Chapter 1.

Influence of the Construction and Use of Pheromone Traps by the Catching Results of Harmful Moths

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Abstract: The pheromone trap catch of five harmful Microlepidoptera species in conjunction with the capsule and base exchange. The Csalomon type gluey traps were in operation in Borsod-Abaúj-Zemplén County (Hungary) between 1993 and 2007. The caught species were the followings: Spotted Tentiform Leafminer (*Phyllonorycter blancardella* Fabricius), Peach Twig Borer (*Anarsia lineatella* Zeller), European Vine Moth (*Lobesia botrana* Denis et Schiffermüller), Oriental Fruit Moth (*Grapholita molesta* Busck) and Plum Fruit Moth (*Grapholita funebrana* Treitschke). Our examinations proved that the highest numbers of caught moth are on the fourth or fifth day following the exchange of capsules and then will decrease. The increase in catches cannot therefore be sustained. Replacing the gluey sheets did not modify the effectiveness of the collection.

Keywords: Microlepidoptera species, pheromone traps, replacement of capsule

1. Introduction

The pheromone traps, similar to light-traps, play an important role in the forecasting system of insect pests. However, the efficiency of the traps can be modified by several biotic and abiotic factors in both the collection method. Understanding these would be exceptionally important. However, the application of the light-traps looks back at longer time (onto more decades); researchers studied the effects of modifying factors mainly in respect of these. Research work is complicated by the fact that the catch result is not daily counted in most cases, but according to the proposal of Tóth (2003) 2-3 days together, aggregated. Ghobari et al. (2007) also checked in every second day the number of captured (*Tortrix viridana* L.) individuals in Iran. Giri et al. (2014) the number of Potato Tuber Moth (*Phthorimaea operculella* Zeller), caught by pheromone trap, was counted in every morning between 6 and 8 a.m. in Nepal.

According to Pénzes et al. (2010) the sex pheromone traps can be used effectively for forecasting if the collected insects are daily counted.

The water with detergent was changed in pheromone traps of Nasseh and Moharam (2011) and the African Armyworm (*Spodoptera exempta* Walker) moths are

counted daily. The pheromone capsules were changed in every three weeks.
As the daily catch results were not recorded, it becomes impossible to recognize the effect of a number of factors, which can change day by day, so their influence changes also day by day (eg. temperature, precipitation, wind etc.).

However, our own daily catch data made it possible to show the influence of the Moon phases (Nowinszky et al. 2010), the Péczely's macrosynoptic weather situations (Károssy et al. 2009) and the Puskás type weather fronts (Puskás et al. 2009; Barczikay et al., 2009) on pheromone trap catch.

There is another problem that other influencing effects prevail, than the light-traps. This problem comes from the due to the method of trapping and baits the way of the deviation, like this eg. type of trap, pheromone dose, the place of trap. Ghobari et al. (2009) have been studied these factors in the context of Green Oak Tortrix viridana (*Tortrix viridana* L.) effectiveness of trapping in Iran.

Braham (2014) experienced, that 2-13 times more Tomato Leaf Miner (*Tuta absoluata* Meyrick) individuals were caught by the fresh baits filled traps, as with weathered ones.

According to results of Kovanci et al. (2006) there were continuously high catch results with the Oriental Fruit Moth (*Grapholita molesta* Busck) traps if the traps were placed in the upper canopy level. This statement supports the earlier reports by Rothschild and Minks (1997) in each orchard with this explanation of this that the mating activity happens in the upper canopy. According to experiments of Herman et al. (2005) the water traps caught the most moths per day. The delta-shaped sticky traps caught more moths than cylinder-shaped sticky traps and funnel traps. Trap height had no significant effect on moth catch.

Field experiments were conducted by Taha et al. (2012) to determine the attractive action of different colours of sex pheromone traps (red, yellow, green and blue) on Tomato Leaf Miner (*Tuta absoluta* Meyrick). The results show the red sticky traps (39.7 % reflection at 612.1 nm dominant wavelengths took most of the moths, 46.89 %) of the total caught moths, while the yellow gluey traps caught the fewest insects, only 13.99 %.

The pheromone traps were checked by the Ágoston and Fazekas (2014) twice a week initially and then after harvesting the tomatoes the frequency was once in every week till the end of November.

González-Caberra et al. (2011) recorded the number of *Tuta absoluta* (Meyrick) males captured twice a week. The sticky plate was changed twice a week, and the pheromone capsule once a month.

Abbes and Chermiti (2011) renewed the sex pheromone capsules every four weeks and the number of captured males of *Tuta absoluta* was recorded every week before the change of the sticky cardboards.

Hári (2014) counted of fruit moths twice a week and replaced every 4-6 weeks the pheromone capsules. The sticky sheets were exchanged on the basis of saturation and degree of contamination.

Sípos (2012) pheromone trapped the Raspberry Cane Midge (*Resseliella theobaldi* Barnes) males. She changed the sticky sheets once a week and pheromone cap-

sules once a months.

The efficiency of the catch is significantly changed by the effectiveness of capsules and sticky sheets with the passage of time, because of the weather and number of caught individuals.

It is a general experience; there is an increase in the number of caught specimens after the exchange of capsules and sticky sheets. The time of these exchanges are after different period. According to Tóth (2003) the efficiency of the sticky sheets can slowly decrease after 4-6 weeks, because of the weather. It is necessary to change at this time. The sticky sheets' exchange, depending on the catch, is proposed after 7-10 days. Voigt et al. (2010) made this change in their used Codling Moth (*Cydia pomonella* L.) traps, in every six week. Kovács et al. (2008) caught successfully Agriotes species, without any capsule exchange in the full time of swarming. If the number of the individuals can permanently increase following the capsule exchange, we receive regularly a false result about the real procession of swarming (Voigt et al., 2010).

However, there is another problem in case of species with multi-generation, when the duration of a swarming for each generation is relatively short. The long-term impact of the capsule exchange cannot be investigated, the results would be false, because the examined days are in overlap with different periods of swarming.

Gebresilassie et al. (2015) collected *Phlebotomus orientalis* Parrot (Diptera: Psychodidae) individuals significantly higher on horizontally placed sticky traps than vertically deployed ones.

It was the aim of our work to determine, with the help of our daily catch data from several years, how many days, following the capsule exchange, can be show the increased catch.

Field trapping experiments were carried out by Guofa Chen et al. (2010) to evaluate effective trap characteristics for maximising *Ips duplicatus* (Sahlberg) catches in pheromone-baited traps in China.

Window-slot and cross-barrier traps had significantly higher catches than multiple-funnel traps. The colour of window-slot traps showed a significant effect on catches, with dark colours (black and red) being more effective than light colours, especially white and yellow. Window-slot traps at a 1.5-2.0 m level caught more beetles than those at either ground level (0-0.5 m) or at 3.5-4.0 m. *Ips duplicatus* can be attracted to pheromone-baited traps over a distance of > 100 m from the forest edge in an open grassy field. There was a strong diurnal pattern of flight activity, with catches on window-slot traps occurring during the daytime with one broad peak at mid- to late afternoon.

According to Tóth et al. (2010) there is a disadvantage with pheromone traps, that they only collect male individuals. Therefore researchers worldwide engaged for developing new attractants suitable for females.

The daily pheromone emission depends on the compound and the species and ranges from a few femtogram to some nanogram (Tóth, 2009 personal communication).

The femtogram is the thousandth part of a picogram. A picogram is the thousandth part of a nanogram, while nanogram itself is only a billionth part of a gram.

2. Material

Six harmful Microlepidoptera species were caught by the Csalomon type sticky traps at Bodrogkisfalud in Borsod-Abaúj-Zemplén County (Hungary) between 1993 and 2007. The caught species were the followings: Spotted Tentiform Leafminer (*Phyllonorycter blancardella* Fabricius, 1781), Peach Twig Borer (*Anarsia lineatella* Zeller, 1839), European Vine Moth (*Lobesia botrana* Denis et Schiffermüller, 1775), Plum Fruit Moth (*Grapholita funebrana* Treitschke, 1846), Oriental Fruit Moth (*Grapholita molesta* Busck, 1916) and Codling Moth (*Cydia pomonella* Linnaeus, 1758). The catch data are shown in Table 1 2. 1.

There were not traps placed for all the five species during some years, but in other years, however, the majority of species were collected by 2-2 traps. The distance was about 50 metres between the traps. In these cases there was available 2-2 monitoring data during a night. The traps in all years were put on leafy branches of the same tree or leafy vines. The height of traps was generally between 1.5 and 2 metres. The distance of pheromone trap from fruit tree determines the number of moths caught. According to our observations, a trap located 25 metres from the plum-tree collected a large number of Plum Fruit Moth *(Grapholita funebrana* Tr.) specimens. The other trap, located 150 metres from the same tree started to catch moths only days after the first one and collected only a few specimens. After replacing this trap, closer to the tree, the catch of the two traps became nearly equal (Nowinszky et al., 2010).

The traps worked from early April to late September. Changing the capsules was 6-8 weeks according to Tóth (2003) proposal. The number of trapped moths was daily recorded.

3. Methods

We calculated the value of relative catch (RC) for all species and generation using the number of caught specimens. The value of relative catch (RC) is a quotient counted of a given sample time unit (1 day) of specimens taken and the average number of individuals on 1 day in the swarming of generation. If the number of caught specimens is the same as the average, the value of RC is 1.

The relative catch values were assigned to days between five days before and ten ones after exchange of capsules. We made daily sum and then averaged them. The results were illustrated. We determined the regression equation, which was shown in the Figures. We calculated the level of significance as well.

4. Results and Discussion

The success of catch on days between the previous 5 and following 10 are show in Figures 1. 4. 1.–1. 4. 6.

There was no any significant difference between the changes of sticky sheets and the pheromone trap catch of these species. Therefore we conclude the changes of sticky sheets always happened professionally in right time during the trapping periods.

We conclude after our results that after changing the pheromone capsules actually increases the number of trapped moths - in the same way as the general opinion - this maximum of 30% growth is not sustained. Because of this the number of yearly caught individuals of species with multi-generation cannot be influenced significantly by the capsule change. Of course, it would be better the catch result of more days, before and after the change, to take into consideration to the examination. However, in this case some distorting effects can be influence the results, such as the lower number of individuals in the period of generation change.

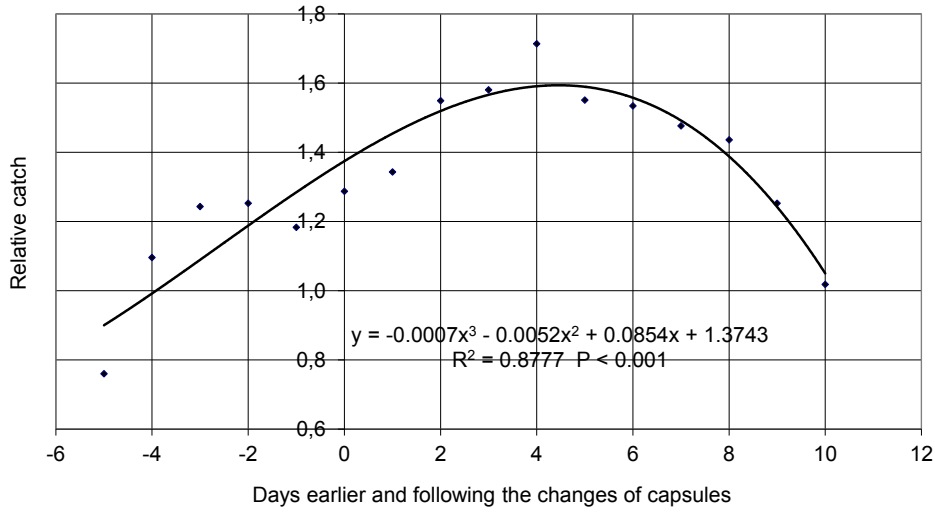

Figure 1. 4. 1.

Figure 1. Pheromon trap catch of Twig Borer Moth (*Phyllonorycter blancardella* Fabricius) in connection with the changes pheromone capsules (Bodrogkisfalud, 1996-2007)

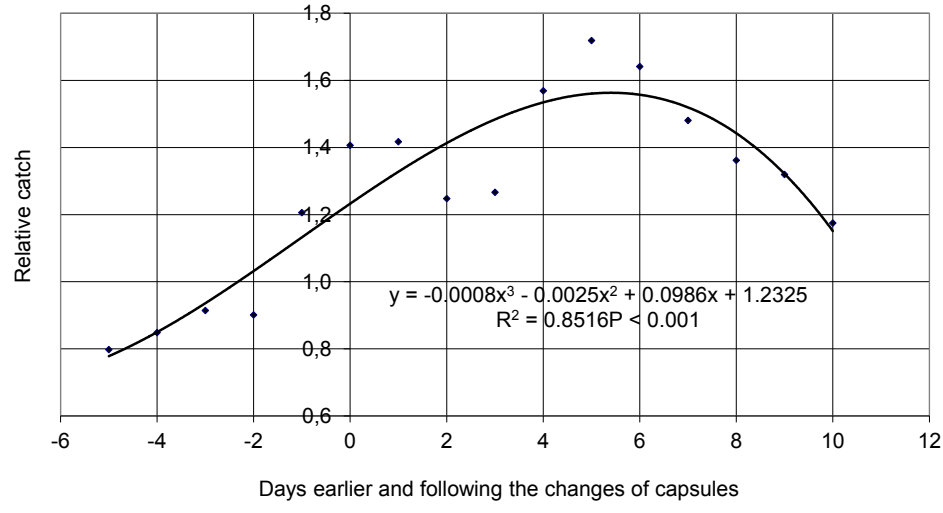

Figure 1. 4. 2.

Figure 2. Pheromone trap catch of the Codling Moth (*Cydia pomonella* Linnaeus) in connection with the changes of pheromone capsules (Bodrogkisfalud, 1996-2007)

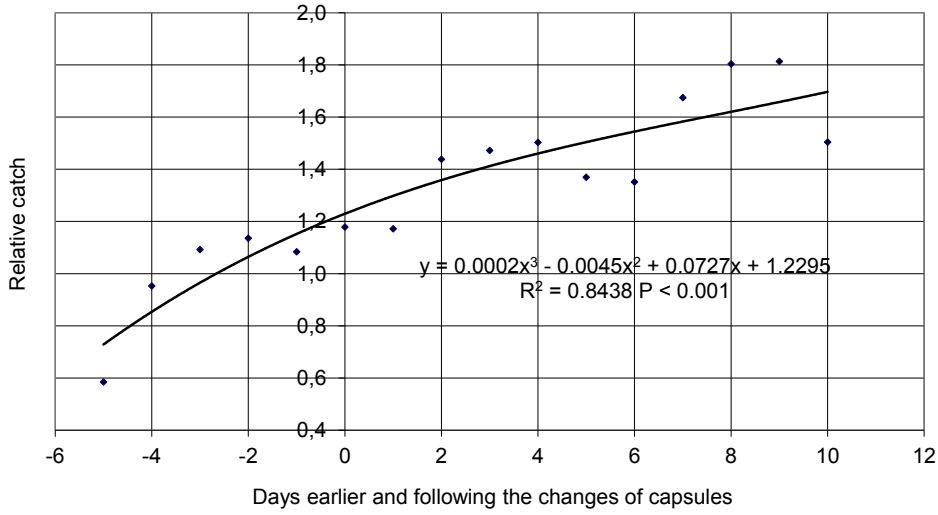

Figure 1. 4. 3.

Figure 3. Pheromone trap catch of the European Vine Moth (*Lobesia botrana* Denis et Schiffermüller) in connection with the changes of capsules (Bodrogkisfalud, 1996-2007)

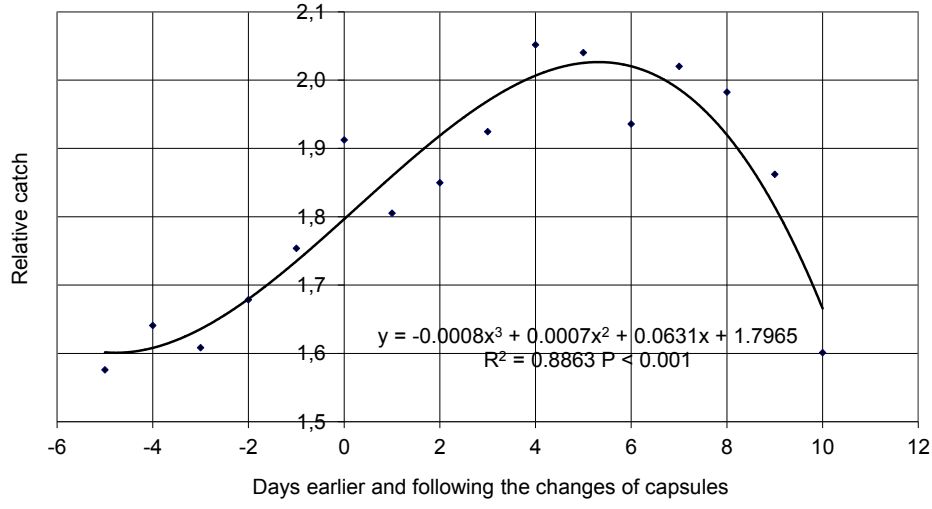

Figure 1. 4. 4.

Figure 4. Pheromone trap catch of Peach Twig Borer (*Anarsia lineatella* Zeller) in connection with the changes of capsules (Bodrogkisfalud, 1996-2007)

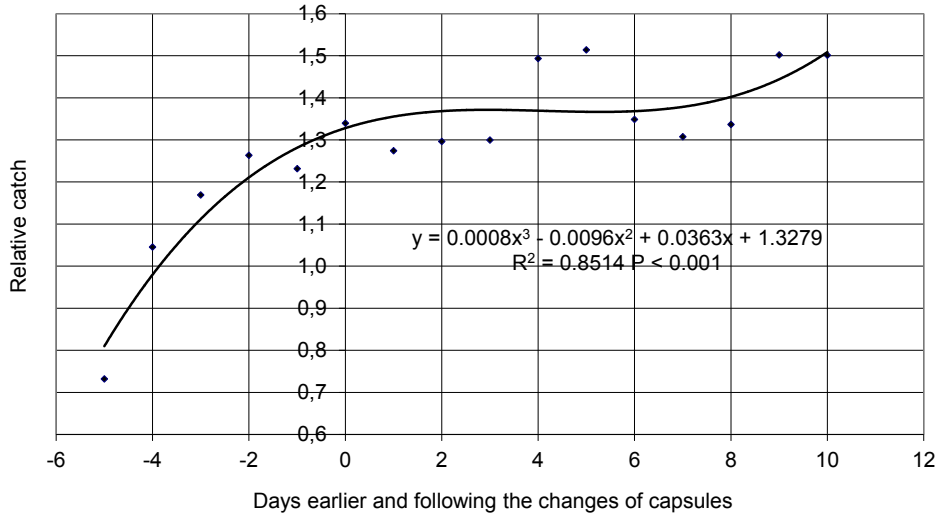

Figure 1. 4. 5.

Figure 5. Pheromone trap catch of Oriental Fruit Moth (*Grapholita molesta* Busck) in connection with the changes of capsules (Bodrogkisfalud, 1996-2007)

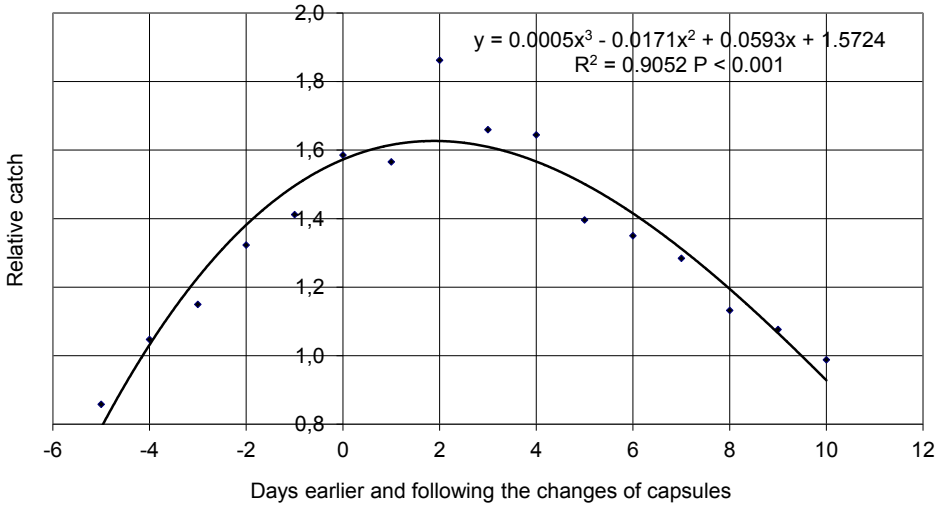

Figure 1. 4. 6.

Figure 6. Pheromone trap catch of Plum Fruit Moth (*Grapholita funebrana* Treitschke) in connection with the changes of capsules (Bodrogkisfalud, 1996-2007)

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