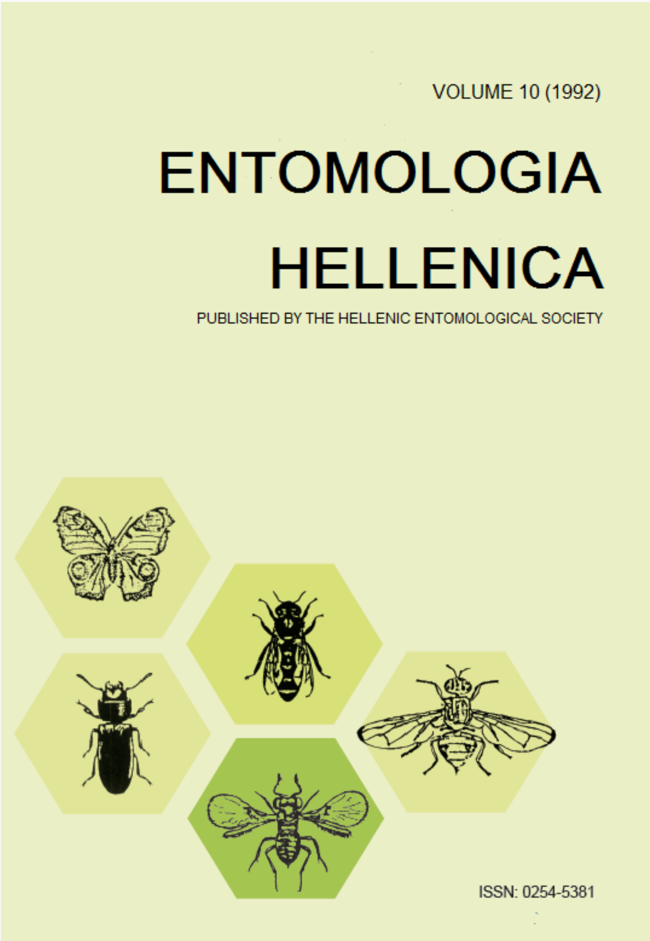
ENTOMOLOGIA HELLENICA

Vol 10 (1992)



The application of an Integrated Control on Eggplant for the Greenhouse Whitefly, Trialeurodes vaporariorum

Safel Dawla Abdallah, S. Michelakis

doi: [10.12681/eh.14001](https://doi.org/10.12681/eh.14001)

ENTOMOLOGIA HELLENICA 10 (1992): 25-32

The application of an Integrated Control on Eggplant for the Greenhouse Whitefly, *Trialeurodes vaporariorum*.[1]

SAFEL DAWLA ABDALLA and S. MICHELAKIS

Mediterranean Agronomic Institute of Chania
P.O. Box 85, GR-73100, Chania, Crete, Greece
Subtropical Plants and Olive Trees Institute
Chania, Crete, Greece

ABSTRACT

Integrated control of the greenhouse whitefly on eggplant, using physical (traps), chemical and biological methods, was tested. The most efficient combination was the use of Quinomethionate and traps. Applaud and Actellic mixture was fairly effective in controlling the greenhouse whitefly. Biological control by the parasite *Encarsia formosa* (Gahan), resulted in moderate, but adequate control when combined with traps. Traps alone gave reasonable results. All treatments were effective in reducing whitefly population to a satisfactory low level, when compared to the untreated populations. Parasitoid/host release ratio play an important role in the results of biological control using *E. formosa*. The higher release ratio of 4:1, parasitoid:host, gave the maximum parasitization percentage.

Introduction

Greenhouse eggplants provide an ideal situation for the utilization of integrated control measures. The integrated control in greenhouse eggplants which is a crop of increasing importance, presents special difficulties because the whitefly *Trialeurodes vaporariorum* West multiplies rapidly in this crop, resulting in a considerable damage, and not much work has been done concerning eggplants. The use of yellow sticky traps to monitor the population changes of the greenhouse whitefly, as well as being a method of control is well documented (van de Veire and Vacante 1984, Boukadida 1991).

Chemical control by the use of selective and systemic insecticides is also used, especially during winter in the unheated plastic greenhouses when temperatures are too low to allow parasite introduction. Applaud and Actellic have a combined action against the greenhouse whitefly (Michelakis 1987). Nucifora (1987) reports that the lethal action of Quinonethionate is slow which does not mean that it is an inefficient chemical, as it has proved to be a good selective chemical against adults, eggs and first and second stage larvae, while it does not kill the third and fourth stage larvae on which the parasitic wasp *Encarsia formosa* develops.

Biological control is regarded as the cornerstone of integrated control programs. However, it cannot entirely replace chemical control. Rumei et al. (1987) reported that a higher release ratio does not always result in a better biological control because if the wasp number exceeds that of the host, this may result in wasp waste, host feeding and finally inefficient control.

This study aimed to investigate the possibilities of the integrated control of the greenhouse whitefly on greenhouse eggplants as well as the proper release ratio of the parasite.

Materials and Methods

Integrated Methods

The experiment was conducted in the glasshouse of

[1] Received for publication September 20, 1992.

TABLE 1. Means of monthly counts of adult whiteflies per plant per treatment.

Date	T. + Enc.*	T.*	T. + Qu.*	App. + Act.*	Control
November 1991	20.8 b.	19.8 b	10.8 c	14.3 bc	48.1 a
December 1991	38.8 b	32.8 bc	29.8 bc	36.0 b	138.0 a
January 1992	54.4 b	53.4 b	45.8 c	54.6 b	252.2 a
Ferbruary 1992	142.4 c	177.4 b	170.6 b	146.1 c	444.3 a

* Enc.: Encarcia, Qu.: Quinomethionate, App.: Applaud, Act.: Actellic, T: Traps.
Means followed by the same letter in the same line are not significantly different at the 5% level of significance (Duncan's multiple range test).

the Mediterranean Agronomic Institute of Chania (MAICH), in which 100 seedlings of eggplant hybrid (Delica-F1) were transplanted to prepared locations. These locations consisted of compartments, consisting of 5 seedlings spaced at 80 cm and covered with white nets. A curtain was constructed to permit access to the compartment. The white nets were installed to prevent invaders from entering and the whitefly inside from escaping. Each compartment was 4 m long, 1.20 m wide and 2.30 m high. There were 40 compartments, each representing a single treatment. The experimental design was the randomized complete block design with 4 blocks and 5 treatments. Treatments were assigned at random for each block.

E. formosa in combination with traps was tested. The parasite was introduced on cards containing black pupae from which parasites emerged. Each treatment received 3 cards, each with about 40 black pupae; cards were fastened to the lower leaves of the plants. Two parasite releases were made, the first on October 30, 1991, the second two weeks later. In this treatment, the whitefly adults were counted every 5 days; trapped insects were counted weekly as well as percentage parasitization which was calculated by counting the black and whitefly pupae at 10 day intervals starting from their appearance on the lower surfaces of leaves.

Physical control methods were tested, using yellow sticky traps. Three yellow sticky boards 18x13 cm were suspended over the tops of groups of 5 plants; the traps were raised as the plants grew so that they were level with the top leaves. Counting of captured adults was made weekly.

Physical and chemical methods were combined; traps in addition to Morestan (Quinomethionate). Traps were installed at planting and the chemical was applied weekly. Counts of adult whiteflies was made every 5 days and the population density on traps was counted at weekly intervals.

Chemical control including two chemicals was tested; Buprofezin (Applaud), the insect growth regulator, at a rate of 40g/100 l of water. It acts on all immature stages of the whitefly with the exception of adults, against which pirimiphos methyl (Actellic), at a rate of 100 ml/100 l was used. These chemicals were applied together to investigate their combined effect. Counts were made every 5 days for adult whiteflies.

The control plots which were untreated, to compare the effectiveness of the four treatments. Counts were made every 5 days for adult whiteflies. Transplanting was done on September 30, 1991. The plants were grown for one month before applying the treatments. During this period, the white nets were left open to permit natural infection by insects coming from weeds. At the end of the last week of October, preliminary counts were made to estimate whitefly numbers and to homogenize blocks by artificial infestation. Artificial infestation was made by introducing adults from weeds on leaf-pieces. After a homogeneous population was established, treatments were assigned at random. Agricultural practice such as watering, fertilization and heating during winter were as normal. Average temperature was calculated daily. The experiment was terminated on February 27, 1992. Data from 25 counts were statistically analysed. Duncan's multiple range test was used to compare and differentiate mean numbers of adults per plant on each treatment (Table 1).

Some plant leaves and fruits were covered with honeydew on which black sooty mould developed. This resulted in unhealthy plants and contaminated fruits. Damage was assessed by counting infested plants and contaminated fruits and the results were expressed as the percentage of damaged plants and fruits. The results were statistically analysed (Table 3 and 4) respectively.

The parasite release ratio

Sixteen plants were grown in peat-perlite post under cylidrical frames. Each plant was covered with a white net to form isolated units, restricting the movement of hosts and parasites and preventing invasion. A window was installed to permit irrigation, treatment application and counts. The design used was the randomized complete block design with 4 blocks and 4 treatments. Treatments were assigned at random to the plants. To each plant, one card containing 40 black pupae was introduced. The variation in the release ratio was obtained by introducing different numbers of adult whiteflies.

Treatments were 40 black pupae and 10 whiteflies at a ratio of 4:1, parasite:host; 20 whiteflies for a parasite/host ratio of 4:3; and 40 whiteflies having a ratio of 1:1. The adult whiteflies were introduced before the black pupae, which were introduced on October 30, 1991. A second release was made 15 days later, on November 14. Counts were begun after the appearance of black parasitized whitefly pupae on the underside of the lower leaves. Counts were made every 10 days. The experiment ended on February 15, 1992.

Results and Discussion

Integrated methods

The most effective treatment was the combination of physical methods using yellow sticky boards and chemical control using Quinomethionate, followed by Applaud and Actellic combination, traps and biological methods and traps alone. Table 1 summarizes the results. Each mean represents 6 counts in 4 replications, 24 observations for each month.

It is clear that during November (Table 1), the lowest whitefly numbers were observed on plots treated with Quinomethionate combined with traps (10.8 adults per plant), followed by the Applaud and Actellic treatments (14.3 adults per plant). During December and January traps combined with Quinomethionate had the lowest number (29.8). In February, the control plots had the highest number, 443.3 adults per plant; traps alone and traps in combination with Quinomethionate had lower numbers. Traps combined with *E. formosa* had the lowest number, 142.4 adults per plant; the Applaud + Actellic treatment had a low number, 146.1 adults per plant, because the traps became crowded with adults towards the end of the experiment and could not catch more adults, which may explain the high population numbers in plots with traps.

Whitefly numbers started to increase in all plots (Fig. 1). The control had the highest number. The initial whitefly density was 6.6 adults per plant, and increased steadily until January 3 (51.5 adults per plant), then decreased to 47.15 on January 8. It then increased to 66.75 on January 13, and decreased again to 62.4, on January 18, due to temperatures below 15°C which affected the development of the whitefly. Cold extends the life cycle (Hargreaves 1915) and thus affects adversely the population density. Hussey et al. (1969) stated that at 15°C the life cycle takes about 4 weeks, explaining the decline in whitefly number in January as shown in Fig. 1. At the end of January there was a linear increase until the beginning of February due to the rising temperatures, which became favourable for the whitefly (22°C). In the period from February 3 until February 17 there was stability in the whitefly population probably due to pupation stage after which a new generation appeared which accounts for the linear increase in the population until February 27 reaching 133.75 adults per plant.

Traps and Quinomethionate

Whitefly numbers were the lowest in this treatment. The first count showed 2.45 adults per plant, which decreased to 1.8 adults per plant, and then increased slowly until the end of January reaching 13.8 adults per plant. A sudden increase was observed on February 2 (25.85 adults per plant) which continued until the end of February, reaching 59.6 adults per plant. This was due to increased temperature which favoured development and because traps became crowded with adults and could not capture any more adults. These results confirm those of Nucifora at al. (1983), who found that selective chemical control using Quinomethionate is appropriate chemical for integrated control. Traps caught active flying adults and the chemical killed those on the top leaves.

Applaud and Actellic

Chemical control using a mixture of Applaud and Actellic gave satisfactory results, especially during winter. This treatment ranked next to

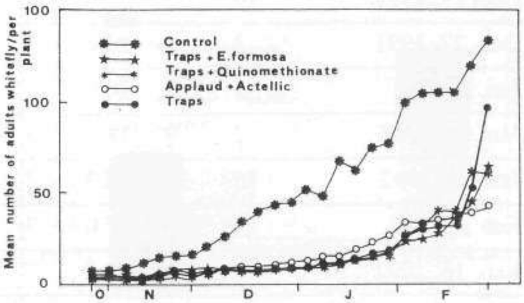


Fig. 1. Population changes over time under different treatment.

Traps + Quinomethionate; the whitefly population at the end of the experiment was the lowest (42.6 adults per plant). This result is in agreement with Michelakis (1987), who reported that the insect growth regulator Applaud, in combination with Actelic, effectively reduced the number of whiteflies on greenhouse tomatoes. The low population of the pest at the last count was due to the action of Applaud on immature stages and the effect of Actellic on adults.

Physical and biological control
The combination of traps with the parasitoid gave moderate results. The first count indicates 4.75 adults per plant; this number decreased slowly to 3.65 adults per plant on November 9 and then increased until the end of the experiment, reaching 62.5 adults per plant. No parasitoids were observed trapped on sticky boards. This suggests compatibility of yellow traps and parasitoids, noted by van De Veire and Vacante (1984), who reported that traps are completely compatible with the parasitic wasp *E. formosa* when used together in an integrated program for the control of the greenhouse whitefly. Parasitoids are not attracted to the traps as long as sufficient and suitable hosts are available.

The first black pupae appeared on November 13, i.e. 14 days after the first parasitoid introduction. On November 17, counts of black and white pupae were made at 10 day intervals. The appearance of black parasitized pupae 14 days after the parasitoid introduction confirms the results of van Lenteren and Hulspas-Jordaan (1987) and Boukadida (1991) who also observed the first black pupae 14 days after introduction. Kassis (1989) reported that the first black pupae were seen 18 days after the parasitoid introduction.

The maximum percentage parasitization was in Block 2 (60%) on December 27 and the minimum (0%) in Block 4 on February 15 (Table 2). During the course of the experiment, Blocks 3 and 1 always had the lowest percentage parasitization. There was no general trend in percentage parasitization over time. There was great fluctuation, which suggests that the distribution of black pupae among blocks was not uniform but varies from one spot to another. Another possible explanation is the dispersal of the parasites occurred when the doors were opened, and this affected the distribution and resulted in fluctuations in percentage parasitization. In Block 4, the plants were less healthy due to leafminers attack which reduced the available leaf surface areas.

Physical methods
Plots in which traps were installed alone show-

TABLE 2. Percentage parasitization in the blocks

	Block I			Block II			Block III			Block IV		
Date	B*	W*	%	B	W	%	B	W	%	B	W	%
Nov. 17, 1991	5	14	26.3	7	9	44.0	4	15	21.0	5	15	25.0
Nov. 27, 1991	3	7	30.0	3	5	37.0	1	39	2.5	5	15	25.0
Dec. 7, 1991	5	11	31.3	6	8	43.0	1	39	2.5	6	8	43.0
Dec. 17, 1991	10	35	22.0	30	45	40.0	5	11	31.3	3	5	38.0
Dec. 27, 1991	3	7	30.0	3	3	60.0	8	55	12.7	5	10	33.0
Jan. 6, 1992	3	7	30.0	4	7	36.0	8	55	12.7	4	7	36.0
Jan. 16, 1992	2	9	18.0	3	8	27.0	2	25	7.0	3	4	43.0
Jan. 26, 1992	8	55	12.7	2	3	40.0	3	30	9.0	4	7	36.0
Feb. 5, 1992	2	25	7.0	7	8	46.6	8	30	21.0	3	5	38.0
Feb. 15, 1992	3	25	10.7	5	10	33.0	3	25	10.7	0	3	0

* B: Black, W: White pupae of the greenhouse whitefly.
The maximum percentage parasitization was in Block 2 (60%) on December.

TABLE 3. Mean percentage of damaged leaves in different treatments.

Date	T.	T+En.	T.+Qu.	App.+Act.	Control
March 1, 1992	2.00 ab	1.75 ab	0.75 b	0.75 b	3.5 a

T.: Traps, En: *Encarcia formosa,* Qu.: Quinomethionate, App.: Applaud, Act.: Actellic.
Means followed by the same letter are not significantly different at the 5% level of significance (Duncan's multiple range test).

ed considerable reductions in whitefly numbers. The population decreased from 5.3 adults per plant, at the first count, to 3.65 on the third. It then started to increase slowly until the last count on February 27, reaching 98.1 adults per plant. This number was higher than the other treatments but lower than the controls, because traps captured only the actively flying insects, not those on the canopy. On the first counts, traps were efficient because whitefly number was low, but with time, they lost their efficiency. This confirms van De Veire (1985), who reported that yellow sticky traps alone could be sufficient in controlling the greenhouse whitefly under conditions of light or moderate infestations but if great numbers occurred, the use of them alone would probably be inadequate.

The number of adults captured per trap per week increased slowly from October 30 until January 6, reaching 50 adults per trap (Fig. 2). It then increased rapidly until January 27, then stabilised until February 10 and increased again until the end of the experiment, reaching 255 adults per trap. The lower numbers of captured adults, before January 6, were probably due to the low population numbers on plants, after which they increased, thus increasing the chances of capture. This may appear contradictory to the previous discussion, which stated that traps were inefficient when densities were high, but this is from the control point of view, because the traps alone cannot protect the crop, but on the other hand the chances of trapping increase.

Evaluation of damage

The control plots were significantly different from the others (3.5%). They had the most contaminated plants (Table 3).

The healthiest plants were in the plots received Quinomethionate in combination with traps as well as those treated with Applaud and Actellic (0.75%). Traps alone were next to the controls in numbers of damaged plants (2.0%). Traps combined with *E. formosa* were intermediate (1.75%) (Fig. 3).

Although most fruits were healthy, there were slight differences between the treatments (Table 4).

The most unhealthy fruits were in the control plots, which had 2.5% damaged fruits. The cleanest fruits were from plots receiving Quinomethioate in combination with traps, followed by those from Applaud + Actellic-treated plots and finally fruits from traps + *En.* plots (Fig. 4).

The treatments tested were satisfactory. The best treatment was the combined physical and chemical method: yellow sticky boards and Quinomethionate, followed by the combined use of Applaud and Actellic. Traps combined

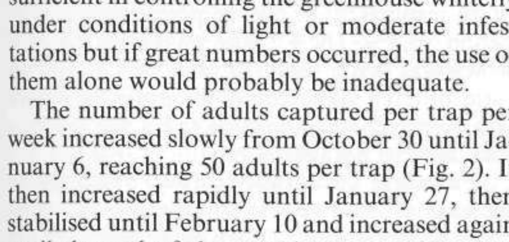


Fig. 2. Mean numbers of captured adult whiteflies on traps over time

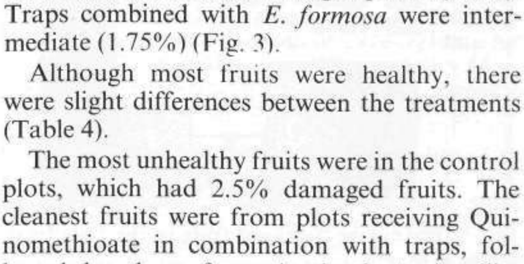


Fig. 3. Percentage of damaged plants in the four treatments in March.

TABLE 4. Mean percentage of damaged fruits in different treatments.

Date	T.*	T.+En.*	T.+Qu.*	App.+Act.*	Control
March 1, 1992	1.5 ab	1.5 ab	0.75 ab	1.0 ab	2.5 a

* T.: Traps, En.: *Encarcia formosa*, Quin.: Quinomethionate, App.: Applaud, Act.: Actellic. Means followed by the same letter, are not significantly different at the 5% level of significance (Duncan's multiple range test).

with biological control using the parasitic wasp *E. formosa* was more efficient than traps alone. The untreated plots indicated that whitefly can be a problem. These results indicate that in an integrated programme for the control of the greenhouse whitefly on eggplant, all these methods should be included in a compatible manner. For an integrated programme on eggplant, traps should be installed at the beginning of the growing season, combined with Quinomethionate, before the introduction of the parasite. Applaud and Actellic can be used in an integrated program because Applaud acts on immature stages, while Actellic acts on adults, resulting in low population densities, healthy plants and high quality produce.

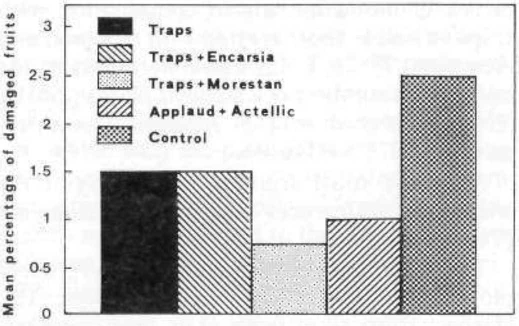


Fig. 4. Percentage damaged fruts in the four treatments in March.

The parasite release ratio

Mean separation using Duncan's multiple range test indicated that the lower the initial whitefly density, the higher the percentage of parasitization (Table 5). The parasite: host ratio of 4:1 resulted in the highest percent of parasitization, 95,5%. The 4:2 ratio was better than 4:3, which was better than the ratio of 4:4. The 4:1 ratio differed significantly from the 4:2 which was approximately the same as 4:3, but 4:4 ratio had the least parasitization.

Percentage parasitization (Fig. 5) started to increase on November 17, reaching its maximum on December 27, then decreased until Fe-

TABLE 5. Mean percentages of parasitization under different parasitoid: host ratios.

Date	4:1	4:2	4:3	4:4
November 17, 1991	74.5a	63.25a	33.75b	20.5c
November 27, 1991	76.5a	59.0b	41.55c	22.6c
December 7, 1991	80.75a	60.75b	44.5ab	25.0c
December 17, 1991	84.5a	63.25a	49.25ab	33.75c
December 27, 1991	85.25a	59.0b	51.75b	37.25c
January 6, 1992	85.0a	60.75b	53.0b	41.0c
January 16, 1992	77.75a	58.75b	53.25b	42.0c
January 26, 1992	73.75a	59.5b	49.75b	42.25b
February 5, 1992	69.25a	62.5a	52.75b	42.25b
February 15, 1992	95.5a	80.0a	73.00b	64.5b

Means followed by the same letter in the same line are not significantly different at the 5% level (Duncan's multiple range test).

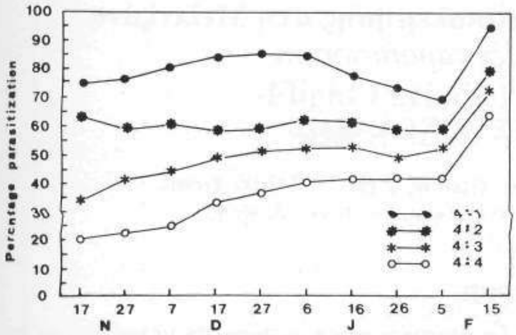


Fig. 5. Percentage parasitization over time under different release ratios.

bruary 5, after which it increased again until the end of the experiment. The highest percentage of parasitization was observed in the 4:1 plots (95.5%) on February 15; the lowest was in 1:1 plots (20%) on November 17. There was an increase in percentage parasitization with time in all treatments, with differences between them. Higher percentages of parasitization were obtained during the first weeks because average temperature during this period was high and the parasitoids continued to lay eggs.

These results indicate that the lower the initial whitefly number at the time of introduction of the parasite, the higher the percentage parasitization; the higher the release ratio of the parasite in relation to its host, the higher the percentage parasitization, confirming Rumei et al. (1987), who showed that the higher the initial whitefly density, the lower the percentage parasitization. Onilion (1976) achieved control with a ratio of 1:1 on tomato and 3:1 on eggplant in greenhouses in south east France. Considering the last ratio namely 3:1 parasitoid: host, it falls in the range of 4:2 - 4:1 which agree with the results obtained in this experiment. For successful biological control, introduction of the parasitoid should be at a low initial whitefly number when temperature is favourable for parasitoid activity. The release ratio should be related to the host plant: for example more parasitoids are necessary for eggplant than for tomato.

Achnowledgements

We would like to acknowledge the Mediterranean Agronomic Institute of Chania for funding the research. Special thanks are due to Dr. Peter Bowen for editing the manuscript.

References

Boukadida, R. (1991). Biological and integrated methods in the control of greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood) on greenhouse tomato and cucumber. Unpublished M.Sc. Thesis. Med. Agr. Inst. Chania: 109 pp.

Hargreaves, E. 1915. The life-history and habits of the greenhouse whitefly (*Aleyrodes vaporariorum*, Westwood) Ann. Appl. Biol. 1: 303-334.

Hussey, N.W.; Read and J.J. Helsing 1969. The Pests of Protected Cultivation. Biology and Control of the Glasshouse and Mushroom pests. Edward Arnold Ltd., London. 177pp.

Kassis, G. (1989). Experiments on the control of the glasshouse whitefly *Trialeurodes vaporariorum* Westwood. Unpublished M. Sc. Thesis, Med. Agr. Instit. Chania, Greece.: 63 pp.

Ledieu, M.S. 1976. Dispersal of the parasite *Encarsia formosa* as influenced by its host, *Trialeurodes vaporariorum*. Bull. OILB/SROP. 4: 121-124.

Michelakis, S. 1987. An integrated control of *Trialeurodes vaporariorum* Westwood in greenhouses of Crete, Greece. Joint Expert's Meeting on Integrated Pest Management in Protected Vegetable Crops, Barcelona, Spain.

Nucifora, A. 1987. Integrated pest control in the protected vegetables in Italy. Integrated and biological control in protected crops. Proceedings of a meeting of the EC Expert's Group, Irakleon, Crete, Greece: 83-84.

Nucifora, A., V. Vacante, and V. Firullo. 1983, Advances in integrated control in Sicily. Bull. OILB/SROP. 6/3:25-31.

Onilion, J.C. 1976. Les aleurodes, biologie et méthodes de lutte. Defense des Vegeteaux no. 180: 189-199.

Rumei, Xu., J.C. van Lenteren and P. Huisman. 1987, Parasitism of whitefly by *Encarsia formosa* at different release ratios. Bull. OILB/SROP. 10/2: 188-192.

van De Veire, M. 1985. Yellow sticky plates as an alternative tool for the control of the greenhouse whitefly and leafminers in greenhouse tomatoes. Bull. OILB/SROP. 8: 51-55.

van De Veire M. and V. Vacante. 1984. Greenhouse whitefly control through the combined use of the colour attraction system with the parasitic wasp, *Encarsia formosa* (Hymenoptera: Aphe.). Entomophaga 29: 303-310.

van Lenteren, J. C., P.M. Hulspas-Jordaan, 1987. *Encarcia formosa* can control greenhouse whitefly at low temperature regimes. Bull. OILB/SROP. X/2: 87-91.

KEY WORDS: *Trialeurodes vaporariorum, Encarsia formosa,* Traps, Applaud, Actellic, Quinomethionate, Release ratio, Parasitization, Integrated methods.

Εφαρμογή Ολοκληρωμένης Καταπολέμησης στη Μελιτζάνα κατά του *Trialeurodes vaporariorum*

S. D. ABDALLA και Σ. ΜΙΧΕΛΑΚΗΣ

Μεσογειακό Αγρονομικό Ινστιτούτου Χανίων, Τ.Θ. 85, 731 00 Χανιά
Ινστιτούτο Υποτροπικών Φυτών και Ελαίας – Χανιά Κρήτης

ΠΕΡΙΛΗΨΗ

Μελετήθηκε η ολοκληρωμένη καταπολέμηση του *Trialeurodes vaporatiorum* στη μελιτζάνα με τη χρησιμοποίηση φυσικών (παγίδες), χημικών και βιολογικών μεθόδων. Ο πλέον αποτελεσματικός συνδυασμός ήταν η χρησιμοποίηση Quinomethionate και παγίδων. Μίγμα Applaud και Actellic ήταν αρκετά αποτελεσματικό για την καταπολέμηση των εντόμων. Βιολογική καταπολέμηση με το παρασιτοειδές *Encarsia formosa* (Gahan) είχε ως αποτέλεσμα μέτρια αλλά επαρκή καταπολέμηση όταν συνδυάστηκε με παγίδες. Οι παγίδες μόνες τους έδωσαν ικανοποιητικά αποτελέσματα. Όλες οι μεταχειρίσεις ήταν αποτελεσματικές στη μείωση του πληθυσμού του εντόμου σε ικανοποιητικό επίπεδο σε σύγκριση με πληθυσμούς που δεν υπέστησαν καμιά μεταχείριση. Η αναλογία απελευθέρωσης παρασιτοειδούς:ξενιστή έπαιξε σημαντικό ρόλο στα αποτελέσματα της βιολογικής καταπολέμησης χρησιμοποιώντας την *E. formosa*. Η υψηλότερη αναλογία απελευθέρωσης, 4:1 παρασιτοειδούς:ξενιστή, έδωσε το υψηλότερο ποσοστό παρασιτισμού.