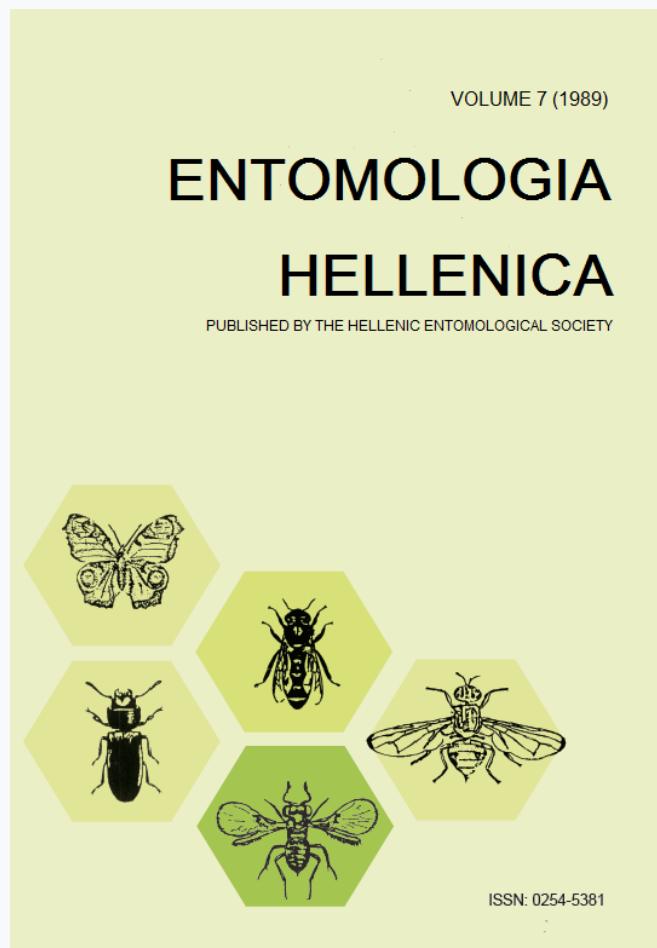


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Simultaneous Control of *Cydia molesta* and *Anarsia lineatella* in Peach Orchards of Northern Greece by Combining Mating Disruption and Insecticide Treatments¹

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ABSTRACT

Trials were carried out in 1987 and 1988 on the combined control of oriental fruit moth (OFM), *Cydia molesta* (Busck), and peach twig borer (PTB), *Anarsia lineatella* (Zell), in peach orchards in Northern Greece with Isomate-M pheromone dispensers (mating disruption technique) and insecticides against OFM and PTB, respectively. One application of the Isomate-M at a rate of 1,000 units per ha, and one application of the insect growth inhibitor (IGI) hexaflumuron 5 EC (200 ml f.p./hl) or two sprays of fluvalinate 25 AF (60 ml f.p./hl) during June provided satisfactory control of OFM and PTB. Total damage per tree in the trials reached 1.0-3.6%, versus 1.4-3.0% in the conventionally sprayed orchards, while in unsprayed control blocks it was 14.4-23%. These encouraging results open possibilities for the combined control of these peach insects in Northern Greece.

Introduction

The oriental fruit moth (OFM), *Cydia molesta* Busck (Lepidoptera: Tortricidae) and the peach twig borer (PTB), *Anarsia lineatella* Zell. (Lepidoptera: Gelechiidae) are the key pests in peach orchards in Northern Greece (Mentzelos et al. 1977), and regular insecticide sprays are applied against both pests. The use of one application of Isomate-M pheromone dispensers (mating disruption technique) opens up the possibility of controlling OFM, especially during the first two generations (April-mid July) in peach varieties that are harvested by early July (Kyparissoudas 1989). Furthermore, the flights of PTB are closely synchronised with those of OFM from May on (Kyparissoudas 1986, 1988, 1989), and by using non-insecticidal control measures against this insect it may result in avoiding insecticide sprays in the control of both insects.

This study collates and analyses the results of trials to control OFM and PTB, by combining synthetic sex pheromone dispensers and insecticide treatments, respectively, in peach orchards of Northern Greece.

Materials and Methods

During 1987 and 1988, in the regions of Naoussa and Velvendos two trials designated as trials 1 (1987) and 2 (1988), respectively, were conducted. These trials involved two commercial peach orchards planted with the variety Junegold, which were harvested at the end of June and early July and were 0.6 ha and 0.5 ha in size, respectively. For the control of OFM in late March, prior to the first moth captures in the pheromone traps (Kyparissoudas 1988), in both orchards, Isomate-M pheromone dispensers (Shin-Etsu Chemical Co. Ltd., Tokyo, Japan) were placed at a rate of 1,000 units per ha. Dispensers were tied around young branches of the trees at a height of about 2.0 m. For the control of PTB in trial 1, a block approximately 0.2 ha in size was treated on June 1 and 20 with fluvalinate 24 AF (Sandoz Ltd.

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Basle, Switzerland) at a rate of 60 ml f.p./hl. Following the same design, trial 2 was divided into two parts, 0.1 ha and 0.4 ha in size, and was treated on June 5 with hexaflumuron 5 EC (insect growth inhibitor/Dow Chemical Company) at a rate of 100 and 200 ml f.p./hl, respectively. Each treated orchard was compared with equal sized control orchards, using a conventional insecticide program with four treatments of phosalone 30 WP at a rate of 200 g f.p./hl against both insects in the same locality. In both control orchards a block about 0.05 ha in size was left unsprayed. This provided information on the actual level of OFM and PTB infestations in the absence of any treatments. Treatment and control orchards were approximately 200 m apart.

The effect of Isomate-M was determined using the following techniques: a. Pheromone traps. At each experimental orchard three Pherocon I-C pheromone traps (Zoecon Palo Alto, California), for monitoring of male insects, were placed 1.8-2.0 m above the ground in the north-east side of the trees. Each trap contained a pheromone dispenser (Zoecon). Trap catches were recorded 2 times each week and dispensers were replaced every 4 weeks. The same number of traps was placed in corresponding control orchards. b. Fruit damage at harvest. A sample of 500 fruits (50 fruits from each of 10 trees) per block at harvest (2.7.87 and 5.7.88) for OFM infestation. From the same fruit samples was also estimated the infestation level of PTB.

To evaluate the efficacy of insecticides against OFM and PTB, in each trial, samples of 500 fruits (50 fruits from each of 10 trees) were taken from each block (Tables 2 and 3).

Results and Discussion

The results of all experiments are presented in Tables 1, 2 and 3.

In both trials, comparisons of the total catch in the first two flights of OFM indicated 100% male disruption, in terms of male captures in pheromone traps, that occurred in the treated orchards (Table 1). In trial 1, fruit damaged by OFM in the Isomate-M treatment was equal to or lower than in the insecticide and untreated control 1, respectively (Table 2). This showed that Isomate-M performed very well for the control of OFM during 1987 and 1988 for a period of three months (April-June). These data are in agreement with those of Rice (1987) and Kyriassoudas (1989).

In trial 1, the combination of Isomate-M and flualinate gave satisfactory control of OFM and PTB (Table 2). The total fruit damage from both insects reached 1%, while in the conventionally sprayed block with four applications (May 1, 20, June 6, 20) of phosalone it was 1.4%, with infestation in the unsprayed block at 14.4%. Flualinate also gave further satisfac-

TABLE 1. Captures of *C. molesta* males in pheromone traps in Isomate-M treated and control orchards in Naousa and Velvendos during 1987, 1988.

Year	Location	Catches in 3 traps		Reduction in male catch (%)
		Isomate-M	Control	
1987	Naousa	0	310	100.0
1988	Velvendos	0	342	100.0

TABLE 2. Fruit infestation by *C. molesta* and *A. lineatella* (measured at harvest) in Isomate-M and Isomate-M + Flualinate treated and control orchards, Naousa 1987.

Damaging insect	Percent damaged fruits/tree ¹			
	Trial 1		Control 1	
	Isomate-M	Isomate-M+F ²	Sprayed ³	Unsprayed
OFM	0.2 a	0.2 a	0.4 a	7.0 b
PTB	6.2	0.8 a	1.0 a	7.4 b
Total	—	1.0 a	1.4 a	14.4 b

¹ Figures not followed by same letter across the table are significantly different ($P < 0.01$, Student's t-test).

² Flualinate.

³ Phosalone.

TABLE 3. Fruit infestation by *C. molesta* and *A. lineatella* (measured at harvest) in Isomate-M + Hexaflumuron treated and control orchards, Vevendos 1988.

Damaging insect	Percent damaged fruits/tree ¹			
	Trial 2		Control 2	
	Isomate-M+H ²	Isomate-M+H ³	Sprayed ⁴	Unsprayed
OFM	0.8 a	1.2 a	1.6 a	10.0 c
PTB	8.6 b	2.4 a	1.4 a	13.0 bc
Total	9.4 b	3.6 a	3.0 a	23.0 bc

¹ Figures not followed by same letter across the table are significantly different ($P < 0.01$, Student's t-test).

² Hexaflumuron (100 ml f.p./hl).

³ Hexaflumuron (200 ml f.p./hl).

⁴ Phosalone.

tory control of the PTB, as fruit damage was reduced to 0.8%, while the infestation in Isomate-M and unsprayed blocks was 6.2% and 7.4%, respectively.

The combination of Isomate-M and application of hexaflumuron at a rate of 100 ml f.p./hl did not provide satisfactory control of both insects (Table 3). The total infestation in trial 2 for both insects reached 9.4%, versus 3.0% of the conventionally sprayed orchards (four applications of phosalone, May 2, 20, June 7, 20), while in the unsprayed block of the control 2 orchard it was 23%. The use of Isomate-M in the mating disruption technique gave very satisfactory results in controlling OFM, while hexaflumuron, at the rate used, did not provide effective control against PTB. Fruit damage by this pest reached 8.6%, whereas in the conventionally sprayed orchard the infestation was 1.4%. In contrast, the combination of Isomate-M and application of hexaflumuron at a rate of 200 ml f.p./hl provided better control, because the total fruit damage reached only 3.6% (Table 3).

The above data show that the application of the mating disruption technique against OFM in early April, using Isomate-M pheromone dispensers, and one or two applications of hexaflumuron or fluvalinate, during June provided satisfactory control of the first two generations of OFM and of the first generation of the PTB, respectively, in peach varieties that were harvested until early July.

The use of Isomate-M can replace the two sprays with conventional insecticides during May against OFM, while later in the season insect growth inhibitors can be used against PTB, thereby reducing considerably environ-

mental problems related to conventional insecticides. Therefore, it is suggested that the combination of treatments of mating disruption and insect growth inhibitors in an IPM program could effectively control both pests in peach orchards of Northern Greece.

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KEY WORDS: *Cydia molesta*, *Anarsia lineatella*, Mating disruption, Isomate-M, Fluvalinate, Hexaflumuron

Ταυτόχρονη Καταπολέμηση των Εντόμων *Cydia molesta* (Busck) και *Anarsia lineatella* (Zell) σε Οπωρώνες Ροδακινιάς της Βόρειας Ελλάδας με Φερομόνες και Εντομοκτόνα

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ΠΕΡΙΛΗΨΗ

Σε δύο οπωρώνες ροδακινιάς, με ποικιλίες Junegold, στις περιοχές Βελβεντού-Κοζάνης και Νάουσας το 1987 και 1988 έγιναν δοκιμές για την ταυτόχρονη καταπολέμηση των εντόμων *Cydia molesta* (Busck) και *Anarsia lineatella* (Zell), με τη μέθοδο "Mating Disruption" (παρεμπόδιση της συνάντησης των δύο φύλων ή σύγχυσης των αρσενικών) και τη χρησιμοποίηση εντομοκτόνων.

Χρησιμοποιήθηκε η συνθετική φερομόνη Isomate-M εναντίον της *C. molesta* και τα εντομοκτόνα hexaflumuron και fluvalinate εναντίον της *A. lineatella*. Με μία εφαρμογή του Isomate-M (δόση 100 dispensers ή 7,525 g/στρέμμα) στις αρχές Απριλίου, πριν την εμφάνιση των ενηλίκων της *C. molesta*, και με μία του ρυθμιστή ανάπτυξης εντόμων hexaflumuron (δόση 200 ml προϊόντος/hl) ή με δύο του fluvalinate (δόση 60 ml προϊόντος/hl) κατά τη διάρκεια του Ιουνίου, η προσβολή των καρπών ανά δέντρο στους οπωρώνες των δοκιμών κυμάνθηκε μεταξύ 1,0-3,6%, έναντι 1,4-3,0% αντίστοιχων οπωρώνων που χρησιμοποιήθηκαν ως μάρτυρες και δέχθηκαν κατά την περίοδο Μαΐου-Ιουνίου τέσσερις επεμβάσεις με το εντομοκτόνο phosalone (δόση 200 g σκευάσματος/hl).

Τα ενθαρρυντικά αυτά αποτελέσματα φαίνεται να ανοίγουν νέες προοπτικές για την ταυτόχρονη αντιμετώπιση των δύο αυτών επιζήμιων εχθρών των ροδακίνων με συνδυασμό βιοτεχνολογικών (φερομόνες, ρυθμιστές ανάπτυξης εντόμων) και χημικών μέσων, στις συνθήκες της Βόρειας Ελλάδας.