

ECOLOGICAL APPROACH FOR CONTROL OF ORIENTAL FRUIT MOTH, *CYDIA MOLESTA* BUSCK AND PEACH TWIG BORER *ANARSIA LINEATELLA* ZELL. USING CIDETRAK® OFM/PTB MESO™ PHEROMONE DISPENSERS

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Abstract

The trials were carried out in the years 2016-2017 in an isolated peach experimental orchard of one ha in the Fruit Growing Institute, Plovdiv – Central South Bulgaria. Mating disruption (MD) was tested as an alternative method controlling oriental fruit moth (OFM), *Cydia molesta* Busck and peach twig (PTB) borer *Anarsia lineatella* Zell from post-bloom till harvest. CIDETRAK® OFM/PTB MESO™ pheromone dispensers were installed once during the season, before the start of OFM and PTB flights. For monitoring of the pests one type of pheromone traps was used in this experiment - PHEROCON® VI Delta traps with a sticky changeable bottoms. The pheromone dispensers, traps and baits are a products of Trécé, Inc.USA. In the reference, conventionally treated orchard, 5-8 insecticide treatments were applied to control oriental fruit moth, peach twig borer, aphids and other pests. The fruit damage by OFM ranges from 2.9 to 3.7 % and by PTB from 1.2 to 1.3 % in the successive years. Percentage of damage in the experimental orchard treated with Cidetrak® OFM/PTB was 0.1 %, by OFM and 0.1% by PTB i.e. rather below the economical threshold; no outbreak of the OFM and PTB appearance was noted. So, the MD method, with use of the Cidetrak® OFM/PTB MESO™ dispensers, proved to be an effective means of control even in a small size orchard lots. The results obtained may open the possibilities of practical use of the method of mating disruption in Bulgaria. This method should favour preservation of the natural environment and enable production of healthy fruits, not polluted by chemicals.

Keywords: *Cydia molesta* Busck, *Anarsia lineatella* Zell., mating disruption, Cidetrak® OFM/PTB MESO™

1. INTRODUCTION

Peach is one of the major fruit species in Bulgaria. It provides rapid return of investments due to early bearing and relatively low phytosanitary problems. Its main pest is the oriental fruit moth (OFM), *Cydia molesta* (Busck) (Lepidoptera: Tortricidae). The larvae of early OFM generations damage current season shoot tips; then they feed in the developing fruitlets and fruits. Peach twig borer (PTB) *Anarsia lineatella* (Zell.) (Lepidoptera: Gelechiidae) is an Eurasian species that has spread extensively worldwide; its larvae can develop on many plant species from the genera *Cydonia*, *Malus*, *Prunus* and *Pyrus*. In Bulgaria the main hosts are *Prunus armeniaca* L. (apricot) and *Prunus persica* L. (peach). Chemical pest control in peach and nectarine fruit orchards of Bulgaria has consisted of a broad spectrum of organophosphate and pyrethroid insecticides. Recently their effectiveness has decreased, apparently due to the development of resistance in the pest. However, this is not well documented. Although quite effective, environmental problems and consumer concerns have arisen. Deregistration of many of the insecticides used in the control of these insects along with public demand for residue free products, has increased the interest for innovative tools in pest management. Behaviour modifying pheromones can be used for environmentally safe insect management. And the technique has become one of the most important treatments for controlling the main insects in orchards. Mating disruption technology has been successfully used for control of oriental fruit moth - as reported by (Barnes and Blomefield 1997), (Trematerra et al., 2000), (Sexton and Il'ichev 2000), (Kovanci, 2003) (Rot and

Blazič, 2005), Molinari (2007), (Lo and Cole, 2007), (Kutinkova et al., 2010, 2011, 2012, 2013, 2015).

The use of sex pheromones for mating disruption of *C. molesta* can be an effective control strategy and has been widely adopted (Cardé and Minks 1995). Commercialization and adoption of PTB-MD for *A. lineatella* has been more recent (Pickel et al. 2002; Molinari et al. 2008).

The objective of our research, carried out in the years 2016-2017, was to evaluate the efficacy of dispensers of oriental fruit moth and peach twig borer, as an alternative method for control of both pests under Bulgarian conditions

2. MATERIALS AND METHODS

The trials were carried out in the years 2016 - 2017 in an isolated peach experimental orchard of one ha in the Fruit Growing Institute, Plovdiv – Central South Bulgaria. Mating disruption (MD) was tested as an alternative method for controlling oriental fruit moth, *Cydia molesta* (OFM) and *Anarsia lineatella* (PTB) from post-bloom till harvest. Cidetrak® OFM/PTB MESO™ pheromone dispensers of Trécé Inc., USA photo 1, were installed once during the season and were hung in the upper third of tree canopy at a density 20 pieces per ha, before the start of OFM and PTB flights.



Photo 1. Cidetrak® OFM/PTB MESO™

These dispensers are designed to deliver a long-lasting performance for the whole season, with remarkably fast application. Against other pests occurring in the trial plots, aphicide treatments (one or two per season) were applied during the years of study.

Another 2 ha site served as a reference orchard and was treated in a conventional way. It was located in the same region. From five to eight chemical treatments (were applied there during each season, to control OFM, PTB and other pests. Four to six of them were timed against OFM and PTB. Monitoring of OFM and PTB flight was carried out by sex pheromone trapping in the years of study. Four sticky Delta traps Pherocon® VI, were installed in the trial orchard. Two of them were baited with a standard capsule OFM L2 orfamone and other two with PTB L2 anemone. The traps and lures used were

products of Trécé Inc., USA. The traps were installed on a scheme given from the producer before OFM and PTB flight started. For comparison, 4 sticky Delta traps Pherocon® VI, were installed in the reference, conventionally treated orchard. All pheromone traps were checked twice a week.



Photo 2. PHEROCON® VI Delta traps

Early in the season sampling of damaged shoots was carried out on 20 trees, randomly chosen in the trial plot and in the reference orchard. During the season, fruit damage was assessed in the trial and reference plots on 1000 fruits each time. At harvest, 1000 fruits were sampled in both orchards, to evaluate the final damage rate. Significance of differences in damage rate between the trial and reference orchards was estimated by use of Chi-square tests.

3. RESULTS AND DISCUSSION

In the reference orchard the first flight of oriental fruit moth in 2016 -2017 began in the last week of March and finished till the second or third week of October (Fig. 1,2). The pest developed 3 generation during the years of study. The traps installed in the reference orchard caught in total 804 moths in 2016 and 508 in 2017. The population density of OFM decreased a little due to new insecticides used.

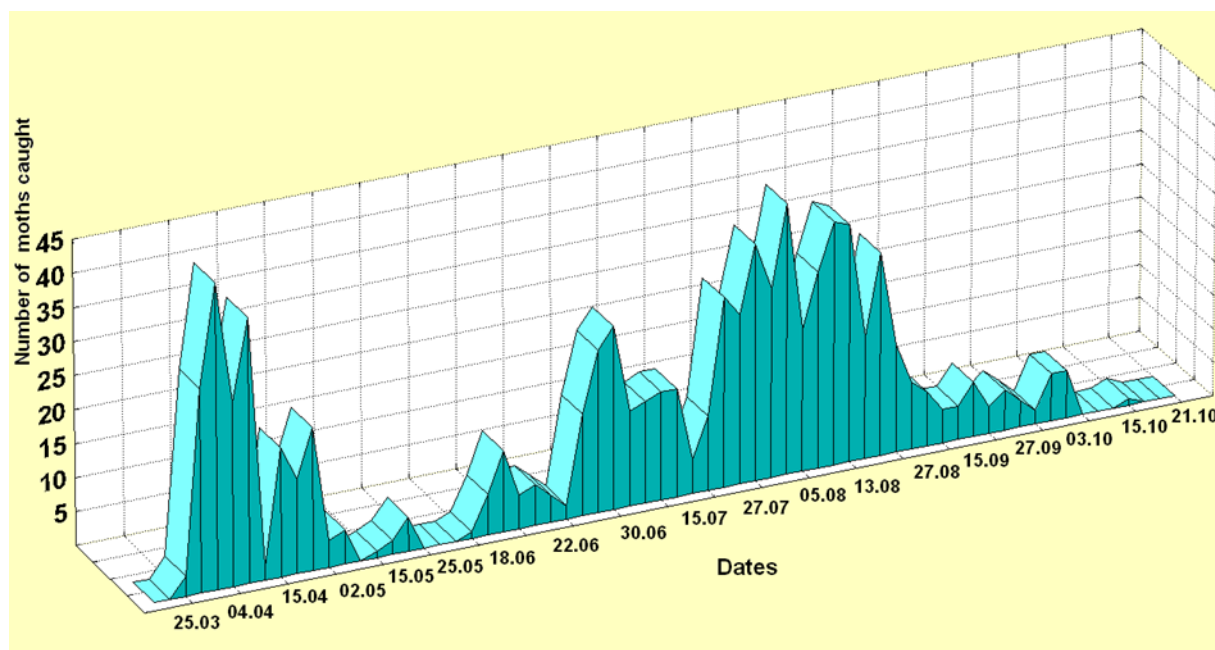


Fig 1. Flight dynamics of oriental fruit moth (*Cydia molesta* Busck) in the reference peach orchard in 2016.

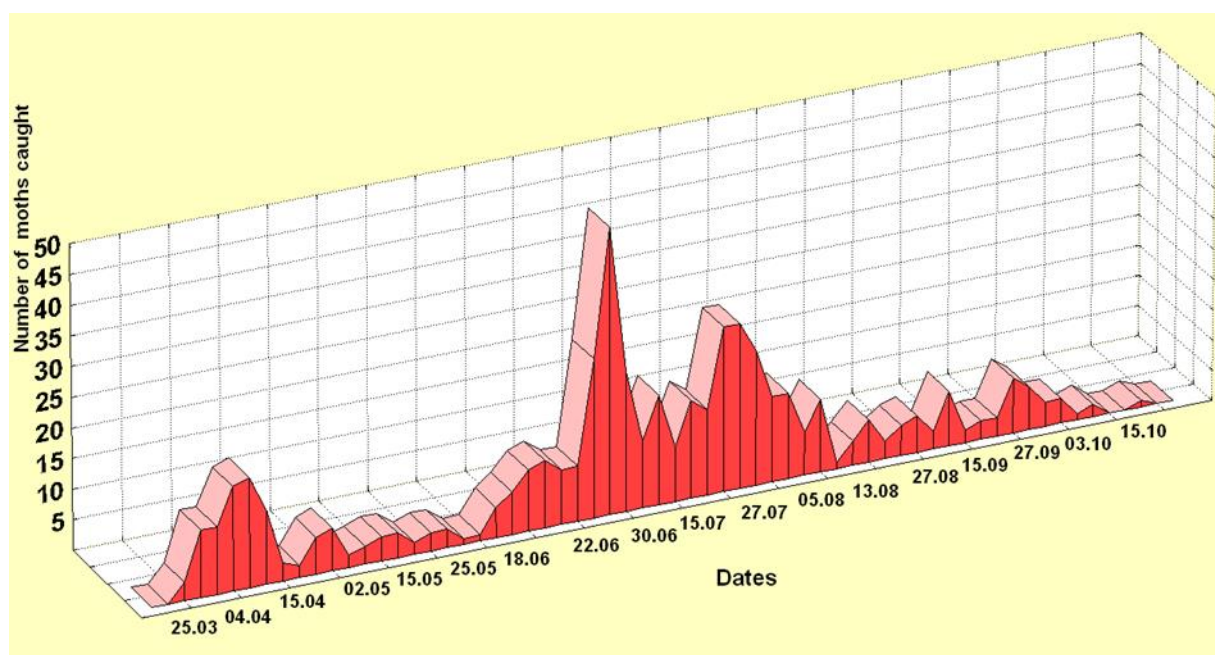


Fig 2. Flight dynamics of oriental fruit moth (*Cydia molesta* Busck) in the reference peach orchard in 2017.

In the reference orchard the first flight of peach twig borer (PTB) in 2016 -2017 began in the third week of April or in the first week of May and finished from the second week of October till the last week of October (Fig. 3,4). The traps installed in the reference orchard caught in total 359 moths in 2016 and 199 in 2017. The population density of PTB decreased season to season. In both years 2016 and 2017 the PTB developed 3 generation during the years of study.

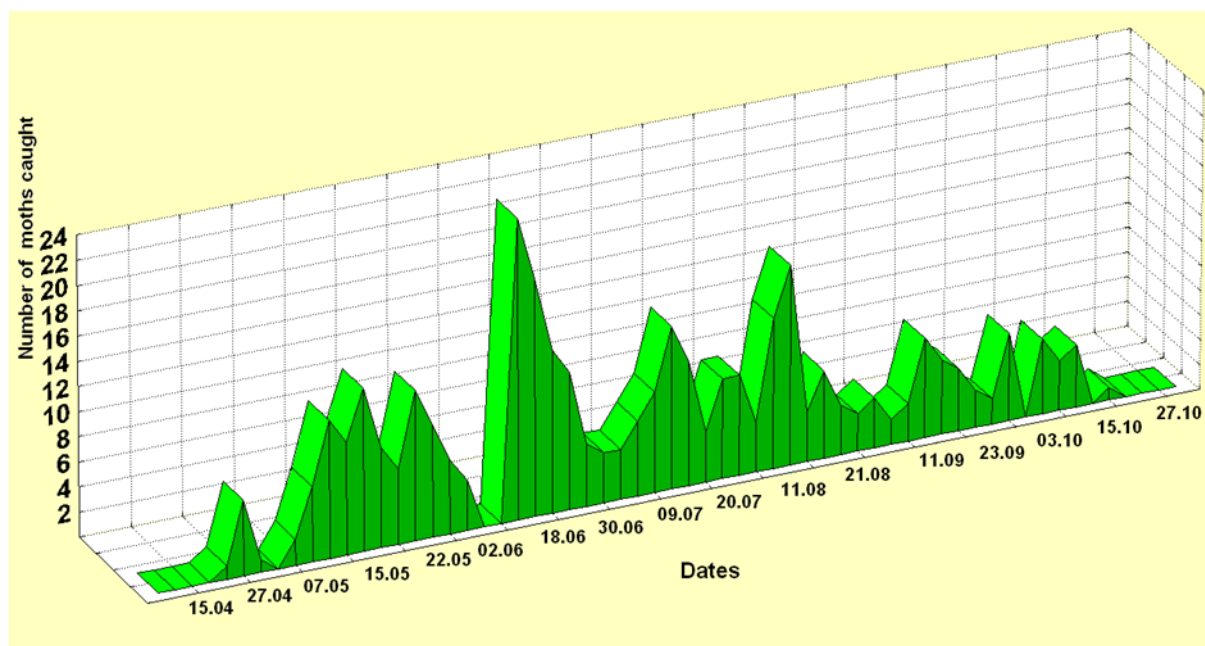


Fig 3. Flight dynamics of peach twig borer (*Anarsia lineatella* Zell.) in the reference peach orchard in 2016

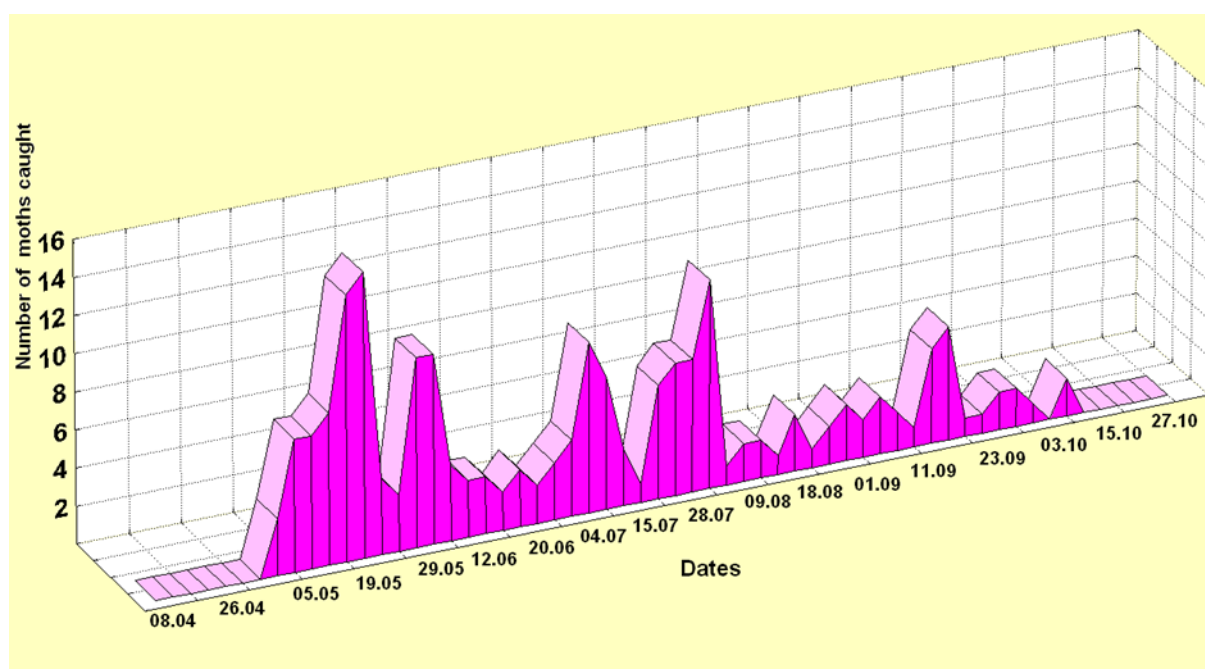


Fig 4. Flight dynamics of peach twig borer (*Anarsia lineatella* Zell.) in the reference peach orchard in 2017

So, Cidetrak® OFM/PTB dispensers almost completely inhibited OFM and PTB captures in the pheromone traps, installed in the trial plot, indicating at a high level of disruption.

In 2016 in the trial plot, where the Cidetrak® OFM/PTB was applied, the damage of shoots by OFM was nil on May 6, 16 and June 13 and stayed at the same level till the third week of June (Table 1). The economical threshold for bearing orchards is 20%. Damage rates of shoots were significantly different between the treated plot and the reference. (Chi-square test, $p < 0.01$). Only one damaged

fruit was found in the trial plot at the end of the season; at harvest the fruit damage rate amounted to 0.1%. Fruit damage in the reference orchard progressed from 3.0% on August 3 up to 3.7% at harvest of the later ripening cultivars. The economical threshold in Bulgaria is 4-6% damaged fruits at harvest time. Damage rates were significantly different between the treated plot and the reference orchard already on August 3 (Chi-square test, $p < 0.01$), and thereafter until harvest (Chi-square tests, $p < 0.001$)

In 2016 in the trial plot, the damage of shoots by PTB was nil on May 6, 16 and June 13 and stayed at the same level till the 20 th of June (Table 2). Damage rates of shoots were significantly different between the treated plot and the reference orchard on June 13 and June 20. (Chi-square test, $p < 0.01$).

Only one damaged fruit was found in the trial plot at the end of the season; at harvest the fruit damage rate amounted from 0.0 to 0.1%.

Fruit damage by PTB in the reference orchard progressed from 0.4% on July 18 up to 1.3% at harvest. Damage rates were significantly different between the treated plot and the reference orchard already on July 18 (Chi-square test, $p < 0.01$), and thereafter until harvest (Chi-square tests, $p < 0.001$).

In 2017 in the trial plot, the damage of shoots by OFM was nil on May 4 and 17 and stayed at the same level in third week of June. (Table 1). Damage rates of shoots were significantly different between the treated plot and the reference orchard on May 17 and June 8 (Chi-square test, $p < 0.01$).

Only 1 damaged fruit was found in the trial plot at the end of the season; at harvest the fruit damage rate amounted from 0.0 to 0.1%.

In 2017 in the trial plot, the damage of shoots by PTB was nil on May 4, 17 and June 8 and stayed at the same level till the 16th of June (Table 2). Damage rates of shoots were significantly different between the treated plot and the reference orchard on June 8 and June 16. (Chi-square test, $p < 0.01$).

Only one damaged fruit was found in the trial plot at the end of the season; at harvest the fruit damage rate amounted from 0.0 to 0.1%.

Fruit damage by PTB in the reference orchard progressed from 0.3% on July 19 up to 1.2% at harvest. Damage rates were significantly different between the treated plots and the reference orchard already on July 19 (Chi-square test, $p < 0.01$), and thereafter until harvest (Chi-square tests, $p < 0.001$).

Index	Date 2016	Damage (%)	Damage (%)	Index	Date 2017	Damage (%)	Damage (%)
		trial	reference			trial	reference
shoot (%)	May 6	0.0	2.6	shoot (%)	May 4	0.0	2.1
	May 16	0.0	18.2		May 17	0.0	11.3
	June 13	0.0	19.7		June 8	0.0	16.9
	June 20	0.0	20.3		June 16	0.0	20.1
	July 4	0.0	1.0		July 5	0.0	1.1
	July 18	0.0	2.2		July 19	0.0	1.7
	July 26	0.0	2.5		July 25	0.0	2.0
	August 3	0.0	3.0		August 3	0.0	2.1
	August 10	0.0	3.1		August 9	0.0	2.4
	August 23	0.0	3.5		August 23	0.0	2.7
fruit damage(%)	September 10	0.1	3.7	fruit damage(%)	September 4	0.1	2.9
	at harvest	0.0-0.1	1.0-3.7		at harvest	0.0-0.1	1.1-2.9

Table 1. Evaluation of shoot and fruit damage (%) by *Cydia molesta* in the trial plot and in the conventionally treated orchard in 2016 – 2017

Index	Date 2016	Damage (%)	Damage (%)	Index	Date 2017	Damage (%)	Damage (%)
		trial	reference			trial	reference
	May 6	0.0	0.1		May 4	0.0	0.1
shoot (%)	May 16	0.0	0.6	shoot (%)	May 17	0.0	0.3
	June 13	0.0	1.1		June 8	0.0	1.9
	June 20	0.0	2.1		June 16	0.0	2.1
fruit	July 4	0.0	0.0	fruit	July 5	0.0	0.0
damage(%)	July 18	0.0	0.4	damage(%)	July 19	0.0	0.3
	July 26	0.0	0.5		July 25	0.0	0.4
	August 3	0.0	0.6		August 3	0.0	0.6
	August 10	0.0	0.6		August 9	0.0	0.7
	August 22	0.1	0.9		August 23	0.1	0.8
	September 10	1.1	1.3		September 10	1.1	1.2
at harvest		0.0-0.1	0.0-1.3	at harvest		0.0-0.1	0.0-1.2

Table 2. Evaluation of shoot and fruit damage (%) by *Anarsia lineatella* in the trial plot and in the conventionally treated orchard in 2016 – 2017

4. CONCLUSIONS

CIDETRAK® OFM/PTB MESO™ are effective, when used at dosage 20 dispensers per ha, applied once during the season, before the first onset of OFM and PTB.

The Cidetrak® OFM/PTB MESO™ dispensers, proved to be an effective means of control even in a small size orchard lots.

For controlling the both important pests in peach orchards - *Cydia molesta* Busck and *Anarsia lineatella* Zell. combined dispensers used are excellent.

Mating disruption is a perspective alternative to chemical treatments in the peach orchards of Bulgaria.

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REFERENCES

1. Barnes, BN, Blomefield, TL 1997, "Goaded growers towards mating disruption: the South African experience with *Grapholita molesta* and *Cydia pomonella* (Lepidoptera, Tortricidae)" *Bulletin OILB/SROP*, vol. 20, no 1, pp. 45-56.
2. Cardé, R, Minks, A 1995, "Control of moth pests by mating disruption: successes and constraints" *Ann. Rev. Entomol.* vol. 40, pp. 559-585
3. Kovanci, O 2003, "Mating disruption for control of the oriental fruit moth, *Grapholita molesta* (Busck) (Lepidoptera: Tortricidae), in North Carolina apple orchards" *Dissertation*, <http://www.lib.ncsu.edu/resolver/1840.16/5586>.

4. Kutinkova, H, Samietz, J, Dzhuvinov, V, Veronelli, V, Iodice, A 2010, "Control of oriental fruit moth, *Cydia molesta* (Busck), by Isomate OFM-Rosso dispensers in peach orchards in Bulgaria – preliminary results", *Bulletin OILB/SROP*, vol. 54, pp. 331-336.
5. Kutinkova, H, Dzhuvinov, V, Samietz, J 2011, "Control of peach twig borer and oriental fruit moth by mating disruption in an apricot orchard" *Acta Horticulturae (ISHS)* vol. 966, pp. 169-174.
6. Kutinkova, H, Dzhuvinov, V, Lingren, B, 2012, "Control of oriental fruit moth, *Cydia molesta* Busck (Lepidoptera:Tortricidae) in the peach orchards of South-East Bulgaria, using CIDETRAK® OFM – L dispensers", *Bulletin OILB/SROP*, vol. 91, pp. 209-213.
7. Kutinkova, H, Dzhuvinov, V, Lingren, B, 2013, "Control of oriental fruit moth, *Cydia molesta*, in the peach orchards of South-East Bulgaria, using CIDETRAK® OFM-L dispensers", *IOBC/wprs Bulletin*, vol. 91, pp. 209-213.
8. Kutinkova, H, Arnaudov, V, Dzhuvinov, V, 2015, "Sustainable Control of Oriental Fruit Moth, *Cydia molesta* Busck, Using Isomate OFM Rosso Dispensers in Peach Orchards in Bulgaria", *Chemical engineering transactions*, vol. 44, pp. 229-234
9. Lo, PL, Cole, LM, 2007, "Impact of pheromone mating disruption and pesticides on oriental fruit moth (*Grapholita molesta*) on peaches", *New Zealand plant protection*, vol. 60, pp. 67-71.
10. Molinari, F, 2007, "Uno strumento a supporto della difesa di pesco, albicocco e susino: l'uso dei feromoni su drupacee contro i lepidotteri carpofagi", *Informatore-Agrario*, vol. 63, no 13, pp. 53-56.
11. Molinari, F, Iodice, A, Bassanetti, C, Natale, D, Sambado, P. and Savino, F, 2008, "Disruption of matings of *Anarsia lineatella* in peach orchards", *IOBC/wprs Bull*, vol. 37, pp. 43-46.
12. Pickel, C, Hasey, J, Bentley, W, Olson, W. and Grant, J, 2002, "Pheromones control oriental fruit moth and peach twig borer in cling peaches", *Calif. Agric*, vol. 56, pp. 170-176.
13. Rot, M, Blazič, M, 2005, "Zatiranje breskovega zavijaca (*Cydia molesta* Busck.) z metodo zbeganja", *Lectures and Papers-Presented at the 7th Slovenian Conference on Plant Protection*, Zreče, Slovenia, 8-10-March 2005, pp. 175-181.
14. Sexton, SB & Il'ichev, AL, 2000, "Pheromone mating disruption with reference to oriental fruit moth *Grapholita molesta* (Busck)", (Lepidoptera:Tortricidae) literature review, *General and Applied Entomology*, vol. 29, pp. 63-68.
15. Trematerra, P, Sciarretta, A, Gentile, P, 2000 "Trials on combined mating disruption in *Anarsia lineatella* (Zeller) and *Cydia molesta* (Busck) using CheckMateReg. SF dispenser", *Atti Giornate Fitopatologiche Perugia*, pp. 349-354.