

PRELIMINARY RESULTS ON THE CHANGES IN THE FLIGHT DYNAMIC OF *CYDIA POMONELLA* (L.) IN NORTH-EASTERN TRANSYLVANIA, UNDER THE INFLUENCE OF CLIMATE CHANGE

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Abstract

The climate change in the last decades have brought increased average annual temperatures all over the world. The north-eastern region of Transylvania is no exception to this trend. Under the influence of this phenomenon and of the way in which average daily temperatures are distributed across the year, we observed certain changes in the flight dynamic of the adult males of the codling moth *Cydia pomonella* (L.). The preliminary data collected by the use of pheromone traps (Atrapom), along the vegetative period of 2019, regarding the flight of the moths, showed an extended flight span with two to five weeks than the flight recorded in the same orchards between 2004 and 2006. There is also a significant increase of the number of moths caught in the pheromone traps in 2019 when compared to the number of moths caught between 2004 and 2006. In the next years the monitoring of the flight dynamic of *Cydia pomonella* (L.) will continue in order to confirm that the rising average temperatures lead to an environment that favour certain pests.

Key words: climate change, codling moth, flight dynamic.

INTRODUCTION

The codling moth is one of the most dangerous pests for the Romanian apple orchards. It is a pest wide-spread across all over the temperate climate zones of fruit growing, except for Japan and Korea (Figure 1).



Figure 1. Distribution of the codling moth *Cydia pomonella* (L.) February 2020 (CABI)

The codling moth larvae annually produce significant damage in Bistrița region orchards, their presence being favored by the existence of a lot of untreated apple orchards. In other orchards the sprays applied at inappropriate timing or insufficient in number not only does it not help maintaining the damage under the economic threshold, but contrary contribute to

destroy the useful fauna. On this context and taking into consideration the climate changes of the last years, it is necessary to study the evolution of this pest, in order to be able to secure efficient control programs that also comply with the tendencies of low insecticide quantities applied. In Bistrița region the climate change consist of rise of annual medium temperature and increasing frequency of extreme weather conditions. There have been previous studies of the codling moth in Bistrița region between 1983-1987 (Minoiu & Boaru, 1989) that showed a low number of captures on the pheromone traps. Later on, another study conducted between 2004-2006 (Kutinkova et al., 2009), in the same region, showed a bigger number of adult males caught and a modified flight dynamic in that period of time. As the average annual temperature is constantly increasing, it is expected to modify the flight curve and the population dimensions in the region. However, there are recent studies performed in other regions of the world that suggest that the rise of the annual mean value of the temperature does not impact the flight span of some *Lepidopterae* (tortricid) species (Pak et al., 2019). Other multiannual studies

came to the conclusion that the rise of the temperature mean value may extend or shorten the flight period in moths depending on the species (Maurer et al., 2018). The aim of this study is to determine if the flight dynamics of the codling moth could shift under the climatic change in the north-eastern Transylvania and will be continued in the next years.

MATERIALS AND METHODS

The pheromone traps were placed in an apple orchard at Fruit Research & Development Station (F.R.D.S.) Bistrița (47°10' latitude North and 358 m above sea level).

The flight dynamic was established based on the number of adult males captured on specific pheromone traps ATRAPOM produced by the Chemistry Institute "Raluca Rîpan" Cluj-Napoca (Figure 2).



Figure 2. Adult male moths on pheromone trap ATRAPOM

The pheromone dispenser was replaced every five weeks and also the sticky part of the trap on which the moths were caught. There were two recordings of the captures per week starting from 25.04.2019 until 19.09.2019. Data collected were compared with the existing data from previous years, 2004-2006. A flight curve of the codling moth males was made using the weekly recordings of the four years. Data recorded along the four years (2004, 2005, 2006 and 2019) were grouped on seven days intervals, so it can be compared using graphic representation. The orchard where the trap was placed has been sprayed with insecticides five

times in the period of *Cydia pomonella* (L.) flight. The dates and substances used to control the codling moth in 2019 are presented in Table 1.

Table 1. The insecticide sprays in the 2019 season

Tr. No.	Data 2019	Active ingredient
1	17 June	clorpirifos metil 225 g/l
2	01 July	clorpirifos metil 225 g/l
3	18 July	Dimetoat 400 g/l
4	08 August	Lambda-cihalotrin 50 g/l
5	22 August	Tiacloprid 480 g/l

Although there are no complete records over an extended period of time of the exact treatments made with insecticides in the plot where the traps were placed, still there are some data. For example, in the year 1997 there were three sprays applied on: 19 of June, 17 of July and 13 of August, and there were 40 adult males caught on traps. Recordings of data regarding insecticides sprays from 2004-2019 indicated a number of five or six treatments per season during the flight span of the codling moth each year.

To check if there is a correlation between the flight span and the number of male adult moths caught the recordings were statistically analysed. We used the 'Pearson' function in Excel to calculate the value of the correlation factor "r". Then was compared with the critical value for Pearson's "r" factor (for two degrees of freedom, $\alpha = 0.05$).

RESULTS AND DISCUSSIONS

The data collected showed both an extended flight span in 2019 and a much bigger number of moths caught (Figure 3).

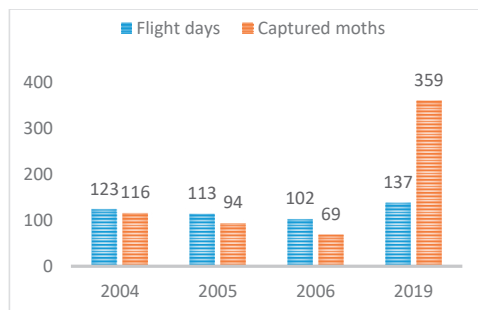


Figure 3. The number of flight days and the number of caught male moths in four years (2004-2006 and 2019)

Previous studies conducted in Bistrita area (Kutinkova et al., 2009) during 2004-2006 placed the beginning of the flight of *Cydia pomonella* L. at the end of April (30.04.2004) or at the beginning of May (2005, 2006), while the last captures were recorded at the end of August in all of the years of study. In 2019, the flight began in the last decade of April and ended in the second decade of September (Figure 4). The flight intensity was bigger from the last decade of June until the end of August and it was highly variable. An intensification of the flight can be observed on the second part of the summer, the same period when the medium temperatures are usually higher than the first part of the summer. The peaks of the flight curve are much higher in 2019 when compared to those in the years 2004, 2005 and 2006. Also the distribution of the peaks suggests a much bigger activity of the pest in the second part of the season of 2019 while in all the other years the first part of the season the captures were higher.

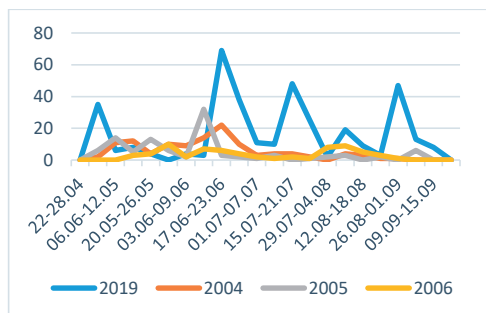


Figure 4. The flight of the codling moth in 2004-2006 and 2019

The number of captures, in 2019 season, decrease after each treatment with insecticides. This indicates that the products used were able to control the population for a period of time but the peaks that followed suggest a high reserve of moths in the area.

Although there seems to be a positive correlation between the number of days of the flight and the number of adult male moths caught, the statistics analysis of the correlation show that the correlation is not statistically significant. The calculated Pearson's "r" factor was 0.891274, smaller than the critical value for Pearson's "r" factor - 0.95 (for two degrees of freedom, $\alpha = 0.05$), that lead to this

conclusion. The drastic increase in number of the moths was much likely to be the result of the growth of the pest reserve in the area over the years. There are certain questions that emerge about the efficacy of insecticides sprays in the period between 2004 and 2019. We found some data indicating that two or more consecutive treatments have been executed with the same substance on repeated occasions and also mixtures of substances that are not recommended by the producer were applied. Such technological mistakes may have had an important effect on the increasing of the pest population by lack of efficacy of the control or even by inducing resistance towards certain insecticides.

CONCLUSIONS

The preliminary results showed an extended length of the flight of the codling moth in the year 2019 compared to the previous period 2004-2006 and a big increase in number of individuals caught, but it remains to clarify the exact factors that led to this situation.

The pattern of the flight was changed, the second part of the season being much more important in the economy of the flight and in consequence the number of treatments should increase in that period of the summer.

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