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COMBINATION OF MATING DISRUPTION AND GRANULOSIS VIRUS FOR CONTROL OF CODLING MOTH IN BULGARIA

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Abstract: An application of mating disruption by use of Ecodian CP dispensers (ISAGRO, Italy) in combination with the granulosis virus product Carpovirusine 2000 (Arysta LifeScience, France) against Codling moth (CM), *Cydia pomonella,* was tested near Plovdiv, Central South Bulgaria. In 2007, the method was applied in an orchard where in the previous year fruit damage reached 18.7% and the CM population was high, as indicated by 3.83 diapausing larvae per tree. Carpovirusine was applied 11 times in the trial plot in combination with Ecodian CP dispensers installed twice during the season. Before harvest, fruit damage in the trial plot amounted to 0.9% and the overwintering population in autumn 2007 was only 0.46 larvae per tree. At the same time in the reference orchard, where 15 insecticide treatments were applied during the season, fruit damage before harvest reached 12.3% and the hibernating population was 7.97 larvae per tree. So, it has been confirmed that combination of both methods might be an effective tool for control of codling moth in the orchards with high population density and resistance to conventional insecticides. This study is being continued.

Key words: codling moth, resistance, mating disruption, Ecodian-dispensers, CpGV, virus, Carpovirusine, fruit-damage, flight-monitoring, diapausing-larvae

INTRODUCTION

Codling moth (CM), *Cydia pomonella* (L.), is the most important pest of apple worldwide. In Bulgaria it has full two generations and its pressure in commercial apple orchards is usually high (Kutinkova and Andreev 2003). Control of CM by conventional methods, in spite of numerous treatments applied, is often ineffective. This is apparently due to the development of resistant CM strains. Charmillot *et al.* (2007)

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detected resistance to organophosphates and pyrethroids by testing diapausing CM larvae collected in several Bulgarian orchards in autumn 2005 and 2006. The presence of resistance requests an urgent implementation of non-chemical methods of control of codling moth.

Mating disruption and CM granulosis virus products were tested in Switzerland and Northern Italy since early nineties of the past century (Charmillot 1995). Under conditions of high pressure of the pest, combining both methods was later recommended (Charmillot and Pasquier 2003). Also Minarro and Dapena (2000), in Asturia (Spain) found that mating disruption combined with application of CpGV reduced considerably fruit damage and that this was accompanied by decrease of diapausing CM larvae. In Poland, Dąbrowski and Olszak (2007) obtained very good results in control of CM with application of Ecodian pheromone dispensers in conjunction with Carpovirusine.

The objective of this study was to assess the effects of mating disruption (MD) method, applied in combination with a granulosis virus product, in an orchard where resistance of codling moth to insecticides was detected and the pressure of CM was high.

MATERIALS AND METHODS

In the years 2006–2007, the experiment was carried out in a commercial apple orchard near Plovdiv, Central-South Bulgaria. In 2006, a virus insecticide Carpovirusine 2000 (Arysta LifeScience, France) was applied only against the second generation of codling moth. It resulted in some decrease of fruit damage. Nevertheless, before harvest the damage reached 18.7% and the CM population remained high, as indicated by an average of 3.83 diapausing larvae per tree. In 2007, the mating disruption method was employed by use of Ecodian CP dispensers (ISAGRO, Italy), installed twice – on April 11 and on June 26, at the rate of 2500 units per ha each time. The dispensers were small blue hooks, impregnated; each one containing 10 mg of codlemone. Additionally, Carpovirusine was applied 11 times, at 10–12-day intervals, against both generations of codling moth, at the rate of 1 litre of the product per ha (10^{13} granules per ha). A single insecticide treatment (cypermethrin + chlorpyriphos-ethyl), against leaf miners, was applied by the grower in the trial plot on May 5.

Another orchard, located in the vicinity, served as a reference. Sixteen chemical treatments were applied there during the season to control CM, leaf miners, leaf rollers, aphids and mites. They included fenitrothion (10×), triflumuron (1×) and cypermethrin+chlorpyriphos-ethyl (5×). Fifteen of these treatments were supposed to have an action against codling moth larvae.

In both orchards (trial and reference), dynamics of CM flights was monitored by triangular traps baited with a standard pheromone capsule (Pheronet OP-72-T1-01), containing 1 mg of codlemone. Evaluation of fruit damage was carried out several times during the season on 1000 fruits and before harvest on 2000 fruits, in each plot. In June, corrugated cardboard band traps were wrapped around randomly selected tree trunks in both plots; 30 bands in the trial orchard and 40 in the reference orchard (6 at the border and 24 inside in the trial and 8 at the border + 32 inside of the reference). They were recovered in autumn in order to count the diapausing larvae and thus estimate the hibernating population of CM.

RESULTS AND CONCLUSIONS

In 2007, the first flight of CM began on April 10 in the reference orchard and reached its maximum in the 2nd decade of the month. Another peak appeared in the second decade of May (Fig. 1). Flight of the second generation, which did not overlap the first one, started at the beginning of July, reached its maximum during the 2nd decade of the month and then declined. Another peak of flights still appeared in the 3rd decade of August, supposedly a partial third generation during the unusual hot summer 2007. The flights finished on September 19. Traps installed in the reference orchard caught 291 moths in total. In the trial plot, where Ecodian dispensers and Carpovirusine were used, the standard pheromone trap has not caught any moth during the whole season.

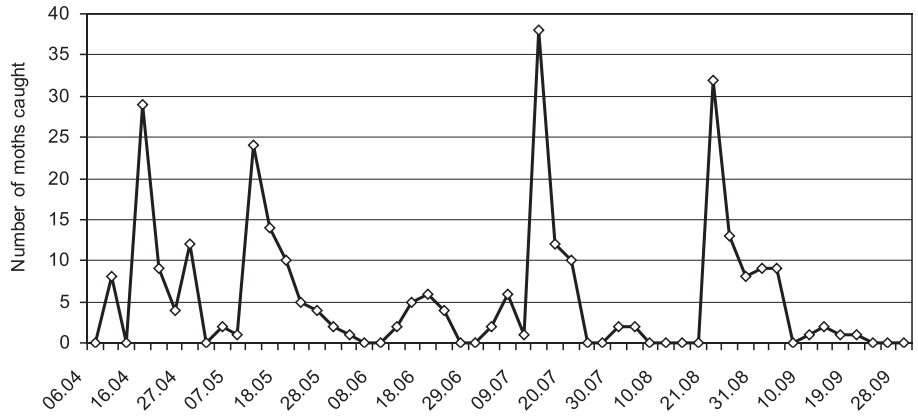

Fig. 1. Seasonal flight of codling moth in the reference orchard in 2007

Fruit damage caused by CM in the reference orchard varied during the season to a great extent, reaching sometimes very high values; finally it amounted to 12.3% before harvest, in spite of numerous insecticide treatments applied (Table 1). At the same time in the trial plot, where two biological methods (MD and virus) were employed, damage caused by CM was negligible, reaching only 0.9% before harvest.

The hibernating population of codling moth in the reference orchard, already high in autumn 2006, more than doubled during the successive year, reaching nearly 8 larvae per tree in autumn 2007. This clearly indicated that the CM population there was already resistant to the pesticides used. In this situation the conventional programme for control of codling moth, with use of chemical pesticide sprays, became obviously ineffective. At the same time in the trial plot, where the MD method was employed in combination with the granulosis virus treatments, population of CM decreased considerably, what was manifested by a low value of 0.46 diapausing larvae per tree in autumn 2007.

Combination of mating disruption and applications of a virus product may be the most effective tool for control of codling moth in the orchards with high population density and resistance to conventional insecticides. It should also prevent pollution of fruits with chemical residues and help to preserve the natural orchard environment.

Table 1. Evolution of fruit damage in 2007 and hibernating CM larvae population in 2006 and 2007

Index	Date	Carpovirusine + Ecodian trial plot	Reference orchard
Fruit damage 2007 [%]	June 8	0.0	0.3
	June 26	1.0	22.4
	July 7	0.0	0.0
	July 14	1.6	1.9
	August 25	0.4	9.8
	September 3	0.9	12.3
	preharvest	0.9	12.3
Larvae per tree in bands	Autumn 2006	3.83	3.32
	Autumn 2007	0.46	7.97

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POLISH SUMMARY

ZWALCZANIE OWOCÓWKI JABŁKÓWECZKI W BUŁGARII PRZY POMOCY METODY DEZORIENTACJI SAMCÓW W POŁĄCZENIU Z ZASTOSOWANIEM PREPARATU CARPOVIRUSINE

Owocówka jabłkóweczka, *Cydia pomonella* (L.), najważniejszy szkodnik jabłoni, występuje w sadach Bułgarii w dużym nasileniu, w postaci dwóch pełnych pokoleń w każdym sezonie. Zwalczanie tego szkodnika przy pomocy metod konwencjonalnych jest często nieskuteczne. Metodę zwalczania owocówki jabłkóweczki poprzez dezorientację samców przy użyciu dyspenserów Ecodian CP (prod. ISAGRO, Włochy) oraz preparatu wirusowego Carpovirusine 2000 (Arysta LifeScience, Francja) testowano w sadzie jabłoniowym położonym w pobliżu Płowdiw, w Środkowo-Południowej Bułgarii. Nasilenie owocówki w tym sadzie w roku poprzednim (2006) było wysokie, o czy świadczy 18,7% uszkodzonych owoców przed zbiorem oraz 3,83 zimujących larw w przeliczeniu na drzewo. W 2007 roku w kwaterze doświadczalnej stosowano Carpovirusine 11 razy, a dyspensery feromonów Ecodian CP instalowano dwukrotnie. Przed zbiorem stwierdzono zaledwie 0,9% uszkodzonych owoców, a populacja zimujących larw wyniosła tam tylko 0,46 na drzewo. W sadzie kontrolnym, mimo przeprowadzonych 15 zabiegów insektycydami, uszkodzenia owoców przed zbiorem wyniosły 12,3% a populacja zimujących larw osiągnęła poziom 7.97 w przeliczeniu na drzewo. Połączenie obu testowanych metod może być więc skutecznym rozwiązaniem w sadach, gdzie owocówka jabłkóweczka występuje w dużym nasileniu i gdzie występuje odporność na stosowane insektycydy. Badania są kontynuowane.