

## Effect of mating disruption on the pheromone trap catches of codling moth (*Cydia pomonella* L.) and fruit damage in walnut (*Juglans regia* L.) orchards under organic farming

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### ABSTRACT

The codling moth (*Cydia pomonella* L.), a key pest in walnut orchards in Bulgaria, is managed mainly with broad spectrum insecticides. Insecticide application often resulted in destruction of beneficial species and environmental pollution. The present study was conducted during 2018 - 2019 in Pazardzhik region of Bulgaria in an isolated orchard. The pheromone trap catches of *C. pomonella* in the organically maintained walnut orchard in the presence of mating disruption (MD) dispensers was compared with the pheromone trap catches in the conventional control orchard. The Pherocon VI sticky traps, type Delta were baited with standard PHEROCON CM L2 – codlemone. CIDETRAK® CMDA COMBO™ MESO™ mating disruption dispensers containing a unique combination of codling moth pheromone and a patented male and female behavior modifying kairomone were used at the rate of 20 pieces per/ha in the organic orchard. There was reduction in fruit damage in the organic orchards, despite the lack of treatment with pesticides. In spite of 9 - 10 treatments with insecticides, fruit damage was higher in the conventional control orchard compared to the organic orchard. The present results brought out that the mating disruption using CIDETRAK® CMDA COMBO™ MESO™ dispensers against codling moth can provide more effective control against *C. pomonella*, than the pesticide treatments.

**Keywords:** Walnut, Codling moth, Pheromone dispensers, Mating disruption

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### INTRODUCTION

Codling moth (*Cydia pomonella* L.) is an economically important pest exerting a significant impact on quantity and quality of the fruits on the walnut (*Juglans regia* L.) in countries of Europe, Asia and United States. First instar larvae feed inside of the fruit. Second and third instar larvae generally feed on green peel of the fruit. The degree of damage depends on several factors among which the most important are the region of production, the variety and the climatic conditions (Angeli *et al.*, 1999; Ginzel, 2010). Crop loss of 20-50% may occur, if no management strategy is applied (Zeki and Özdem, 2013; Canhoş *et al.*, 2014). *C. pomonella* established in Plovdiv region in Bulgaria during the period 1946-1950 and is causing significant damage to walnuts

by *C. pomonella* (Popov, 1962). It is managed mainly with broad spectrum insecticides. Insecticide application often resulted in destruction of beneficial species and environmental pollution. Monitoring the adult population development and the management of codling moth is conducted by pheromone traps and mating disruption dispensers (Witzgall *et al.*, 2008). Light *et al.* (2005) from California, USA has reported that use of Isomate-C dispensers at the rate of 1000 dispensers per/ha reduced the adult population of *C. pomonella* 90% proving mating disruption of the pest was an effective method for the management of the pest. Another study conducted in walnut orchards in Bursa, Turkey in 2012-2013 using *C. pomonella* dispensers (1000 dispensers/ha) dose revealed that the average fruit damage was fruit less than 1.3%

when assessed during fruit harvest (Demir and Kovanci, 2015). The aim of the present study was to establish the opportunity to manage codling moth through the use of an ecofriendly method mating disruption.

### MATERIAL AND METHODS

This study was conducted during 2018-2019 in a walnut orchard certified for organic production with an area of 2.35 ha in the region of the Velichkovo village, Pazardzhik region. That orchard is an isolated one. Another walnut orchard in the area of Plovdiv was under a conventional control. Both orchards had the Bulgarian varieties - Izvor 10, Silistrenski, Sheynovo, Dryanovski and Perushtinski and introduced ones Chandler, Lara and Fernet. The treatments in the reference were performed with a conventional chemical pesticides permitted in Bulgaria at registered doses. Two pheromone traps Pherocon VI type "Delta" of the company "Trécé" Inc. USA, baited with L2 capsules containing 1 mg codlemone were used for monitoring the flight dynamics of codling moth (*C. pomonella*) in organic and in the conventional control orchards.

The trap catches were recorded twice a week. The bottoms of the traps were replaced, when they get dirty and the lures every 30-45 days depended on weather conditions. Pheromone traps were installed 10 days before the first onset of codling moth (Fig.1). CIDETRAK® CMDA COMBO™ MESO™ mating disruption dispensers containing a unique combination of codling moth pheromone and a patented male and female behavior modifying kairomone were used at the rate of 20 pieces per hectare in the organic orchard only (Fig. 2). They were placed on greater height in the crown of the trees at 50-60 cm from the top, using a platform. Damage to walnuts on 1000 fruits was visually recorded before and after harvesting following the methodology of Light (2016).

### RESULTS AND DISCUSSION

The results are presented in Fig. 3 and 4 and Table 1. The results have shown that the flight of the first male moths from the overwintering generation of the codling moth began in the third decade of April - on the 23<sup>rd</sup> and ended on the 22<sup>nd</sup> of June

during 2018 (Fig. 3) in the conventional control orchard. The two generations of the pest did not overlap.

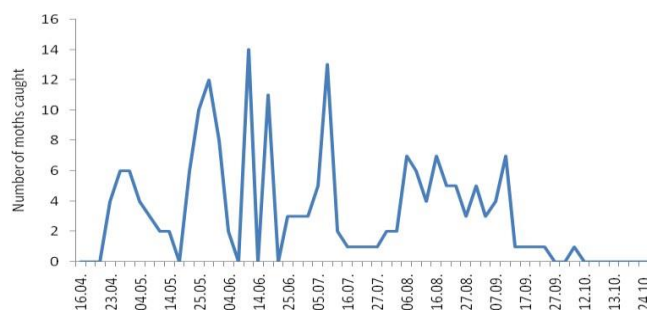


**Fig. 1.** Pheromone traps, Pherocon VI type Delta, "Trécé" Inc., USA



**Fig. 2.** Pheromone dispensers CIDETRAK® CMDA COMBO™ MESO™

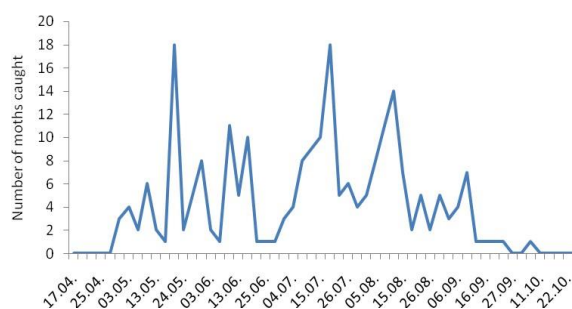
The flight of the first summer generation began on June 25 and lasted until the end of September as single moths were caught until October 9 (Fig. 3).



**Fig. 3.** Flight dynamic of codling moth (*C. pomonella*) in a conventional control walnut orchard in 2018

The species has developed two full generations. It should be noted that the first generation has a higher density than the second generation.

In 2019, in the conventionally treated walnut orchard, the flight of the first male moths of the overwintering generation began in the third week of April on 30<sup>th</sup> and ended in 25-28 June. The first and second generation of the pest overlapped. The flight of the second generation began in the last week of June and lasted until the end of September, with single moth being caught until October 8 (Fig.4).



**Fig. 4.** Flight dynamic of the codling moth (*C.pomonella*) in a conventional control walnut orchard in 2019

The codling moth developed two full generations. In the reference 188 and 228 moths were recorded in 2018 and 2019 respectively. The density of codling moth increased despite of 9-10 treatments with conventional pesticides.

In the organic orchard no moth was caught in the pheromone traps, which indicates a successful disorientation and good efficiency of the installed mating disruption dispensers. In Northern Italy Waldner (1997) has earlier obtained excellent results in apple orchards with mating disruption. In spite of 9 - 10 treatments with pesticides, fruit damage in the reference was 17.2 % and 18.1 % during 2018 and 2019 respectively (the economic threshold is 2% damaged walnuts for fruit-bearing orchards). In the organic orchard, the fruit damage recorded during the harvest was 0.6 and 0.5% for 2018 and 2019 respectively.

The damage to walnuts in 2018 and 2019 has a significant difference in the experimental and

conventional orchards, already in the reports in June. (Chi-square test, P = 0.014) and then in all examination during the season (Chi-square tests, P <0.001), both before harvest and in November after harvest (Chi-square tests, P <0.001) (Table 1). According to Witzgall *et al.* (2008) mating disruption (MD) of codling moth, *Cydia pomonella* (L.) (*Lepidoptera: Tortricidae*), in pome fruit orchards is well established and broadly used, while research continues to make advances to improved disruption efficacy.

**Table 1.** Damaged walnuts in the experimental organic and conventional control orchard in 2018 - 2019

Date of observation	Fruit damage (%)	
	Experimental organic orchard	Conventional control orchard
<b>2018</b>		
27.06	0.0	0.9
27.07	0.0	1.7
28.08	0.3	10.9
03.10	0.4	13.6
02.11	0.6	17.2
<b>2019</b>		
25.06	0.0	0.9
26.07	0.0	1.9
27.08	0.2	11.3
06.10	0.4	14.5
03.11	0.5	18.1

The high percentage of damaged walnuts in the conventional control orchards is an indication that the codling moth might developed resistance to the frequently used organophosphates and pyrethroids in the reference.

The present study shown that the codling moth is a key pest of the walnut and develops two full generations per year. The use of CIDETRAK® CMDA COMBO™ MESO dispensers is an effective alternative method for control codling moth in an isolated walnut orchards. The use of this environmentally friendly approach the method of mating disruption for control the codling moth in walnut orchards can leads to a reduction in environmental pollution, improving the quality of walnuts and protecting human health.

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