RESULTS AND DISCUSSION

The present work carried out in citrus orchard in Qalubia Governorate, for the purpose of the possibility of using relatively safe methods in control citrus leaf miner (CLM) *Phyllocnistis citrella* Stainton. This study include a try to create a programs of integrated pest management, which was the use of all suitable techniques in compatible manner as possible to maintain the population levels below those causing economic injury. Every factor of integrated control was tested alone and finally the use of some the previous methods in an integrated programme.

The methods of CLM control:

1. Chemical Control:

This experiment was carried out during the summer of 2003 season, where sour orange trees highly infested with CLM as a trial to find some more effective compounds against *P. citrella* to decrease its damage in citrus orchards. Three insecticides were applied, Vertimec 1.8% (abamectin), Confidor 35% (imdacloprid) and Admiral 10%. Three insecticides were sprayed in recommended and half recommended concentrations.

Data presented in **Table (1)** indicated that the population of citrus leaf miner after one day from the beginning of treatments was highly affected by spraying Vertimec + KZ oil at the recommended concentration giving maximum reduction (54.67%), while Admiral at the recommended and half recommended concentrations gave minimum reduction (6.85%) and 22.02%, respectively. Nearly there was no any difference between the two used concentrations of Confidor in reducing the CLM population where caused 39.69 and 39.16%, respectively. Vertimec in the recommended concentration occupied the first category in killing and reducing the mean number of CLM when it reduced 54.67% and the half recommended concentration caused (33.07%).

The second sample was picked up after two days post treatment. the results of mean numbers of larvae and pupae of CLM showed decrease in the population percentages. The reduction in larval and pupal density were 77.48%, 67.56%, 80.04%, 75.24%, 53.10% and 33.43% for Vertimec + KZ oil, Confidor and Admiral with the two concentrations, respectively.

The third sample was picked up three days post treatment. Numbers of larvae and pupae were reduced sharply in the first third treatments, while its reduced moderately during the last third treatments. The rate of reduction recorded higher values on Confidor and Vertimec + KZ oil with recommended concentrations (93.22% and 92.44%, respectively), while the reduction percentages in larval and pupal density of Confidor and Vertimec + KZ oil with half recommended concentrations were less and recorded 86.75% and 85.51, respectively. However, the Admiral with two concentrations was more less of percentages reduction where recorded 51.62% and 49.01%, respectively. One and two weeks after treatment were the most effective periods after the treatment with all tested materials except for the last tested insecticide Admiral which the peak of its influence was after two and three days of treatment. The most effective treatment was the use of Vertimec + KZ oil either at 25 + 250 and 12.5 + 125 ml. The 100% reduction of CLM was achieved after the use of Vertimec and KZ oil in the two form of concentration. As for, the overall mean of reduction, the results given in **Table (1)** showed that the tested chemical treatment were descendingly, arranged due to their effect in reducing CLM population as follow. Vertimec 1.8% + KZ oil (25 + 250 ml/100 lire water) was the most effective one occupying the first position within all treatments followed by the half recommended dose of the same previous treatment (67.99%). Confidor either in the high concentration or the half recommended were moderately effective recording 63.82% and 50.82% reduction.

tab1

Either the high recommended concentration of Admiral (50 ml/100 L water) or the half recommended one (25 ml/100 L water) have weak effect not exceed 32.52% and 29.61% for the two concentrations, respectively. So, Vertimec + KZ oil with the two concentrations and Confidor with the recommended concentration in foliar application gave the best results. The residual effectiveness of Vertimec + KZ oil was longs than other insecticides (21 days), Vertimec insecticide + KZ oil, at the two concentrations was the most effective against citrus leaf miner resulting in 100% reduction of larval population in comparison with the control after 7 days of application. So, it can be recommended to reduce 100% of the pest by using Vertimec + KZ at recommended concentration (25 + 250) depending on the rate of reduction and the period of insecticides activity (residual effect). The aforementioned results agree with the findings of **Nucifor (1996)** who mentioned that imadcloprid (Confidor) has recently been registered for use on citrus in Italy, and experimental trials in that country in 1986 was found to be very successful against the pest, with a persistence of about 100 days. Also, **Salas *et al.* (1997)** mentioned that spraying with abamectin (1.8%, 20 cm^3/100 L water) or imdacloprid (35%, 35 cm^3/100 L water) gave > 90% control of *P. citrella*. Also, **Alrubea *et al.* (1997)** mentioned that Confidor (imidacloprid) gave the highest larval mortality (97%). Results also go with **Bene *et al.* (1998)** who found that, Abamectin and imdacloprid, the latter either in soil or foliar applications, gave the best results. Also, **Salas *et al.* (2002)** mentioned that aerial application of abamectin was evaluated for control of *P. citrella* on citrus in effective control, with successive applications disrupting the development of 3rd instar larvae and pupae and reducing the percentage leaf damage.

2. Biological Control:

This course of investigation was carried out during the period from 11th of September to 4th December 2003 in citrus orchard in Qalubia Governorate, which included more shoots of sour orange *Citrus aurantium* (L), with high level of numbers of citrus leaf miner.

This experiment was depended on the release of two rates of parasitoid *Cirrospilus quadristriatus*, 8, 12 parasitoid individuals per replicate, with control without treated. Tests aimed to study the population and percentage of parasitism of citrus leaf miner (CLM). Weekly samples (20 leaves) were picked up periodically to record the larvae and pupae and calculated the infestation rate. Also, the percentage of parasitism was recorded by exam 50 stages of *P. citrella*. The obtained data can be summarized as the following:

2.1. Study of percentages of infestation:

a- A rate of 8 parasitoids:

Data obtained in **Table (2)** and illustrated in **Fig. (5)** showed that the infestation rate was 100%/sample before the release operation. But the infestation rate after release of the parasitoids decreased relatively to record 91.6% infestation rate/20 leaves occurred during the 14th September (After three days from release). The infestation rate decreased to record low level of infestation rate at the 2nd October, which was 60% infestation rate/20 leaves. After that the infestation rate increased again to record 75%/sample (20 leaves). But it decreased again to record very low level occurred at October, 16th recording 46.6% infestation rate/20 leaves. But the period from 23rd October to 13th November show high of infestation rate which was 88.3% infestation rate/20 leaves on October, 23rd. But at the 4th of December the infestation rate was 10%/sample because, the number of *P. citrella* was very low. From the previous results it may be concluded that the highest infestation rate was occurred during the period pre-release, directly which was 100 *i.e.* all the sample of 20 leaves but the lowest rate of infestation was recorded on December 4th.

tab2

fig5

b- A rate of 12 parasitoid:

On the other hand, the results represented in **Table (2)** and **Fig. (5)** cleared that the infestation rate was 98.3%/sample pre the release of parasitoid. But the infestation rate decreased to 88.3%/sample after one week of release. The infestation rate increased again to 95%/20 leaves at 25th of September. After that the infestation rate fluctuated between decrease and increase reaching 18.3% by the end of infestation. As for the general, overall mean between the infestation rates under the two levels of release and control there was no clear difference, between the two rates of release (68.68 and 68.82%). The two infestation rates in the case of control was more (74.20) than after the release of parasitoids the 4th December which was 18.3% infestation rate/20 leaves. So the highest infestation rate was occurred pre release the parasitoid which was 98.3%/20 leaves, while the lowest level was occurred during the 4th December which was 18.3% infestation rate/20 leaves.

2.2. Effect of release of parasitoid on the numbers of larvae and pupae:

Generally, the results shown in **Table (2)** and illustrated in **Fig. (5).**

a- In a rate of 8 parasitoid:

The total number of larvae and pupae pre release was 45 individuals/20 leaves the number of larvae and pupae of pest fluctuated recording the highest population (51.6 individuals) on October 23rd and sharply decreased and further decreased reaching the lowest number (2.9) by the end of inspection on December 4th.

b- A rate of 12 parasitoid:

Before the release of parasitoid the number of CLM was 43.6 stage/sample, after that the number of CLM, gradually, decreased except for after 10 weeks of release which show increase in population number of CLM recording 33.6 and reduced again reaching the lowest population 3.6 individual without any clear

variation with the first role of release. The comparison between overall seasonal means of population showed small overcome to the side of release. Seasonal means were 26.75, 28.30 and 30.53 in the case of 12, 8 released parasitoids and control, respectively without clear variation and reduction between them.

2.3. Study of percentage of parasitism:

In such course infestation was carried out during the period at the 11th September to 4th December. Weekly samples were picked up randomly of each replicate. The number of each sample was 50 individuals (larvae and pupae) of *P. citrella*.

The results represented in **Table (3)** and **Fig. (6)** cleared that:

a- A rate of 8 parasitoids:

The rate of parasitism pre release was 10%. The parasitism was doubled 20.6 one weeks of the starting of experiment. the percentage of parasitism increased to 28.6% two weeks after the release, 25th of September. After that the percentage of parasitism decreased in fluctuating forms recording 3.6% by the end of experiment on December 4th. The highest level of parasitism rate was recorded on October 23rd.

b- A rate of 12 parasitoid release:

The percentage of parasitism was 10.6%/sample pre the release of parasitoid three days after release the percentage of parasitism increased to 23.3%. After that the parasitism was increased gradually to 34.6% on September 25th. But the parasitism continuously increased to record the high level (61.3%) by the end of October. The parasitism again decreased recording 54.6% at the 6th November. It increased again reaching the highest record of parasitism percentage 70% on November 11th. After that the rate of parasitism gradually decreased recorded the lowest level in the 4th December (4.6%).

fig6

As for, the overall seasonal means between the percentages of parasitism in the two treatments (two rates of release) as shown in **Table (3)** and illustrated in **Fig. (6)** it is clear that overall seasonal mean of parasitism increased by increasing the rate of parasitoid release. The grand mean of parasitism was 23.58% after the release of 8 parasitoid/30 shoots and 41.49% after the release of 12 parasitoids. On the other hand, overall seasonal mean of parasitism was 14.05% in the case of untreated shoots (control). So, it can be included the release of 8 parasitoid individuals of *C. quadristriatus* caused highest level of percentage of parasitism 35.3%/sample on October 23rd lowest level was 3.6%/sample with annual average 23.58. But the release of 12 parasitoid individuals of *C. quadristriatus* gave the highest level of parasitism was 70/sample and the lowest one was 4.6%/sample compared to parasitism in untreated shoots. The highest rate of parasitism was 30%/sample and the lowest level was 1%/sample, with annual average 14.05%. So, the relation between treatments of percentage of parasitism was highly significantly and positively on the parasitism rate. The above mentioned results on the efficacy of tested levels revealed that release of 12 parasitoid individuals achieved the highest of parasitism rate, hence it can be recommended to release 12 parasitoid individuals depending on the rate of parasitism and the annual average.

The obtained results seemed to be compatible with those attained by **Smith and Hoy (1995), Neale *et al*. (1995), Argov** and **Rossler (1996), Nia *et al*. (1997)** and **Malausa and Vacante (1997).**

3. Agricultural Control:

Investigation were carried out during two successive seasons 2002-2003 and 2003-2004. Aiming to study the effect of fertilization on the population of citrus leaf miner (CLM) *P. citrella* Stainton. Two kinds of fertilizer, nitrogen (N) and potassium (K) were tested. Weakly samples (20 leaves) were picked up from every replicate of navel orange at Qalubia Governorate to estimate the infestation rate

for the larvae and pupae of CLM in order to explore the effect of different levels of fertilization (recommended level, half recommended and twice of recommended level) which considered important for the control program of citrus leaf miner. The rate of fertilization was nitrogen fertilizer 500 kg/feddan (N_1), 250 kg/feddan (N_2) and 1000 kg/feddan (N_3), potassium fertilizer 200 kg/feddan (K_1), 100 kg/feddan (K_2) and 400 kg/feddan (K_3). The obtained data can be summarized as follows:

3.1. The first experiment:

Data obtained in **Table (4)** during the first season (2002-2003) show the percentages of infestation.

3.1.1. Study the percentages of infestation:

A. Percentages of infestation in nitrogen (N) treatments:

Percentages of infestation of CLM was zero during the first two weeks of inspection until the mid- of May, 2002 in all treatments and control. The population of CLM started in the third week of May 2002, where percentage of infestation ranged 8.3% - 25.0%, 11.6% - 25% and 18.3 – 31.6% in the three treatments, N_1, N_2 and N_3, respectively. During June 2002. Percentages of infestation increased gradually to reach the maximum levels from 100% the three levels of N treatments. On June 28th, 2002, percentage of infestation ranged 1.6% - 50% in N_1 treatment, 0.0% - 53.3% in N_2 treatment and during early July to late August, percentages of infestation ranged 1.6% - 46.6% in N_3. Percentages of infestation increased for the second time during the season reaching 98.3% in September 13th in N_1 treatment, while it was 91.6% in N_3 treatment. Percentages of infestation decreased sharply during the period from 18.10 – 6.12, 2003, where its ranged 0.0% - 13.3%, 0.0% - 8.3% and 1.6% - 13.3% in N_1, N_2 and N_3 treatment percentages. During the second half of December, 2002, percentages of infestation recorded zero% in the three treatments; N_1, N_2 and N_3. The demonstrated mean counts of infestation and statistical analysis of the obtained data indicate significant differences between

the applied quantity of N fertilizer and control. The whole mean of 2002 seasonal count of infestation were estimated as 24.4 in the case of recommended level of N fertilizer (500 kg/feddan 27.07 after the treatment with the half recommended level N_2, 250 kg/feddan) and 30.7 when the higher application (twice of recommended level 1000 kg/feddan) apposed to 28.36% in the control treatment.

B. Percentages of infestation in potassium (K) treatment:

Table (4) indicated that percentages of infestation with CLM were zero from the beginning of infestation until the Mid- of May, 2002 in all treatments and control. The population of CLM started in late May, 2002, where percentages of infestation ranged between 15 and 20% on May 24th and increased to on the followed on section 15% - 30% in the three treatments K_1, K_2 and K_3. Percentages of infestation increased to reach the highest level (100%) in the three levels of K treatment on June 28th. As for the period from November, 2002, the infestation fluctuated between decrease and increase recording another two peaks the first on September 13th and the other on November but with low record of infestation in the three K treatments (200 kg/feddan, K_1, 100 kg/feddan, K_2 and 400 kg/feddan) and control. From the previous results, in **Table (4)** it is clear that no obvious variation between the three levels of K treatments and control in 2002 season. The seasonal means of infestation after adding K fertilizers were 21.79, 25.36 and 25.96 for 100, 200 and 400 kg K/feddan, respectively apposed to 28.36% in control, 0.0% - 10.0% in K_1 treatment, 0.0% - 8.3% in K_2 treatment and 0.0% - 20.% in K_3 treatment. During the second half of December. So it can be said that the highest infestation rate was recorded at 28th June per every treatment of fertilization and the control (without treated). Statistical analysis showed that significant differences between treatments, but the highest mean was recorded for double recommended nitrogen level (N_3) 1000 kg/feddan (about 6 kg/tree) during the year and the lowest mean was recorded for half recommended potassium (K_2) 100

kg/feddan (about 0.6 kg/tree) during one year. So using high level of nitrogen led to very high infestation rate of *P. citrella*, while using of potassium fertilizer led to low of infestation rate. To explore this may be said by using nitrogen fertilizer led to produce more shoots and terminal leaves which considered highly attractive to citrus leaf miner. But using potassium fertilizer may be led to tissue toughness and may be somewhat limit citrus leaf miner mobility and feeding. The aforementioned results are agreement with the findings of **Ateyyat and Mustafa (2001)**, in Jordan who mentioned that increasing rates of fertilization with urea on 6-years-old lemon trees resulted in increasing numbers of live larvae, pupae and parasitized larvae of citrus leaf miner. Numbers of live larvae and parasitized larvae were greatest at 850 g of urea per tree.

3.1.2. Effect of fertilization on numbers of larvae and pupae:

A. Total numbers of larvae and pupae in nitrogen (N) treatments:

From data in **Table (5)** it is clear that the total number of larvae and pupae during January 2002 to January 2003, were as follow. The larvae and pupae of *P. citrella* appeared at 17th May with low number (about 3.3 larvae and pupae/sample). The total number of larvae and pupae increased gradually to reach the first peak on June 28 (30.9, 26.3 and 20.4 individuals/sample) in N_1, N_2 and N_3 treatments, respectively. The total number of larvae and pupae fluctuated to reach again the second peak of pupae to record on August 2nd but with low population (10.9, 11.9 and 11.2) for the previous N application, respectively. Another two peaks were recorded on 13 September and on October 11th with score (30 and 25.6) and (14.6, 13.3 and 18.6 individuals/sample) for the two peaks, respectively. By the end of inspection from the mid of October the population of larvae and pupae of CLM decreased and disappeared on December 13th. The highest number of larvae and pupae were recorded 28.9 stage/sample at the end of the third week of September.

Double of the recommended rate of nitrogen (N_3): the population of larvae and pupae of citrus leaf miner were started at 24th May with low number (about 4 stage/sample). After wards the population of citrus leaf miner increased again to recorded 19.3 stage/sample at the end of the second week of June, 22.2 stage at 21st June and 20.4 stage at 28th at 21st June and 20.4 stage at 28th June. After that the population declined except at the first of August to record 11.2 stage/sample.

B. Total numbers of larvae and pupae in potassium (K) treatments:

Data obtained in **Table (5)** revealed that there was not any individuals of CLM appeared through the first three inspections until the mid of May. By the end of May larvae and pupae of the pest were recorded in low densities and increased gradually as in N treatment to reach also the first peak on June 28th with score (29.6, 32.6 and 32.9 individuals/sample). On the first week of July the population sharply decreased to range between 2.6 – 4.3 individuals/sample. After that the population again increased to reach the second peak on August 2nd scoring 7.6, 8.2 and 8.2 to the three K treatments and 12.6 individuals in control. The third peak of population was in September 13th recording 22, 33 and 33 larvae and pupae/sample after the application with K_1, K_2 and K_3, respectively apposed to 34.3 in untreated sample. From the mid of September the population varied between increase and decrease until it reached the fourth peak on October 11th with score 11.0, 11.9, 11.9 and 13.0 individuals/sample for K levels 200, 100, 400 and zero kg/feddan, respectively. The population after that, decreased gradually and disappeared by the second week of December.

Comparing the overall seasonal means of population, statistical analysis showed no significant variation between the three K treatments and control.

tab4

tab5

In conclusion it can be said that, the population of citrus leaf miner in most treatments were started at 24th May, because of the spring shoots were never infested (this shoots is about 75 from all the shoots which are promoting during the year), so the infestation rate of *P. citrella* Stainton appeared during summer and autumn seasons. The highest number of larval and pupal stages in most treatment were recorded at the 28th June and at 13th September. High level of nitrogen (1000 kg/fed.) showed the highest number of larval and pupal stage during summer and autumn seasons. But using 100 kg potassium fertilization/feddan exhibited the lowest population of larval and pupal stage of citrus leaf miner. So it can be recommended with no use of high level of nitrogen fertilization which may be give more infestation rate of citrus leaf miner depending on the rate of infestation and the number of pupae and larvae which was the period of insect activity. Also, it can be recommended to use the second level of potassium (100 kg/feddan), depending on rate of infestation and the period of insect activity which was lowest number of larvae and pupae. Such results agree with those were observed before by **Ateyyat and Mustafa (2001).**

3.2. The second Experiment:

Data of the second season of 2003 in **Table (6)** revealed the populations of larvae, pupae and percentages of infestation were recorded after the application with the combination of nitrogen (N) and potassium (K) fertilizer at the recommended rates as follow:

3.2.1. Study the percentages of infestation:

A. Percentages of infestation at the recommended rate of nitrogen (N1) mixed with three rates of potassium (K_1, K_2 and K_3):

The infestation of *P. citrella* in all treatments appeared in the 2nd half of May. The infestation started at 23rd of May with low level of infestation. It increased gradually till reach 46.6, 61.6 and 83.3% on

June 20th. It continues in increasing in the following week recording 55.0, 46.6 and 100% in N_1K_1, N_1K_2 and N_1K_3, respectively. The highest infestation was recorded on June 27th. The infestation fluctuated between increase and decrease till the beginning of December for the first two application and until the second week of December for the third treatment. At the end of the season appeared no infestation.

B. Percentages of infestation at half of the recommended rate of nitrogen (N_2) mixed with three rates of potassium (K_1, K_2 and K_3):

The infestation rate appeared relatively low, but after that it was increased gradually to record 46.6, 43.3 and 78.3% infestation rate/20 leaves on June 20th for N_2K_1, N_2K_2 and N_2K_3, respectively. Also, at the 11th June it was recorded 66.6, 70.0 and 71.6%/sample. 43.3% after N_2K_1, 40% after N_2K_2 and 36.6% after N_2K_3. After that the infestation fluctuated until the mid of November nearly it disappeared. The highest peaks of infestation were on June 20th for the higher treatment of potassium and on July 11th after the application with the other two K treatments (recommended and half recommended). The high level of potassium (K) due to early appearance of infestation this may be due to the early maturity of leaves.

C. Percentages of infestation at double of the recommended rate of nitrogen (N_3) mixed with three rates of potassium (K_1, K_2 and K_3):

The infestation rate was started at the 23rd May on the leaves treated with the third level of fertilization (N_3K_1) with low infestation and began to increase gradually to record 48.3% infestation/20 leaves at the 11th July. After that the population decreased relatively, but at the mid of August infestation rate was high (about 53.3%/20 leaves), but at the 19th September it was 33.3%/sample. After that the population began to decrease, but at 10th October the infestation rate was 30%/sample. The

highest level of infestation rate was occurred at mid of August, (53.3%)/20 leaves. On the trees received N_3K_2 level the infestation on May 16th with low infestation which increased at the 6th June to record 50% infestation/20 leaves. After that during the period from 13th June to the 11th July the infestation was relatively high, but at the 11th July it was 50%/20 leaves. The highest infestation was occurred during the period from 6th June to 11th of July. On the other hand, the leaves of trees received the highest levels of nitrogen (N) and potassium (K) [N_3K_3] infestation started on 16th May with low raise up gradually to record 56.6% infestation/sample (20 leaves), on 20th June. After that the population still high, to the 11th July. But after this period the infestation was low, while during on August 8th it was 33.3% infestation/20 leaves. The highest rate of infestation of *P. citrella* was occurred during June on 20th (about 56.6% infestation rate/20 leaves). Results given in **Table (6)** revealed clearly that the application 1000 kg nitrogen/feddan and 200 kg potassium/feddan (N_3K_1) resulted in infestation lower level (12.49) occupied the first category followed by N_1K_2 (500 kg N + 100 kg K/feddan) with 14.49 whole season mean count of infestation and the third level in decreasing infestation was N_3K_3 level (1000 kg N/feddan + 400 kg K/feddan) recording 15.92 seasonal mean count of infestation. On the other hand, the highest seasonal mean count of infestation was 21.93 after the treatment with N_2K_3 (250 kg N/feddan + 400 kg K/feddan) followed by the leaves of the trees received N_1K_3 (500 kg N/feddan + 400 kg K/feddan) recording 21.55 whole seasonal mean count of CLM infestation. The third highest level of infestation was 17.11 in case of N_2K_2 (250 kg N/feddan + 100 kg K/feddan). The seasonal mean count of infestation on the leaves of trees didn't receive any kind of fertilization (control) was 14.78. So, it can be said that data analysis showed significantly between half recommended of nitrogen with double recommended of potassium fertilization (250 kg nitrogen + 400 kg potassium per feddan) which was high level of infestation rate and double recommended of nitrogen with recommended of potassium fertilization (1000 kg nitrogen + 200 kg potassium) which were lowest

level of infestation rate of P. citrella. So, the relation between treatments of combination fertilization simple significant effect in most treatments.

3.2.2. Effect of nitrogen and potassium fertilization on the mean numbers of larvae and pupae of *P. citrella* in navel orange trees:

Three levels of nitrogen and others of potassium were applied. The three rates of nitrogen were recommended (500 kg/fed.), half recommended rate 250 kg and two times of recommended dose 1000 kg. Three rates of potassium fertilizers were added 200, 100 and 400 kg/fed. as recommended, half recommended and double recommended rate respectively to study the effect of these fertilizers on the population of larvae and pupae of *P. citrella*. The control treatment didn't receive any fertilizer.

Table (7) presents the weekly mean counts of *P. citrella* larvae and pupae that infested navel orange trees after application of ammonium nitrate (33.5%) and potassium sulfate (48%). Data clearly indicate that the first two inspection in the first and 2nd week of May showed no any larvae or pupae in all treatments. In the 2nd half of May lower numbers of larvae and pupae were recorded (between 0.3 and 1.6 individuals in some treatments and control). The mean numbers of larvae and pupae gradually increased but in low population except in N_1K_1 and N_3K_1 which their trees were free of any larvae and pupae till the end of the third week of May and the fourth week respectively. At the beginning of June high and slight increase in larvae and pupae populations were achieved. The highest mean was recorded in the first week of June (13.9 individual/sample in the leaves of trees received 1000 kg of nitrogen and 100 kg potassium followed by 12.9 in the case of N_2K_3, 12.3 individual in N_1K_1, while the lowest population (1.3) recorded on the trees received N_3K_1 appeared to 9.6 individual in the leaves of control trees. Data indicate also that during June and the first week of July the highest occurrence of larvae and pupae was estimated. After that the population decreased and increased in

fluctuating direction. In November the trees of all treatments harboured very few numbers of larvae and pupae and in these three weeks of December all the trees of all treatments and that didn't receive any kind of fertilizers become free from any larvae and pupae except for the trees received N_2K_1 which become free of larvae and pupae only two weeks before the end of inspection. So, it can be said that there was limited difference in the numbers of citrus leaf miner in most treatments. As the whole seasonal means in **Table (7)** and according to the calculated L.S.D. it is clear that *Phyllocnistis citrella* larvae and pupae was significantly the highest (6.15 individual/sample) in the leaves of the trees that received 250 kg nitrogenous fertilizer and 400 kg potassium fertilizer/feddan. On the other hand, trees received 1000 kg of nitrogenous fertilizer and 200 kg potassium fertilizer/feddan showed the lowest infestation harbouring the lowest population of larvae and pupae of citrus leaf miner recording seasonal mean count 3.05 individuals/sample followed by 3.64 for the trees applied with N_1K_2 (500 kg N + 100 kg K), the plants received N_3K_3 and the trees received N_2K_1 (3.94). The trees did not receive any fertilizer recorded seasonal mean count 3.73.

From the results demonstrated in **Table (7)** it could be concluded that there were 3 categories of populations. The first category that harboured the lowest populations of CLM individuals included the treatments of N_3K_1, N_1K_2, N_3K_3 and N_2K_1 harbouring seasonal mean count of larvae and pupae 3.05, 3.64, 3.92 and 3.94, respectively. The second category harbouring from 4 and minimum than 6 comprising the treatment of N_3K_2, N_1K_1 and N_2K_2. The third category of infested trees that infested with further than 6 individuals/sample representing with the three fertilized by N_1K_3 and N_2K_3 harbouring the highest seasonal mean counts of larvae and pupae. The seasonal mean count 3.73 individual/sample was recorded in the case of trees didn't receive any kind of fertilizers.

Statistical analysis showed significant difference between the first category and the third one. No significant differences were recorded between the second category recording the moderate infestation and the two other groups.

Data revealed also that the application of fertilizers had a significant effect on the pest population. The balance between types of fertilizers may limit the population of the insect. The increase of potassium level may play a role in decreasing population or at least didn't effect in this scale.

These results seemed to be compatible with those of **Atyyat and Mustafa (2001)**.

4. Study of natural control:

This course of investigation was carried out in two successive years in two citrus orchards of navel orange trees, one of this orchard was subjected to all conventional and chemical control and another was left absolutly without any chemical control. This study included comparison between the effect of natural factors on the occurrence of larvae and pupae of CLM. Percentages of parasitism or predatism were recorded on the trees of the two different orchard (treated and untreated) in two successive years.

4.1. The first season:

4.1.1. Percentages of parasitism:

Data in **Table (8)** and **Fig. (7)** showed the effect of natural conditions in comparison on the CLM natural mortality (parasitism or predatism) during 2002 season on navel orange as follow:

4.1.1.A. Untreated orchard:

- Percentages of parasitism:

Two peaks of parasitoids appeared during January 2002 to December 2002. The first one was at the first half of July 2002 (on July 15th). The top of the second peak was at the end of the second week of

October (on October 15th). The highest percentage of parasitism recorded at the end of the second week of October (about 36%).

4.1.1.B. Treated orchard with insecticides:

Also two peaks were recorded to CLM parasitoids on the untreated trees, the first one was recorded at the end of the second weeks of July. The second peak appeared at the end of the second week of October (on October 15th). The highest percentage of parasitism was recorded at the end of the second week of October 2002 (about 28%). So, it can be said that there are two peaks for parasitoids of CLM in both untreated and treated orchards with insecticides. The percentage of parasitism in an untreated orchard with insecticides was higher than in treated orchard, because the use of insecticides due to reduction in the population of natural enemies.

4.1.2. Study of percentages of predation :

Data presented in **Table (8)** and **Fig. (7)** showed that the percentages of predation on the citrus leaf miner *P. citrella* Stainson on navel orange trees during the first season 2002.

4.1.2.A. The percentage of predation in untreated orchard:

In this course of investigation data showed that appearance of the predators was at the end of May with predation rate of 8%. After that it increased gradually reaching 40% on June 15th and continuing in increasing to reach the first peak 52% on June 30th. The second peak was at the end of the second half of September recording 64% of predatory. After that the percentage of predation decreased through the period from the beginning of the second half of November and all December month.

tab8

fig7

4.1.2.B. The percentage of predation in treated orchard with insecticides:

Data in **Table (8)** and **Fig. (7)** showed three peaks to the predation on CLM. The first one on July 15th recording 34% predation rate and gradually decreased and again increased reaching peak (48%) on September 15th and gradually decreased only for two weeks and increased again to appear the third peak on October 30th with 38% percentage of predation to CLM. The highest peak of predation rate recorded at the end of the second week of September (about 48% predation rate). So, it can be said that such results agree with those were observed before on the percentage of parasitism.

4.2. The second season:

4.2.1. The percentages of parasitism:

Data obtained in **Table (9)** and, illustrated in **Fig. (8)** representing the percentages of parasitism on CLM during the second season 2003 showed the followings:

4.2.1.A. An untreated orchard with insecticides:

Two peaks of the parasitism rate on CLM were appeared during the period of inspection from February 2003 to February 2004. The first one was recorded at the end of the second week of July with 36% percentage of parasitism. The second peak was recorded at the end of the second of October. After that it gradually decreased until it disappeared absolutely by the end of December with the disappearance of the host. From the previous results it is clear that the highest percentage of parasitism was recorded at the end of the second week of October 2003 (about 52%).

4.2.1.B. A treated orchard with insecticides:

According to the results presented in **Table (9)** the number of the peaks of percentage of parasitism was two peaks as on the untreated trees. The first one was recorded at the end of the second week of July (34% parasitism). The second peak was (24%) at the end of the fourth week of September. The mean numbers of parasitoids

showed decrease and disappeared also by the end of the year. It is clear that the highest percentage of parasitism was recorded at the end of the second week of July (about 34%). Regarding the over all seasonal percentage of parasitism counted on the individuals of CLM during 2003 there was no significant differences between the treated orchard and the untreated one with 13.28 and 8.48% percentages of parasitism, respectively.

4.2.2. The predation rate:

On the other hand, the obtained results of the predation rate during the period from February 2003 to February 2004 were given in **Table (9)** and **Fig. (8).**

4.2.2.A. An untreated orchard with insecticides:

The numbers of peaks were recorded during the year two peaks reaching the same percentage of parasitism (50%). The first one was recorded at the mid of July. The second peak was recorded at the end of the second week of September. The highest percentage of predation was recorded at the mid-July and the mid of September (about 50% predation rate).

4.2.2.B. A treated orchard with insecticides:

As for the treated orchards the numbers of peaks were recorded was two. The first one was recorded as that on the untreated one at the end of second week of July with 46% predation. The second peak was recorded at the end of October. The highest percentage of predation rate was recorded at the mid-July (about 46%). So, it can be said that the highest percentage of predation was recorded in the untreated orchard but with the same numbers of peaks. In conclusion it can be said that the intensive use of insecticides may be due to many risks such as environmental pollution and reduce the natural enemies. So, the data obtained in this investigation indicated that, the mean numbers of natural enemies in the untreated orchard with insecticides was higher than that on the treated with insecticides. The role of the these natural enemies was important to reduce the citrus leaf miner.

The percentage of parasitism and predation differ from year to the other. So, the highest level of percentage of parasitism in the first year was about 36% but the highest level of predation rate in the same year was about 64%. But in the second year the highest level of percentage of parasitism was recorded 52% and the predation rate was 50%. Also, these differences from year to year was recorded on the treated orchards with insecticides. So, it can be said the role of natural enemies is important and may be integrates with other methods within insecticides, but with choosing the time in which the population of natural enemies out of peaks for managing the CLM pest.

In this scale **Pena *et al.* (1996)** mentioned that overall percentages of parasitism was higher on unsprayed than sprayed trees. **Liotta *et al.* (1996),** in Italy found that the rate of parasitism by the species varied, but in some cases exceeded 60%. It could be concluded that the total level of parasitism was not always sufficient to control population of *P. citrella*. **Costa *et al.* (1997)** in Spain, stated that the percentage of parasitism by *Pnigalio* sp. increased steadily, rising from below 10% between May and July, to 10 – 20% in August and September, and to > 30% in October. **Liotta and Vacante (1997)** in Italy, reported that when levels of parasitism were high, the reduction in number of *P. citrella* was not significant. Also, when chemical control is used, the presence of these natural enemies must be taken into consideration. **He-Mido *et al.* (1998)** in China, recorded the number of predators was lower in June and showed an increase in logistic curve style over the next few months. **Wang *et al.* (1999)** in China, reported that parasitoids played a more significant role than predators. **Jacas *et al.* (2001)** in Spain, found that the means pesticides applied against the pests harmless as possible against natural enemies responsible for natural control of the former group of phytophages. Side-effect testing of pesticides with the most important natural enemies. **Urbanja *et al.* (2001)** found that predation on *P. citrella* increased as the season progressed, reaching maximum values of 38% at the end of summer.

tab9

fig8

5- Using the mechanical control:

Such course of investigation was carried out during two successive years 2002 and 2003. The present work aimed to study the effect of pruning and light all day (for one year) on the population fluctuation of citrus leaf miner (CLM) *P. citrella* Stainton. Weekly samples (20 leaves) were picked up from orchards in Qalubia Governorate to record CLM individuals (larvae, pupae) and calculate the percentage of infestation to explore the effect of two kinds of pruning and light all day. Which was considered important for the control programme of citrus leaf miner. The obtained data can be summarized as the following:

5.1. The pruning:

This investigation was carried out during two successive seasons 2002 and 2003 on navel orange trees by using two kinds of pruning (oppress pruning and moderately pruning) during winter season.

5.1.1. The first season (2002):

Data obtained in **Table (10)** and **Fig. (9)** represent the population density of larvae, pupae and percentages of infestation with CLM as follows:

5.1.1.1. The percentages of infestation:

A. Oppress pruning:

Data in **Table (10)** showed that there was absolutely no infestation of *P. citrella* during the period from January 2002 till the second half of may then the population of *P. citrella* started in appearance at 17th May with low infestation (6.6%). After that the infestation rate increased gradually to record the first peak at June 21 (100% infestation). After that the infestation rate decreased gradually and increased again to record the second peak at September 13th, (about 100% infestation/sample). The third peak was recorded on October 4th (about 86.6% infestation) after that the infestation decreased gradually again to record the fourth peak at November 15th.

The highest infestation was recorded at the June 21st and the September 13th which was 100% infestation.

B. Moderately pruning:

The infestation rate started on May 17th low (1.6% infestation/sample). After that the infestation rate was increased gradually reaching 100% infestation on June 28th (the first peak). The second peak was recorded on September 13th (about 100% infestation/sample). After that the infestation decreased gradually giving the third peak on October 11th which was 65% infestation. The fourth peak recording be about 16.6% infestation in the mid of November. The highest peak was at the June 28th and at the September 13th (about 100% infestation/sample).

5.1.1.2. Population of larvae and pupae:

A. Oppress pruning:

Data in **Table (10)** and **Fig. (9)** show the total numbers of larvae and pupae during the period from January 2002 to January 2003. Larvae and pupae of *P. citrella* started on May 17th with low number (about 1.3/sample). The first peak was recorded on the June 28th (30.96 larvae with pupae/sample). The second peak recorded at the September 13th (about 36.3 larvae and pupae/sample). The third peak was on October 4th which was 19.9 larvae and pupae/sample. But the fourth peak was recorded at mid-November (11.6/sample). The highest peak was recorded on September 13th (about 36.3 larvae and pupae/sample).

As for the overall seasonal means either of infestation rate or of larvae and pupae population, the tree with moderately pruning harboured low infestation with CLM 19.20% compared to the oppress pruning trees which recorded 25.48% significant variation between the oppress pruning-trees and moderately ones from the dise of CLM population giving 6.11 and 4.74 individuals (larvae and pupae)/sample for oppress and moderately pruning trees, respectively.

fig9

5.1.2. The second season:

Data in **Table (11)** and **Fig. (10)** represent the effect of two kinds of pruning (oppress and moderately) on the infestation rate with citrus leaf miner and its population (larvae and pupae) during the second year 2003 in orchard in Qalubia Governorate.

5.1.2.1. Percentages of infestation:

A. Oppress pruning:

Data in **Table (11)** and illustrated in **Fig. (10)** stated appearance on the leaves of May 16th with low infestation (1.6%). After that the infestation rate increased gradually to record 65% infestation by the end of the first week of June. The first peak was recorded in the end of the second week of June (96.6% infestation). The second peak was recorded at the end of the last week of June which was 75% infestation. The infestation calculated and recorded the third peak on August 8th (50% infestation/sample). The fourth peak was recorded on September 12th which was 41.6%. But the fifth peak was recorded at the October 24th which was 83.3% infestation. The highest peak of infestation was recorded on June 13th giving 96.6% infestation/sample.

B. Moderately pruning:

The infestation started late one week than on oppress pruning on May 23rd also with low (1.6% infestation), then the infestation rate increased gradually to recorded the first peak on the June 20th (35%). But the second peak recorded on July 11th (56.6% infestation). The third peak recorded in the second week of August (43.3%). The fourth peak recorded at the end of August which was 31.6% infestation/sample. The last peak recorded on October 10th (28.3% infestation). The highest peak was recorded at the July 11th which was 56.6%.

fig10

5.1.2.2. The total numbers of larvae and pupae:

A. Oppress pruning:

Larvae and pupae of CLM appeared on the mid-May with low (0.6). After that the population increased gradually to record 30.2 larvae and pupae at the end of the second week of June. The second peak was recorded on June 27th which was 19.6. After that the population decreased again and increased to record the third peak on August 8th (16.6). The fourth peak was recorded on September 26th (10.6). The last peak was recorded on October 24th which was 19.6. The highest population of insect individuals was recorded on June 13th which was 30.2 larvae and pupae/sample.

B. Moderately pruning:

The population of CLM began the appearance on May 23rd with low numbers of CLM (about 0.3). The first peak was on June 20th which was 10.2%. The second was abundance of population on July 11th (14.3 larvae and pupae/sample). The population decreased again and increased on August 8th to record the third peak which was 10.6%. The fourth peak recorded at the end of August which was 12.3 larvae and pupae. The last peak was recorded on October 10th (about 6.3 larvae with pupae/sample). The highest population numbers was recorded at the July 11th (14.3 larvae and pupae/sample). So it can be said that the CLM started in appearance on May 16th in oppress pruning and late one week in moderately pruning (May 23rd). There were five peaks the two treatments. The highest abundance of infestation rate in both oppress and moderately pruning was on June 13th which giving 96.6% infestation. The highest population of larvae and pupae in both oppress and moderately pruning was on June 13th and was very higher (30.2 larvae and pupae/sample) than on oppress pruning ones. The grand mean of percentages of infestation in both oppress and moderately pruning was 34.81 and 17.08, respectively. But the grand mean of mean numbers of larvae and pupae in both oppress and moderately pruning was 9.28 and 4.67, respectively. It may be conclude that the population of CLM in both oppress and

moderately pruning in two season of study was higher in oppress pruning than on moderately pruning. So it can be recommended to avoid the oppress pruning to minimize the CLM infestation and its population. Statistical analysis showed significant differences between the treatments. Such results agree with **Ateyyat and Mustafa (2001)** in Jordan who mentioned that the summer pruning in which the pruned branches were placed under the trees resulted in decreasing numbers of live larvae and pupae without affecting numbers of parasitized larvae.

5.2. Effect of light all day:

This experiment was carried out during one year (April 2003 – April 2004) by using light all day in treatment and another treatment without light during the night. This experiment was carried out on Sour orange seedlings at Qalubia Governorate. The numbers of larvae and pupae were recorded, also the percentages of infestation was calculated as follow:

5.2.1. The percentages of infestation:

A. Under light:

Data obtained in **Table (12)** and illustrated in **Fig. (11)** demonstrated the percentages of infestation with citrus leaf miner during April 2003 to April 2004. The infestation began in low on June 20th (6.6%) and again gradually increased until the first peak of infestation 13.3% on July 18th and varied between decrease and increase to reach the highest record of infestation 48.3% on September 19th. The lowering infestation was recorded again to disappear absolutely by the second half of December, From the previous results it was obvious that the beginning of infestation was at June 20th and the highest infestation was recorded in the beginning of the second half of September which was 48.3% infestation/sample.

B. Without light:

The results under without light conditions demonstrated in **Table (12)** and **Fig. (11)** in this conditions the infestation started three weeks early than under light condition (0.6%) and disappeared two weeks lately (November 28th). The timing of light infestation appearance was the same under the two different conditions (under light and without light) on September 19th. While was lower (33.3%) without light then under light condition (48.3%). As for the second total infestation it was clear that it was higher in the case of absence light (329.8) with overall mean (10.99%) than under light condition (219.2) with overall mean seasonal mean 9.30. It means that the conditions of light presence during the night due to decrease in the rate of infestation because the light attracted the moths far from the seedlings of sour orange.

5.2.2. Total numbers of larvae and pupae:

A. Under light:

Generally, as shown in **Table (12)** and illustrated in **Fig. (11)** the results during one year from April 2003 to April 2004 cleared that the total numbers of larvae and pupae of citrus leaf miner (CLM) in Sour orange seedlings recorded four peaks. The first one was recorded on July 18th with low number of CLM (about 2.9/sample). The second peak recorded on August 22nd with 4.3 larvae and pupae/sample. While the third peak recorded on September 19th with 9.6 individual/sample. The last peak was recorded on October 10th with 4.3 insect/sample. Poor numbers were recorded during the period from October 17th to December 12th.

B. Without light:

The numbers of larvae and pupae showed five peaks in the conditions without light. The first one recorded on June 20th with 5.2 individuals/sample. But the second peak recorded on July 18th with 2.9 individuals/sample. The third peak recorded on August 22nd with 5.3

insect/sample and fourth one recorded on September 19th which was about 7.6 individuals/sample. The last peak was recorded on October 10th with 5.3 insect/sample. The highest peak was at the September 19th which was recorded 7.6 individuals/sample. On the other hand, *P. citrella* appeared lately on seedlings under light than on that without light and also the numbers of insect pest individuals were under light than in the case of seedlings in dark conditions. The above mentioned results on the efficacy of tested light on the population of citrus leaf miner may be achieved the best results to reduce the citrus leaf miner population. Hence it can be recommended to put seedlings of orange under light a long part of night in the period of pest outbreak.

6. Using IPM programme:

The present work aimed to study the population fluctuation of citrus leaf miner (CLM) *Phyllocinstis citrella* Stainton by using IPM programme (chemical and biological control) on sour orange trees in Qalubia Governorate as a try to integrate two of control factors (chemical and biological control agents). Weekly samples (20 leaves) were picked up periodically. The obtained data can be summarized as the following:

A. The percentages of infestation:

Data obtained in **Table (13)** and illustrated in **Fig. (12)** during the period from 23rd June to September 15th showed that the infestation rate was 96.6% before any treatment at the 23rd June. After chemical treatment the infestation rate recorded 51.6% on June 24th. Two days after chemical treatment, the rate decrease to record 26.6% on June 25th. After that the residual effect chemical control (Vertimec 25 cm^3 + KZ oil 250 cm^3/100 Litres water) continued during the period from 26th of June to 14th July recording 0%, *i.e.* the infestation rate disappeared absolutely during this period. After the previous period the infestation rate appeared with low level (5% infestation rate/sample) on July 14th, and increased to recorded 48.3% on July 28th. After that the biological control was applied, by release 12

parasitoids individuals of *C. quadristriatus*/replicate on August 2nd. From **Table (13)** and **Fig. (12)** the infestation increased in the first week after the release of parasitoids because the late efficacy of parasitoid. Two weekly from the biological control agent application was recorded 78.3%/sample. After the infestation rate decreased to reach only 30% and that the infestation rate decreased continued in lowering until reach 21.6% on gradually to record 30%/sample third week of August after passing three weeks of treatment then increased reaching 80% on September 8th.

B. Larval and pupal populations:

Data presented in **Table (13)** and **Fig. (12)** the same trend in all case of larvae and pupae population. The total number of larvae and pupae of *P. citrella* Stainson on sour orange was 45 individual/20 leaves (sample) before any kind of treatment. After chemical control it decreased recording 16.6 individual/20 leaves (sample) after 24h of treatment larvae and pupae absolutely disappeared 72 h after chemical treatment and prolonged for four weeks. Larvae and pupae population appeared recording 1.6 individual/20 leaves (sample) on July 21st and increased to reach 13.9. Then the biological control was applied on August 2nd. The number of larvae and pupae started in increase for two days after the release of parasitoids. After 10 days of release the population decreased recording 14.3 on August 11th continuing in decrease till August 25th recording 6.9 and return to increase again recording 20.6 individuals/20 leaves (sample). Concerning the overall means of infestation rate and also of numbers of larvae and pupae under IPM programe or without any treatment the results in **Table (13)** showed that there were obvious differences between the mean of infestation with CLM under IPM programe recording 37.99% opposed to 84.33% in the case of untreated trees. As for the number of CLM larvae and pupae data in the aforementioned Table indicated to increase number on the trees that didn't receive any kind of pest control treatment 452.4 individual/20 leaves (sample) as a total number compared at 199.2 individual under IPM programme with

28.27 individuals opposed to 12.45 as overall seasonal means in the case of control and IPM programme, respectively.

All treatments ether separately, or in combination in IPM programe were effective in reducing the population of CLM compared with control. From the above mentioned results it can be concluded that the highest level of infestation was before using of IPM programme (96.6% sample). But after three days of using IPM programme was zero%/sample. Also, the total numbers of larvae and pupae before using IPM programme was 45 individuals/sample (the highest level) but the lowest level was after three days of using IPM programme (zero individuals/sample).

So it can be said there highly significant for infestation rate and total number of larvae and pupae between IPM programme treatment and without treated. It can be conclude that the use of IPM programme achieved good results hence it can be recommended to use this programme, twice during the season of infestation with CLM (from mid-May to the first of December). So it can be recommended to use of IPM programme depending on infestation rate and numbers of CLM, also the long activity period of programme. Integrated pest management-compatibility of petroleum oil Diflubenzuron, and Azadirachtin. Pesticides can be considered compatible for IPM programme if they are effective in suppressing the target pest and preventing its resurgence and outbreaks of secondary pests, yet selective for natural enemies of both the primary and secondary pests **(Villanueva *et al.*, 2000)**. Petroleum oil, Diflubenzuron, and Azadirachtin were selective to *Ageniaspis citricola*, as well as effective in managing populations of *P. citrella* in both laboratory **(Villanueva-Jimenez and Hoy, 1998b)**. Experiments confirm that the IPM-compatibility ratings obtained in the laboratory **(Villanueva-Jimenez and Hoy, 1998b)** are useful in predicting field performance during 2 years in grapefruit trees grown in North Central Florida. Additional trails are needed to confirm the validity of the IPM-compatibility ratings in other geographic locations and with other citrus varieties. **Wu (1995)** in Taiwan indicated that the integrated control of 3 arthropod pests of citrus using a predatory chrysopid and

selective acaricides was investigated in Taiwan in 1992-93. One thousand eggs of *Mallada basalis* with hatch rate of about 90% were introduced to each tree for each release of the predator in chrysopid release plots. *M. basalis* kept population densities of the *Phyllocnistis citrella* and the tetranychid *Panonychus citri* at a significant low level, but failed to control the eriophyid *Phyllocoptruta oleivora*. **Siscaro *et al.* (1997)** reported that first results on the integrated management of *P. citrella* in Italy are presented. Short notes on biology and damage are also given. A biological control programme has already been initiated in Sicily and Calabria, through studies on indigenous parasitoids (*Cirrospilus picus, C. vittatus* and *Pnigalio* sp.), their rearing and field release. The exotic parasitoids *Ageniaspis citricola* and *Quadrastichus* were introduced, reared and recovered in the field. **Conti *et al.* (1997)** setup the results of an integrated control programme for combating the gracillariid *Phyllocnitis citrella* on citrus crops in Sicily during 1995-96. The pest was monitored on a regional scale by periodic observation of the levels of infestation, and capture rates of adults in pheromone traps. The activity of indigenous natural enemies and biological control agents was also monitored. The effectiveness of various insecticides against the pest strategy of defence is based on the alternate use of methomyl, flufenoxuron and white mineral oil. The use of alternative control techniques, including mechanical methods, such as the use of protective nets, is recommended. **Vacante (1997),** recommended that this proceedings, held on 29 August 1996 in Florence, Italy, contains 17 papers, 8 of which cover integrated pest management in citrus leaf miner (*Phyllocnistis citrella*) in the Mediterranean region. **Villanueva *et al.* (2000)** reported potentially selective and integrated pest management (IPM)-compatible pesticides for the citrus leaf miner and its parasitoid *A. citricola* were compared under nursery field conditions at Gainesville, Florida, USA during November, 1995. Pesticide applications were not justified when *P. citrella* infestations were <1 min per leaf and the biological control agent *A. citricola* was present.