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USING NORMAL AND REDUCED RATE OF PHEROMONE DISPENSERS ISOMATE A/OFM FOR CONTROL OF PESTS ON PEACH AND PLUM IN BULGARIA

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Abstract

Combined pheromone dispensers Isomate A/OFM are used for control of most important pests on peach and plum - Oriental Fruit Moth (OFM), Grapholita molesta (Busck.), Plum Fruit Moth (PFM), Grapholita funebrana (Tr.) and Peach Twig Borer (PTB) Anarsia lineatella (Zell.) by means of mating disruption (MD), at a rate of 800-1000 dispensers per hectare. The aim of the study was to evaluate possibilities for MD of these three important pests using dispensers Isomate A/OFM at a normal and a reduced rate.
Experiments have shown that pheromone dispensers Isomate A/OFM at a rate of 1000 pieces per ha provide excellent control for all three pests. At a reduced rate of 300 pieces per ha Isomate A/OFM shows a high degree of control of the OFM and PTB - no damage from both pests was found, but this rate was not sufficient for PFM and damaged plum fruits at harvest exceeded 40%. At the rate of 600 pieces per ha the results were better - damaged fruits from PFM, at harvest time, did not exceed 14%.

Key words*: mating disruption, oriental fruit moth, Grapholita molesta, plum fruit moth, Grapholita funebrana, peach twig borer, Anarsia lineatella.*

INTRODUCTION

Peaches and plums are traditional fruit crops in Bulgaria grown on large areas - more than 16 thousand hectares (Agrostatistics, 2018). Their fruits are used both for consumption and for production of juices, nectars, and purees for children and other foodstuffs. Farmers annually apply a significant number of treatments with agrochemicals to protect the orchards from pests. Both fruit crops are greatly affected by fruit moths, sawflies, aphids, scale insects, etc (Stancheva et al., 2008; Lecheva et al., 2006; Andreev and Kutinkova, 2004; Lecheva et al., 2003; Arnaudov and Andreev, 2002). On the one hand this practice is necessary to protect fruit production, but on the other hand the use of chemical pesticides poses a risk of food contamination with toxic substances and this is directly related to the health of consumers. Another important theme is the harmful effect of pesticides on beneficial insects in agrocenoses and in general on the environment. Reducing this harmful effect as well as obtaining healthy foods is a leading trend in modern plant protection. Therefore, more and more attention is paid to methods of pest control that do not use harmful chemical pesticides. Such a method is the mating disruption applied to some of the economically important pests of the two fruit crops, using synthetically derived sex pheromones. Some successful results of trials on mating disruption of different moths were reported by Kovanci (2019); Kutinkova et al. (2019, 2011); Andreev and Kutinkova (2010); Riolo et al. (2010); Brouwer et al. (2008); Toffolutti et al. (2008); Falta et al. (2007); Veronelli and Iodice (2004).
Combined pheromone dispensers Isomate A/OFM are not registered in Bulgaria. They are used in other EC countries for control of important pests on peach and plum - oriental fruit moth *Grapholita molesta* (Busck.) and peach twig borer *Anarsia lineatella* (Zell.) by means of mating disruption (MD), at a rate of 800-1000 dispensers per hectare (Biogard, 2019). The chemical composition is similar to the pheromone for the plum fruit moth *Grapholita funebrana* (Tr.).
The aim of the study was to evaluate possibilities for MD of these three important

pests using dispensers Isomate A/OFM at a normal and a reduced rate.

MATERIALS AND METHODS

The experiments were carried out in the period 2017-2019 in isolated peach and plum orchards without chemical treatments. Combined pheromone dispensers Isomate A/OFM produced from ShinEtsu Chemical LTD, Japan were used for MD of oriental fruit moth, peach twig borer and plum fruit moth. The dispenser contains (Z)-8-Dodecenyl acetate, (E)-8-Dodecenyl acetate, (Z)-8-Dodecen-1-ol, (E)-5-Decenyl acetate. (E)-5-Decen-1-ol (a.i. LOAD guaranteed 274.4 mg).

In 2017 the trial plots for oriental fruit moth and peach twig borer were located in the region of Plovdiv, Sliven and Karnobat - Central South and South-East Bulgaria.

Experiments in the Plovdiv area were conducted on a 5 ha, in an 8-year-old orchard with peaches and nectarines of different varieties. The orchard is located in the Experimental Field of the Agricultural University (AU), Plovdiv - Brestnik village, 5 km south of Plovdiv. Two conventional private orchards with a total area of 3 ha, in a distance of 1.5 km were used as control plots. Six organophosphate and pyrethroid treatments were conducted there.

Isomate-A/OFM was used at a rate of 1000 dispensers per hectare. Dispensers are hung on trees in early April when peaches and plums are in full bloom.

A similar experiment was conducted 15 km south of Sliven, in the village of Glufishevo. The trial plot was 4.5 ha with peaches and nectarines of different varieties. Located a kilometre away from it, a 7-hectare plot with conventional plant protection was selected to serve as a control orchard. It is treated with pyrethroids and neonicotinoids for 12-14 days.

In the town of Karnobat trial and control plots are two orchards with peaches and nectarines, 10 ha each and at a distance of 0.5 km. The control orchard is treated for 14-20 days with neonicotinoids and organophosphorus insecticides.

The trial plots for plum fruit moth was 0.5 ha plums, 'Stanley' and 'Chachanska Lipotica' varieties. The orchard is located at the Agro-Ecological Center at the AU, Plovdiv, which is certified for the producing of organic fruit production. The control plot was a similar one, but conventional orchard, at a distance of 0.5 km, where seven chemical treatments have been conducted with neonicotinoids, pyrethroids and organophosphates.

In 2018 and 2019, only the orchards in the area of Plovdiv were monitored. In 2018, the pheromone dispensers were set in the trial plots at a rate of 300 dispensers/ha and in 2019 - in the plum orchard only, the rate was increased to 600 dispensers/ha. Only three insecticidal treatments were conducted in the conventional orchard due to poor fertility.

The flight of oriental fruit moth, peach twig borer and plum fruit moth flights was monitored using sex pheromone trapping in the years of the study. PHEROCON® VI Delta sticky traps were installed in the trial orchards and in reference orchards, located in the vicinity, treated with conventional pesticides.

The damages to shoots from oriental fruit moth and peach twig borer, as well as the damages to fruits from the three pests, were evaluated on 20 trees, randomly selected for each block.

RESULTS AND DISCUSSIONS

In the period 2017-2019, the oriental fruit moth was developing three or four generations per year depending on weather conditions in the three regions where the experiments were conducted.

In the Plovdiv's region, adults (moths) were flying from the first decade of April to the last decade of September. Caterpillars were damaging shoots from May to August.

The last two generations were damaging fruits from the beginning of August till harvest in September (Figures 1, 2, 3).

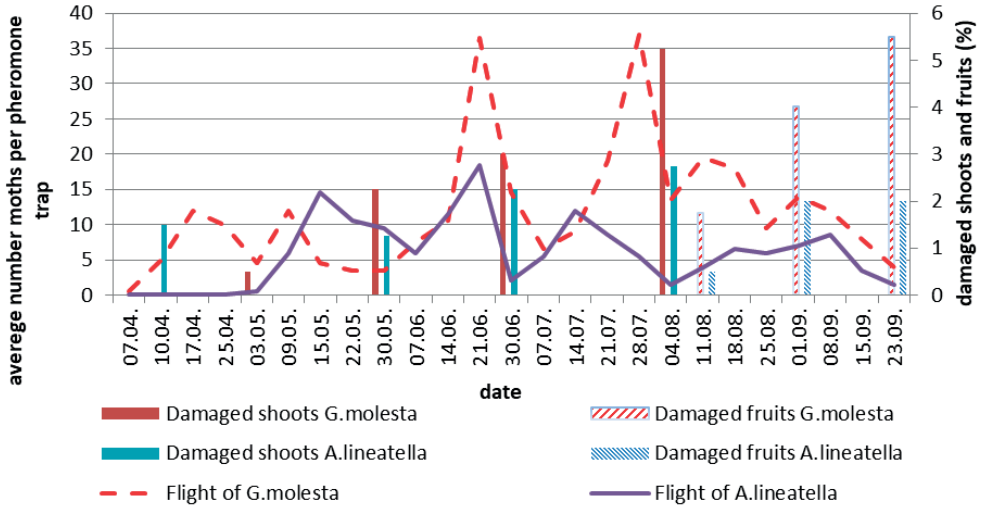

Figure 1. Flight dynamics and damages from *G. molesta* and *A. lineatella* in the control conventional orchard in the region of Plovdiv in 2017

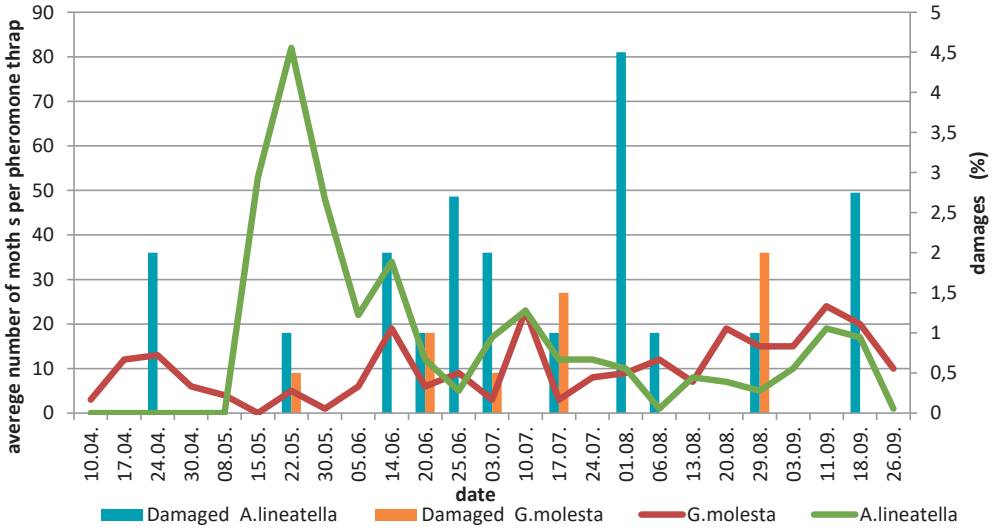

Figure 2. Flight dynamics and damages from *G. molesta* and *A. lineatella* in the control conventional orchard in the region of Plovdiv in 2018

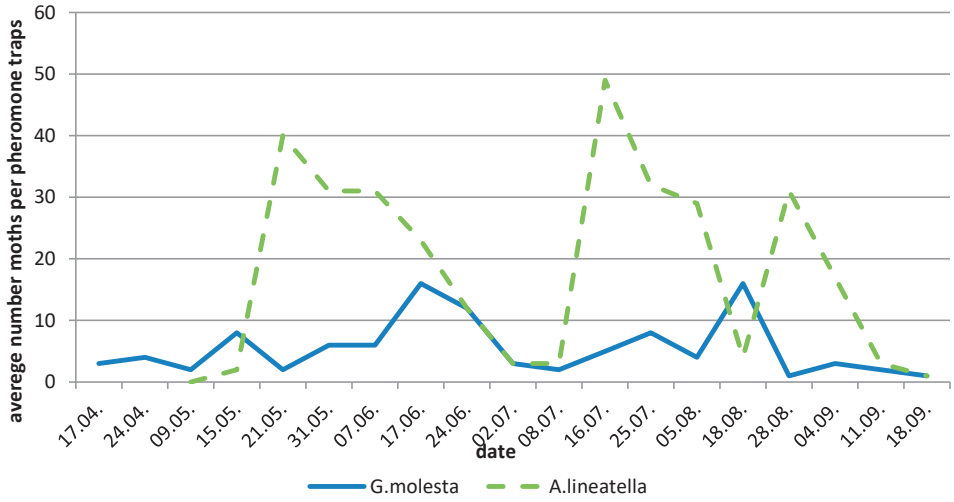

Figure 3. Flight dynamics and damages from *G. molesta* and *A. lineatella* in the control conventional orchard in the region of Plovdiv in 2019

In the other two regions the moths appeared in spring two weeks later, but also were flying to the end of September. The population density varies and depends on weather conditions but also on control measures. For control of the pest in conventional orchards, insecticide treatments were carried out from May to September every 12-14 days. With such a plant protection system, damage to shoots and fruits remained within 2-4.5% (Figures 4, 5), however, in unprotected orchards even relatively low population densities of the pest can cause a severe economic damage (Rothschild and Vickers, 1991).

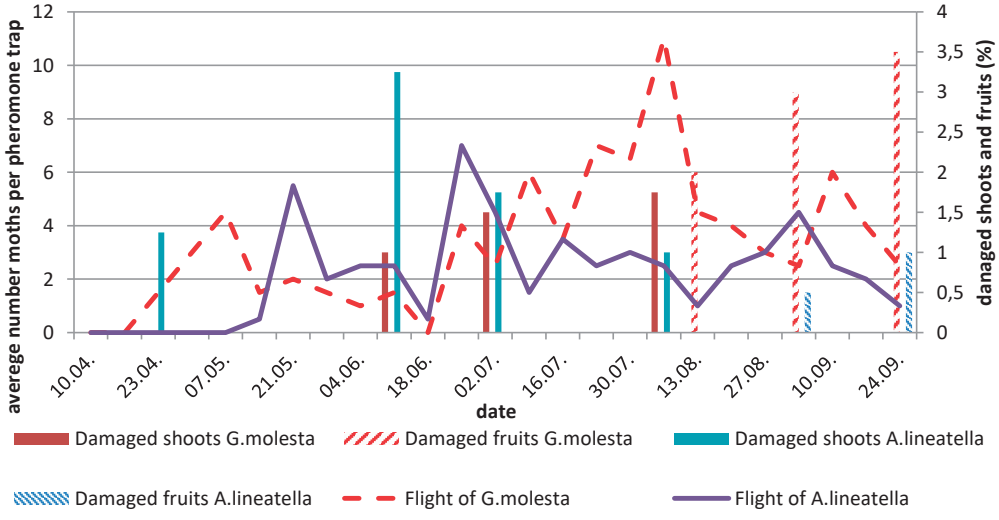

Figure 4. Flight dynamics and damages from *G. molesta* and *A. lineatella* in the control conventional orchard in the region of Glufishevo (near Sliven) in 2017

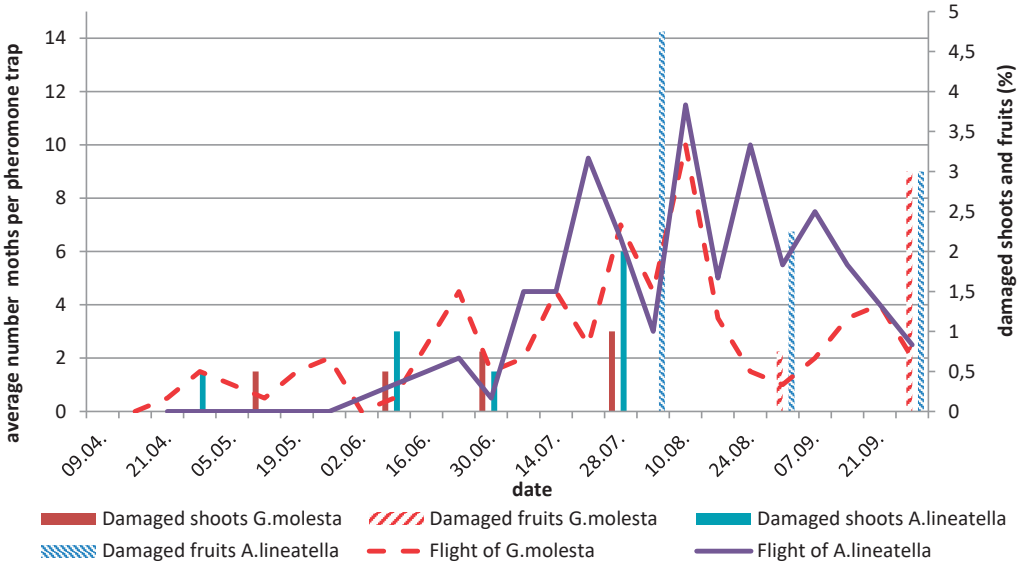

Figure 5. Flight dynamics and damages from *G. molesta* and *A. lineatella* in the control conventional orchard in the region of Karnobat in 2017

The peach twig borer also damages shoots and fruit. The pest overwinters as a caterpillar that has not completed its development and in April it began to cause damage on shoots. The moths were flying from May to September, and the species developed 3-4 generations too (Figures 1, 2, 3, 4, 5). Control was combined with that of the oriental fruit moth.

The plum fruit moth appeared a week later than the oriental fruit moth and developed two or three generations till September (Figures 6, 7, 8).

The caterpillars of the pest attacked only fruits and without control the damages exceeded 70% (Figure 8).

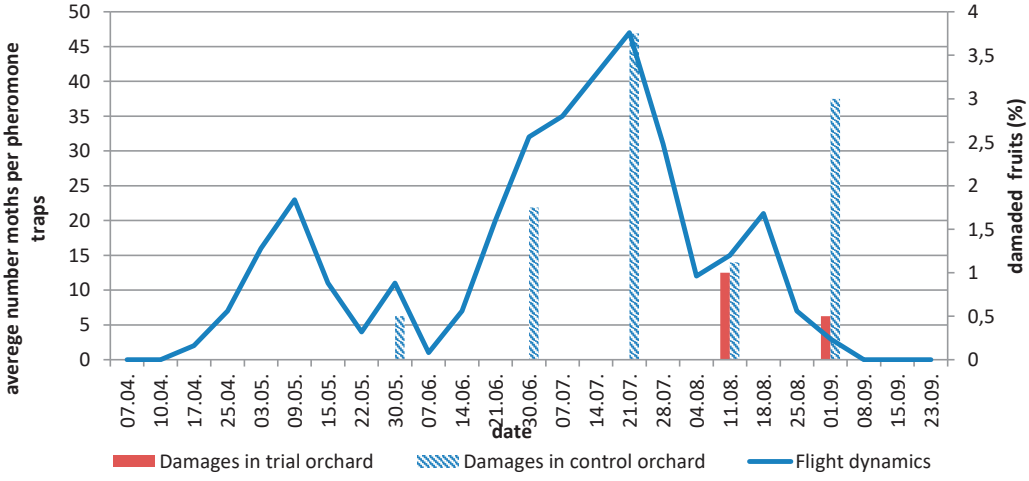

Figure 6. Flight dynamics and damages from *G. funebrana* in the control conventional and the trial organic orchards in the region of Plovdiv in 2017

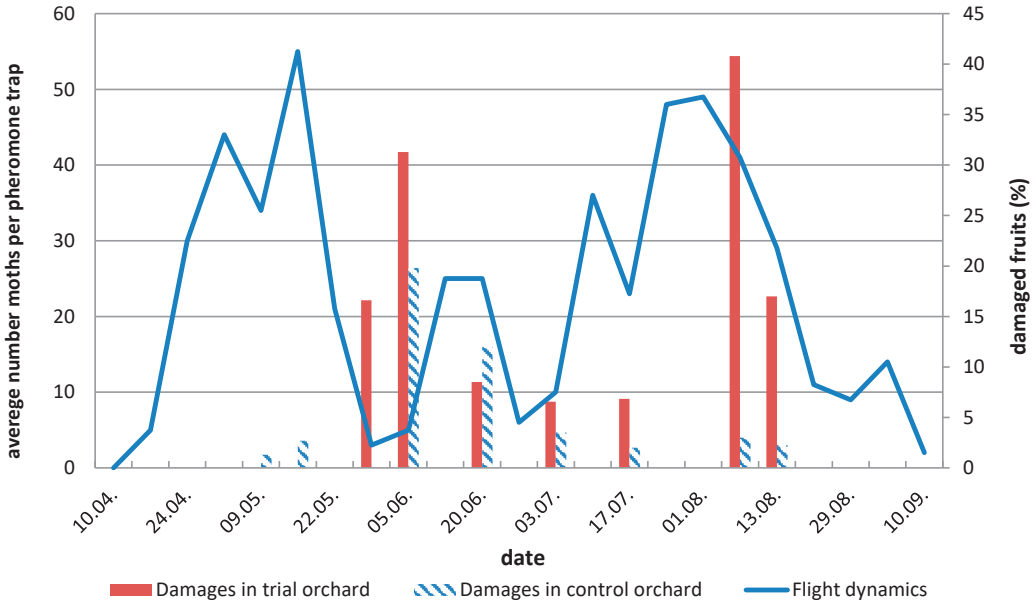

Figure 7. Flight dynamics and damages from *G. funebgana* in the control conventional and the trial organic orchards in the region of Plovdiv in 2018

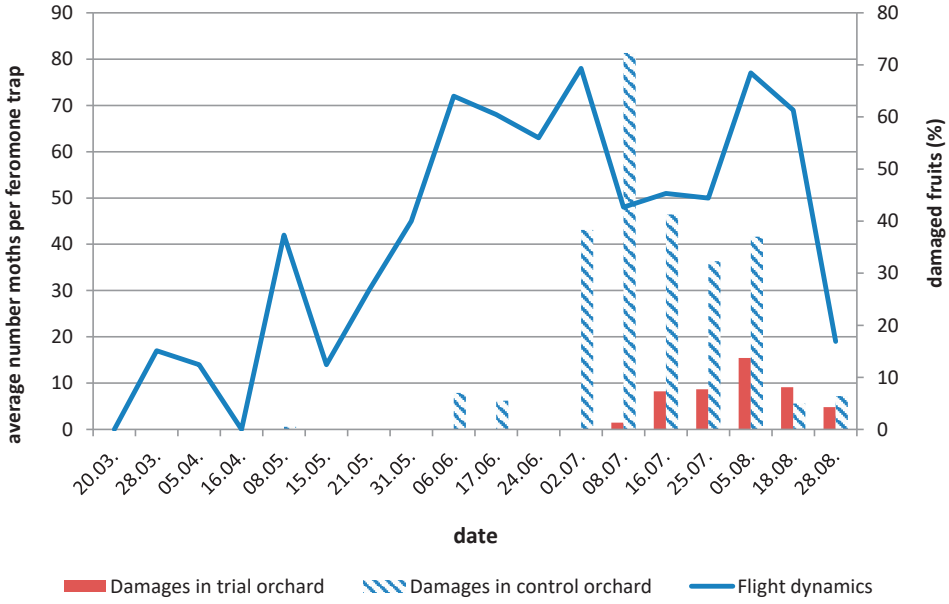

Figure 8. Flight dynamics and damages from *G. funebgana* in the control conventional and the trial organic orchards in the region of Plovdiv in 2019

The experiments in 2017 demonstrated that the pheromone dispensers Isomate A/OFM at a rate of 1000 pieces per ha provided excellent control for these three pests - no damage by *G. molesta* and *A. lineatella* was detected in any of the trial plots with peaches. Only in the trial plots with plums a small number of fruits damaged by *G. funebrana* were found. The

damages were minor (1% and less) and in fact could be ignored. In the control conventional orchards, despite the conducted insecticidal treatments, a certain percentage of damaged shoots and fruits were found (Figures 1, 2, 3, 4, 5, 6, 7, 8).

In the following year (2018) only the orchards in the Plovdiv's region were monitored. The rate of the dispensers was reduced to 300 pieces per ha. The experiments showed that Isomate A/OFM had a high degree of control of the oriental fruit moth and peach twig borer - no damage from both pests was found in the experimental orchards, but this rate was not sufficient for the plum fruit moth and the damaged plum fruits in May exceeded 30%, and in August - 40% (Figure 7).

Due to the unsatisfactory result in 2018 in the plum orchard, the rate of the pheromone dispensers in 2019 was raised to 600 pieces per ha. The result was significantly better and the damaged fruits from caterpillars of the plum fruit moth at harvest time did not exceed 14% while in the abandoned control orchard the fruit damage exceeded 72% in July and the subsequent reduction was due to the drop of damaged fruits (Figure 8).

CONCLUSIONS

The pheromone dispensers Isomate A/OFM at a rate of 1000 pieces per ha provide excellent control for the oriental fruit moth *G. molesta*, the plum fruit moth *G. funebrana* and peach twig borer *A. lineatella*.

At a reduced rate of 300 pieces per ha Isomate A/OFM showed a high degree of control of the oriental fruit moth and of the peach twig borer, but this rate was not sufficient for the plum fruit moth and the damaged plum fruits at harvest exceeded 40%.

At the rate of 600 pieces per ha, the number of fruits damaged by the plum fruit moth at harvest time did not exceed 14% but this is unsatisfactory. In order to control this pest, the recommended rate of 1000 pieces per ha must be applied.

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