CONTROL OF CODLING MOTH, *Cydia pomonella*
with CIDETRAK® CM MEC and CIDETRAK® CM MEC + CIDETRAK® DA MEC liquid formulations in Bulgaria

[1]Hristina Kutinkova, [1]Vasiliy Dzhuvinov, [2] Bill Lingren
[1]Fruit Growing Institute, "Ostromila" 12, 4004 Plovdiv, Bulgaria; e-mail: kutinkova@abv.bg
[2]Trécé Inc., Adair OK, USA e-mail: blingren@trece.com

Introduction

The codling moth (CM) *Cydia pomonella* L. (Lepidoptera: Tortricidae) is the major pest of apple worldwide. Its larvae feed internally within the fruits and cause severe damage to apples, pears, quinces, and walnuts in Bulgaria. Recently CM has developed resistance to organophosphates and other commonly used insecticides that have been the major tools used for control of this pest historically. Reduction of pesticide use is an important issue for human health as well as for conservation of biodiversity. Hence, there is an urgent need to find alternative solutions for crop protection from pests. Environmentally friendly methods such as microencapsulated semiochemicals including pheromones and kairomones are among the most promising.

Objectives

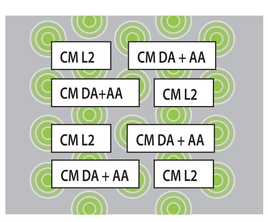
The aim of this study was to test the effectiveness of microencapsulated pheromone mating disruption in apple orchards using CIDETRAK® CM MEC (pheromone) liquid formulation for control of codling moth (CM) and CIDETRAK DA MEC (kairomone) for enhancement of CM MEC for adult control and insecticide applications for larval control. These products were developed and manufactured by Trécé Inc., USA

Methods

PHEROCON® VI Delta trap

PHEROCON® CM DA COMBO - P + AA lures

Lures for MD plots developed and manifactured by Trécé Inc., USA



Layout of thaps in MD treated plots

The trials were carried out during the years 2018 and 2019 in the South East region of Bulgaria. Monitoring of CM flights was implemented using pheromone or pheromone and kairomone lures with traps during the years of the study. PHEROCON® VI Delta, sticky traps were installed in the trial orchard using a scheme provided by the producer. All traps were installed before CM flights started. Traps were baited with standard PHEROCON® CM L2 – codlemone lures, which were changed at 8 week intervals. We also used PHEROCON® CM DA COMBO + AA lures and separately PHEROCON® CM DA COMBO - P + AA lures, which are new products developed by Trécé Inc., USA for the orchards with MD during the years of study. These lures were also changed at 8 week intervals. PHEROCON® VI Delta sticky traps baited with PHEROCON CM COMBO + AA lures and standard CM L2 caps were installed, for comparison, in a reference orchard located nearby. This orchard was treated with insecticides only in 2018 and with insecticides and CIDETRAK DA MEC in 2019. All pheromone traps were checked twice per week and sticky liners changed at 4 week intervals in all traps, in all treatments in both years of the study.

CIDETRAK® CM MEC is a flowable formulation of microencapsulated **CM** pheromone, which we applied for mating disruption as an addition to an insecticide treatment regimen. Accordingly, CM MEC was tank mixed with the insecticide designated for application at the recommended time interval within a series of insecticide treatments.

CIDETRAK® CM MEC was used in the experimental orchard tank mixed with insecticide treatments in 2018. Furthermore, **CIDETRAK® CM MEC** was used on half of the trial orchard, while the other half was treated **CM MEC + DA MEC** to enhance the **CM MEC** and insecticide activity in 2019. Accordingly, the products were tank mixed with insecticides and used at recommended, timely intervals in the series of insecticide treatments. Correspondingly, the grower made only 4 treatments per season, in the MEC treated plots, in both years of this study.

The damage to apples was inspected during the season and at harvest on 2000 fruits.

Results and Discussion

The results with **CIDETRAK® CM MEC** and **CIDETRAK® CM MEC + DA MEC** in the trial apple orchard was positive. Correspondingly, fruit damage in the trial plot was compared with that in a reference orchard, which was located nearby and treated with conventional insecticides without **CIDETRAK CM MEC** or **CIDETRAK CM MEC + DA MEC**.

The damage in the trial plot increased slowly with time and even in late cultivars, fruit damage by CM was below the economical threshold – from 0.0 to 0.2% in both years of the study. Comparatively, ten insecticide treatments were applied to the reference orchard during the season, to control CM and other pests. Correspondingly, fruit damage, in this orchard, by CM was from 1.2 to 3.6%. The significance of differences in the damage rate between the trial and the reference orchard was estimated by the use of Chi-square tests.

Fig.1 Flight dynamics of codling moth with CM /DA + AA lures and L 2 caps in the experimental plot treated with insecticides only in 2018 in Sliven region

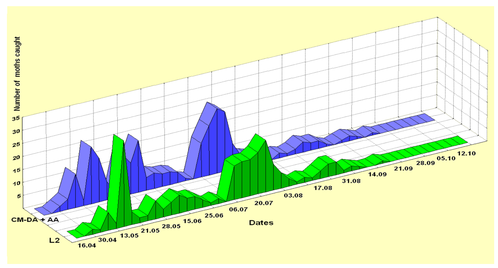


Fig.2 Flight dynamics of codling moth with CM /DA + AA lures and L2 caps in the experimental plot treated with insecticides and CM MEC in 2018 in Sliven region

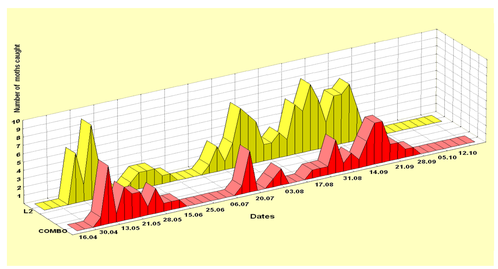


Fig.3 Flight dynamics of codling moth with CM DA Combo-P + AA lures and L 2 caps in the experimental plot treated with insecticides + DA MEC in 2019 in Sliven region

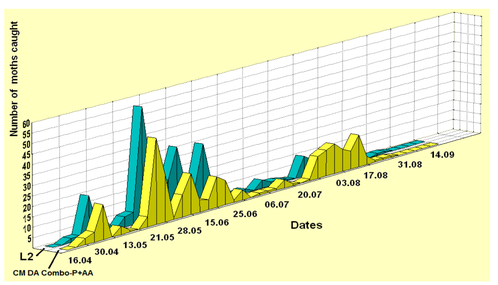


Fig.4 Flight dynamics of codling moth with CM DA Combo - P + AA lures and L2 caps in the experimental plot treated with insecticides CM MEC and CM MEC + DA MEC in 2019 in Sliven region

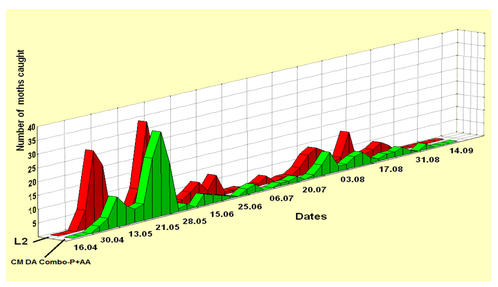


Table 1. Fruit damage rate [%] at the end of the first and at the end of the second CM generation – in the TRIAL PLOT 1 near the village Krushare (Sliven region), treated with conventional pesticides only in 2018

Cultivars	Date of evaluation	
	at the end of the first generation (end of June)	at the end of the second generation (at harvest)
Golden Delicious	**0.6**	**0.8**
Red Delicious	**0.6**	**0.9**
Granny Smith	**0.7**	**1.0**

Table 2. Fruit damage rate [%] at the end of the first and at the end of the second CM generation – in the TRIAL PLOT 1 near the village Krushare (Sliven region), treated with DA MEC and conventional pesticides in 2019

Cultivars	Date of evaluation	
	at the end of the first generation (end of June)	at the end of the second generation (at harvest)
Golden Delicious	**0.4**	**0.5**
Red Delicious	**0.4**	**0.5**
Granny Smith	**0.5**	**0.6**

Table 3. Fruit damage rate [%] at the end of the first and at the end of the second CM generation – in the TRIAL PLOT 2 near the village Krushare (Sliven region), treated with CM MEC 1505 and insecticides in 2018

Cultivars	Date of evaluation	
	at the end of the first generation (end of June)	at the end of the second generation (at harvest)
William's Pride	**0.0**	**0.1**
Pinova	**0.0**	**0.2**
Florina	**0.1**	**0.2**

Table 4. Fruit damage rate [%] at the end of the first and at the end of the second CM generation – in the TRIAL PLOT 2 near the village Krushare (Sliven region), treated with CM MEC 1505 and insecticides in 2019

Cultivars	Date of evaluation	
	at the end of the first generation (end of June)	at the end of the second generation (at harvest)
William's Pride	**0.0**	**0.1**
Pinova	**0.0**	**0.1**
Florina	**0.1**	**0.2**

Table 5. Fruit damage rate [%] at the end of the first and at the end of the second CM generation – in the TRIAL PLOT 3 near the village Krushare (Sliven region), treated with CM MEC 1505 + DA MEC and insecticides in 2019

Cultivars	Date of evaluation	
	at the end of the first generation (end of June)	at the end of the second generation (at harvest)
William's Pride	**0.0**	**0.0**
Pinova	**0.0**	**0.1**
Florina	**0.0**	**0.1**

Table 6. Fruit damage [%] at the end of the first and of the second CM generation – in the CONVENTIONALLY TREATED (REFERENCE) plot near Sliven in 2018

Cultivars	Date of evaluation	
	at the end of the first generation (end of June)	at the end of the second generation (at harvest)
William's Pride	**0.6**	**1.6**
Golden Delicious	**0.8**	**1.2**
Red Delicious	**0.8**	**1.8**
Pinova	**0.8**	**2.2**
Florina	**0.9**	**2.2**
Granny Smith	**1.4**	**3.5**

Table 7. Fruit damage [%] at the end of the first and of the second CM generation – in the CONVENTIONALLY TREATED (REFERENCE) plot near Sliven in 2019

Cultivars	Date of evaluation	
	at the end of the first generation (end of June)	at the end of the second generation (at harvest)
William's Pride	**0.5**	**1.7**
Golden Delicious	**0.7**	**1.5**
Red Delicious	**0.7**	**1.7**
Pinova	**0.8**	**2.3**
Florina	**0.9**	**2.4**
Granny Smith	**1.3**	**3.6**

Conclusions

The present results confirm that, **CIDETRAK® CM MEC MD** added to the grower insecticide program as a timed tank mix increases the effectiveness of the insecticide program for adult control. Furthermore, **CIDETRAK® DA MEC** (kairomone) enhances the activity of **CM MEC MD** (pheromone only) for adult **MD** and enhances the related insecticide treatments against CM larvae when combined in a tank mixed at timed intervals in an insecticide treatment series. Correspondingly, these mixtures can provide more effective control compared to insecticide treatments alone.

Notably, timely tank mixes of **CIDETRAK® DA MEC** and insecticides enhanced the activity of **CIDETRAK® CM MEC** and the insecticides such that the fruit damage in the experimental plot reached only 0.1 %. Accordingly, these data show that growers may potentially save 5 to 6 insecticide treatments and reduce damaged fruit below the economic threshold level.

These new products developed by Trécé Inc., USA can be used in Organic Farming and fits perfectly into any IPM system. The use of **CIDETRAK® CM MEC used alone or enhanced** by **CIDETRAK® DA MEC** will help growers to decrease the number of chemical treatments in the field. Introduction of these products for pest management should result in reduction of the use of conventional chemical insecticide treatments, thus resulting in reduction of environmental pollution and improved food quality.