<b>120.34</b>
Aug.2000	140.50	121.25	135.88	104.25	49.25	551.13	<b>110.23</b>
Sep.2000	101.25	92.25	87.36	80.00	44.25	405.11	<b>81.02</b>
Oct.2000	90.00	99.00	55.40	60.00	17.00	321.40	<b>64.28</b>
<b>Total</b>	<b>734.67</b>	<b>634.13</b>	<b>624.19</b>	<b>617.70</b>	<b>261.50</b>	<b>2872.19</b>	<b>574.44</b>
<b>Mean</b>	<b>122.45 a</b>	<b>105.69 b</b>	<b>104.03 b</b>	<b>102.95 b</b>	<b>43.58 c</b>	<b>478.70</b>	<b>95.74</b>

F value between citrus hosts = 31.64 P value = 0.0001

L.S.D. <sub>0.05</sub> between citrus hosts = 15.85

**Table (2): Monthly mean numbers of *P. citrella* larvae/50 leaves of five species of citrus at El-Kanater El-Khairia, Qalyubiya Governorate during the season of 2001.**

Species Months	Sour orange	Grape Fruit	Orange	Lime	Mandarin	Total	Mean
May.2001	90.50	91.50	60.85	71.25	26.25	340.35	<b>68.07</b>
Jun.2001	116.25	126.25	105.25	101.25	44.75	493.75	<b>98.75</b>
Jul.2001	138.80	138.20	127.90	71.00	64.60	540.50	<b>108.10</b>
Aug.2001	125.25	77.50	114.03	84.00	37.00	437.78	<b>87.56</b>
Sep.2001	87.50	63.75	74.65	74.65	33.75	334.30	<b>66.86</b>
Oct.2001	73.00	39.00	44.00	76.00	14.00	246.00	<b>49.20</b>
<b>Total</b>	<b>631.30</b>	<b>536.20</b>	<b>526.68</b>	<b>478.15</b>	<b>220.35</b>	<b>2392.68</b>	<b>478.54</b>
<b>Mean</b>	<b>105.22 a</b>	<b>89.37 b</b>	<b>87.78 b</b>	<b>79.69 b</b>	<b>36.73 c</b>	<b>398.78</b>	<b>79.76</b>

F value between citrus hosts = 14.34 P value = 0.0001

L.S.D. <sub>0.05</sub> between citrus hosts = 20.07

The above results are in agreement with those obtained by Badawy 1967, Lin, *et al.* 1985, Singh, *et al.* 1988, Wilson 1991. El-Saadany, *et al.* (2002) in contrast reported that navel orange was the most preferable species for citrus CLM - insect infestation and the most susceptible compared with other citrus varieties throughout the three successive years. Lime variety ranked second, while mandarin variety was the least.

All above authors indicated that the resistance is partly dependant on the plant leaf size, as larger leaves seem to be more susceptible to attack. Less wax and larger numbers of stomatal openings on leaves may also make it more susceptible.

## 2. Weekly Seasonal fluctuations of *P. citrella* on sour orange *Citrus aurantium* L., in relation to certain biotic and abiotic factors:-

Data given in Table (3) show the fluctuations in the population of *P. citrella* larvae expressed as total number of larvae per weekly samples (each 50 leaves) during the both tested seasons of 2000 and 2001. The obtained data revealed that total number of larvae collected from Sour orange in 2000 was relatively higher than that in 2001, where the values were 2699 and 2445 of two years, respectively. The infestation in the first year 2000, started at mid-May and the number was 51 insect / 50 leaves. After that, the population fluctuated recording 5 peaks of infestation (on 29<sup>th</sup> of May., on 10<sup>th</sup> of July., on 31<sup>th</sup> of July., on 14<sup>th</sup> of Aug. and on 18<sup>th</sup> of Sep.). The highest peak was 195 insect / 50 leaves on 31<sup>th</sup> of July. Finally the population fluctuated until the end of season with total number of 90 insect / 50 leaves. While in the second year 2001, the infestation of the insect started in the first week of May and the number was 39 insect / 50 leaves. The population also had 5 peaks (on 28<sup>th</sup> of May., on 9<sup>th</sup> of July., on 30<sup>th</sup> of July., on 13<sup>th</sup> of Aug. and on 17<sup>th</sup> of Sep.) and the highest peak was 187 insect / 50 leaves in 30<sup>th</sup> of July, finally the population fluctuated until the end of season with total number 73 insect / 50 leaves.

Such observations may be assured by finding of Lin *et al.*, (1985), who mentioned that *P. citrella* was a serious pest of *C. aurantium* (Seville orange). Also Pena *et al.*, (1996) who reported that high peaks of populations were observed during summer (June-July) and in fall (September-October).

Data in Table (4) showed the simple correlation and partial regression values for the effect of abiotic factors (daily mean max. temperature (in °C), daily mean min. temp., daily mean temp., daily mean range temp., daily mean R.H. %, daily mean sunshine duration), and biotic factors involved the parasitoids which included culphid, *Pnigalio* sp. a primary ectoparasitoid and *Cirrospilus* sp. Endoparasitoid, on the population density of the insect on sour orange trees.

Results showed that all the tested abiotic factors were positively correlated but insignificant while R.H. % had negative and insignificant effect on insect population during the first year 2000, this mean that all these factors were within the activity zone of insect population. In the same year the biotic factors were negatively correlated and had highly significant effect. Also in the second year 2001 daily mean max. temperature and daily mean temp. had positive and highly significant effect. But other factors were positive insignificant except R.H. % was negative but insignificant, this means that daily mean max. of temperature and daily mean of temp. were below the range of insect activity zone. While biotic factors were negative and significant. The combined effect of all tested factors gave 60.58 % in 2000 and 59.09 % in 2001. Such observations may be assured by the findings of Bagmare *et al.*, (1995) in India, they found that the mean temperature and sunshine hours had a positive correlation with the population of *P. citrella*. While Abo-Sheaasha (1997) in Egypt, mentioned that the weather factors particularly temperatures played an important role in the development of *P. citrella* and had shown a highly significant positive relation between daily mean temperature and larval population.

Table (3) Weekly mean numbers of *P. citrella* larvae / 50 leaves on sour orange trees accompanied with associated parasitoids and means of some weather factors affecting the population fluctuations of the insect during years, 2000 and 2001 at El-Kanater El-Khairia, Qalyubiya Governorate.

First year	No. of Larvae	No. of Parasitoids	Weather Factors					
			Max. Temp.	Min. Temp.	Mean Temp.	Range Temp.	Mean R.H.	Sunshine
15/5/2000	51	2	31.6	13.6	22.7	17.8	57.57	11.3
22/5	127	2	34.0	17.9	25.9	16.0	56.4	11.1
29/5	190	0	33.9	18.4	26.4	15.2	58.0	10.9
5/6/2000	160	6	31.7	17.7	24.7	13.9	69.1	12.0
12/6	155	5	26.3	15.9	21.3	10.8	56.1	12.5
19/6	93	9	29.1	17.3	19.7	12.0	56.1	12.5
26/6	101	11	26.4	17.0	23.1	9.5	58.2	12.0
3/7/2000	144	6	29.9	18.4	24.0	11.5	59.7	12.2
10/7	172	6	35.6	18.3	28.7	14.3	58.7	12.3
17/7	88	14	34.4	20.0	29.6	12.3	58.4	12.2
24/7	166	6	36.9	22.1	26.6	14.7	57.2	12.1
31/7	195	5	33.6	19.3	31.6	14.4	59.9	12.2
7/8/2000	74	13	38.0	24.7	31.5	13.4	64.7	11.7
14/8	183	3	38.7	25.1	30.3	12.6	64.4	11.1
21/8	157	6	36.9	22.9	29.7	13.9	64.0	11.4
28/8	148	6	35.1	24.2	24.3	10.9	64.1	11.3
4/9/2000	92	18	29.4	18.9	22.9	10.5	62.0	11.0
11/9	109	12	29.3	17.0	23.6	12.2	59.7	10.9
18/9	114	10	28.9	18.6	23.6	10.4	59.9	10.3
25/9	90	19	29.7	17.0	23.1	12.8	64.7	10.7
2/10/2000	90	18	29.7	17.1	23.6	12.8	72.9	10.2
<b>Total</b>	<b>2699</b>	<b>177</b>	<b>679.1</b>	<b>401.4</b>	<b>536.9</b>	<b>271.9</b>	<b>1281.7</b>	<b>241.9</b>
<b>Mean</b>	<b>128.52</b>	<b>8.42</b>	<b>32.33</b>	<b>19.11</b>	<b>25.56</b>	<b>12.94</b>	<b>61.03</b>	<b>11.51</b>
<b>Second year</b>								
7/5/2001	39	2	32.1	18.1	25.1	14	57.9	9.3
14/5	50	2	31.3	14.5	22.9	16.8	57.0	10.4
21/5	112	2	31.7	17.0	24.4	14.7	56.7	10.5
28/5	161	0	33.4	15.4	25.7	15.4	57.0	11.5
4/6/2001	145	7	36.5	20.2	28.6	16.3	60.9	11.7
11/6	153	5	36.5	18.5	29.0	14.9	59.0	12.1
18/6	77	15	31.5	18.0	29.1	16.5	56.1	11.8
25/6	90	11	33.9	19.9	26.9	14.0	57.1	11.9
2/7/2001	130	7	38.2	22.8	30.7	15.4	59.1	12.0
9/7	147	6	37.2	22.8	30.1	14.4	59.6	12.0
16/7	85	17	35.3	20.3	27.9	14.9	59.7	11.7
23/7	145	6	38.2	23.0	30.7	15.2	58.9	11.8
30/7	187	5	34.4	20.6	27.6	13.7	61.9	11.8
6/8/2001	59	18	37.6	23.8	30.9	13.9	62.9	10.8
13/8	154	3	37.9	25.4	31.9	12.7	64.9	11.3
20/8	143	6	37.0	23.4	30.6	13.6	64.1	11.0
27/8	145	6	36.1	23.9	30.3	12.2	64.1	11.2
3/9/2001	72	18	30.2	20.1	25.3	10.2	64.3	11.7
10/9	97	12	29.0	16.7	22.7	12.1	59.3	11.1
17/9	106	10	29.4	18.3	23.7	11.3	58.7	11.0
24/9	75	13	29.1	17.3	23.0	12.1	64.1	11.0
1/10/2001	73	14	27.6	17.0	22.3	10.7	74.7	11.2
<b>Total</b>	<b>2445</b>	<b>185</b>	<b>744.1</b>	<b>437</b>	<b>599.4</b>	<b>305</b>	<b>1338</b>	<b>248.8</b>
<b>Mean</b>	<b>111.13</b>	<b>8.80</b>	<b>33.82</b>	<b>19.86</b>	<b>27.24</b>	<b>13.86</b>	<b>60.81</b>	<b>11.30</b>

Table (4): Simple correlation and Partial regression values of certain biotic and abiotic factors with their variability and probability levels to the population fluctuation of *P. citrella* larvae on Sour orange trees during 2000 and 2001 at El-Kanater El-Khairia, Qalyubiya Governorate.

Year	Source of variation	Simple correlation		Partial regression		"F" value		E.V. %
		r	P	b	p	f	p	
First year 2000	Daily max. temperature	0.374	0.044	2.590	0.812	5.534	0.001	60.58
	Daily min. temperature	0.340	0.131	-4.234	0.696			
	Daily mean temperature	0.403	0.059	4.886	0.242			
	Daily range temperature	0.104	0.651	-11.984	0.329			
	Daily mean R.H.%	-0.062	0.788	2.406	0.262			
	Mean of sunshine duration	0.211	0.357	1.032	0.915			
	Parasitoids No.	-0.612	0.013	-6.632	0.013			
Second year 2001	Daily max. temperature	0.561	0.016	6.901	0.395	5.579	0.001	59.09
	Daily min. temperature	0.406	0.060	-14.871	0.150			
	Daily mean temperature	0.512	0.014	15.034	0.139			
	Daily range temperature	0.138	0.537	-18.783	0.098			
	Daily mean R.H.%	-0.022	0.920	0.300	0.901			
	Mean of sunshine duration	0.012	0.954	3.958	0.567			
	Parasitoids No.	-0.498	0.018	-3.699	0.041			

r: Simple correlation coefficient value P: Probability level

b: Partial regression coefficient value E.V.: Explained variance

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تفضيل العائل و التذبذب الموسمي لتعداد ناخره أوراق الموالح على العائل المفضل  
وعلاقة ذلك بالعوامل الجوية والطفيليات

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تم إجراء دراسة بيئية على ناخره أوراق أشجار الموالح في محطة البحوث الزراعية بالقناطر الخيرية-محافظة القليوبية وذلك خلال عامين ٢٠٠٠-٢٠٠١ م، وأظهرت النتائج أن الحشرة تصيب جميع أنواع أشجار الموالح. وأن النارنج كان أكثر الأنواع قابلية للإصابة بالحشرة. بينما احتل الليمون والجريب فروت والبرتقال مرتبة متوسطة للإصابة بالحشرة في العام الأول والثاني للدراسة. أما اليوسفي فكان أقل العوائل إصابة بالحشرة في العامين. وبوجه عام كانت الإصابة في السنة الأولى أشد من السنة الثانية. حيث بدأت الإصابة في السنة الأولى في منتصف شهر مايو وتم تسجيل خمس ذرات للحشرة خلال هذه الفترة وكانت أعلى ذروة في ٢١ يوليو حيث بلغ تعداد الحشرة ١٩٥ يرقة/٥٠ ورقة. بينما بدأت الإصابة في السنة الثانية في أول شهر مايو وتم تسجيل خمس ذرات أيضا خلال فترة الإصابة وكانت أعلى ذروة في ٣٠ يوليو حيث بلغ تعداد الحشرة ٨٧ يرقة/٥٠ ورقة. كما تبين من نتائج معامل الارتباط أن طفيليات الحشرة لها تأثير سالب على المعنوية على تعداد الحشرة خلال عامي الدراسة، بينما وجد أن التأثير المشترك للعوامل الجوية (الحرارة، الرطوبة النسبية، الشمس) مع العوامل الحيوية (الطفيليات) كان تأثيرا معنويا قويا وإيجابيا على تعداد الحشرة خلال عامي الدراسة.