THE FLIGHT OF CODLING MOTH (*Cydia pomonella* Linnaeus, 1758) POPULATION IN APPLE ORCHARDS IN SĂLIȘTEA (ALBA: ROMANIA)

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Abstract: *Cydia pomonella L. (Lepidoptera: Tortricidae) is the most important pest of apple plantations worldwide. In Romania this pest produces damage in all areas of growing apple and pear. Seasonal activity of the codling moth, Cydia pomonella L., was conducted by pheromone traps in the apple orchards in Sălișstea (Alba: Romania). In our researches, pheromone traps and baits Atra-Pom, produced by the Institute of Chemistry "Raluca Ripan" in Cluj-Napoca, were used. The earliest catches of Cydia pomonella L. in Alba County were recorded in the third decade of April. The mass flight was recorded in the first decade of June for the first generation and in the third decade of July for the second generation. In the area under study, the codling moth develops two generations per year, the first generation being more harmful than the second one. The data obtained are important in order to improve the control programs for the Alba county area.*

Keywords*: Cydia pomonella, flight, population, apple orchard, Alba County*

INTRODUCTION

Several members of the lepidopteran family *Tortricidae* are important pests of apple orchards in Romania with potential to cause significant ecomomic loss to commercial apple growers (GHEBAN et al., 2014; BEȘLEAGĂ et al., 2013; SOMSAI et al., 2010).

The most important species, producing significant damages, both from a quantitative point of view, but especially qualitative, is codling moth (*Cydia pomonella* L.).

The species was originally from Eurasia, but in the last two centuries, once with the expansion of apple cultivation, it has spread all over the world (BASHEER et al., 2016; PISKORSKI & DORN, 2011; BOTTO & GLAZ, 2009; JONES & WIMAN, 2008; THALER et al., 2008).

In Romania, the species is widely distributed in all regions of the country. In recent years many apple growers from western part of the country have reported high infestation levels and damaged produced by codling moth (STANCĂ – MOISE, 2015; ȘTEF et al., 2010).

Although many studies have been carried out regarding the occurrence, the seasonal activity of *Cydia pomonella* L., the climatic changes of the last period of time have required the carrying out of new research to target the mentioned species. In this context, the present paper intends to establish the date of first appearance, the seasonal activity of these lepidopterans, in the climatic conditions of Alba County, but also the evolution of specimens number according to the age of the trees studied.

MATERIAL AND METHODS

The researches regarding the seasonal activity and evolution of codling moth according to trees ages, were performed in an apple orchard, located in Sălișstea, Alba County, during the year 2019.

The dynamic of adult flight was monitored with the help of traps with AtraPOM synthesis sex pheromones produced by "Raluca Repan" Institute of Chemistry of Cluj-Napoca.

Traps were placed in the orchard at the beginning of apple flowering and recorded twice a week, for the presence of codling moth, which were counted and removed from the sticky inserts. Pheromone traps were placed in the tree crown at a height of 1.5-2 m above the ground, using 1 trap/ 200m^2.

For this experiment, 3 plots were taken into study, the plot size being 0.5 ha. From each plot were randomly selected 3 trees in which the traps were installed.

Statistical analysis was performed using SPSS software. The descriptive elements (mean, standard deviation, minimum and maximum value) were highlighted and ANOVA was applied to determine the significant differences between groups. Graphically, the Box-Plot diagrams were used, respectively, representing the chronological series of daily records.

RESULTS AND DISCUSSIONS

Cydia pomonella L. occurred in all three study plots in 2019. The average daily catch is 8.75 specimen, with a standard deviation of 11.47, the minimum recorded being zero specimens, and the maximum 64 (figure 1).

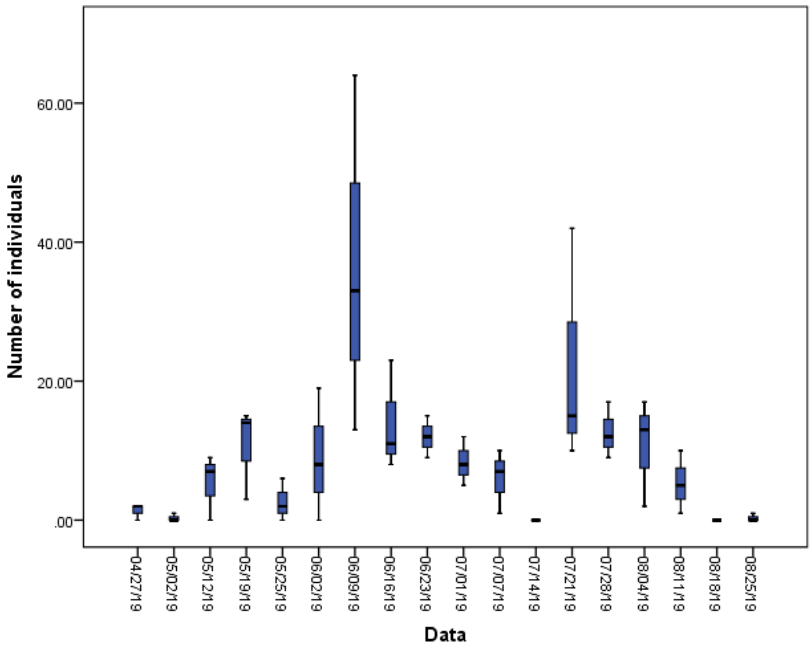

Figure 1. Box-plot diagram associated with total number of *Cydia pomonella* L. caught/day

Codling moth total trap catches were high in trap 1 with 262 adults and an average of 14,56 specimens/day. In comparison, were caught in trap 2 and 3 only 148 (an average of 8,22 adults/day), respectively 54 specimens (an average of 3 adults/day. Moth catches in the trap 1 were distributed heterogeneously between different apple trees elements.

Statistical analysis of the number of individuals caught by trap shows significant differences ($F = 4,759$, $p = 0.013$).

By the relatively high incidence of *Cydia pomonella* L. in experimental plots it turned out that the pest is of real economic importance.

The flight dynamics of *Cydia pomonella* L. adults was in correlation with climatic condition, especially with temperature and humidity. During the entire active period of codling moth adults, recorded two generations/year, presenting three maximum curve flights, which has be taken for the investigated area in 119 days.

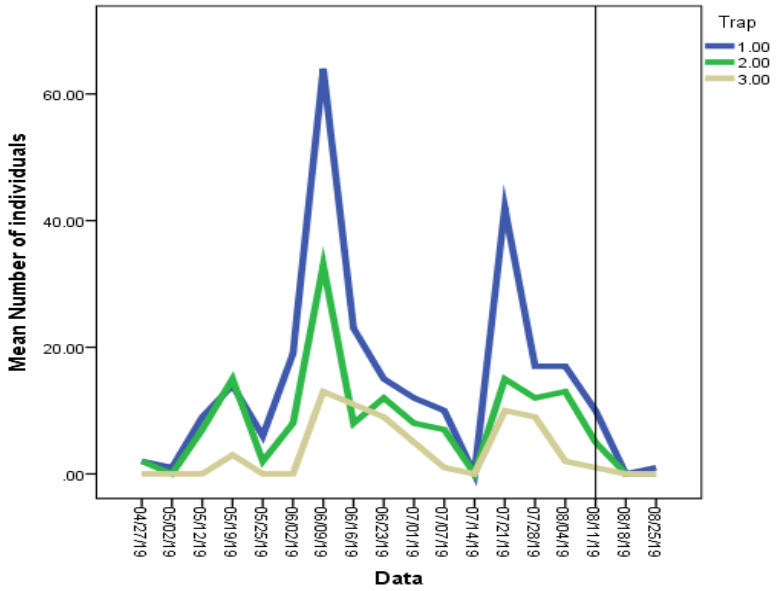

Figure 2. Cydia pomonella L. curve flight in Săliștea (Alba), 2019

In the climatic conditions of the experimental field from Săliștea (Alba county), in 2019, the flight of the first generation started on April 27. The first maximum of the curve flight was recorded shortly after the beginning of the research, between May 12 and 19, followed by a significant decrease in the number of adult specimens. This period was followed by a fast increasing of temperatures, which positively influenced the number of catches, so between 2 and 9 June there was a gradual increase in the number of specimens, when the second maximum curve flight was reached for the first generation, registering the largest number of specimens (64) collected for the *Cydia pomonella* L. in 2019. By the end of the first generation, there has been a gradual decline in adult populations (figure 2).

The flight of the second generation began on July 14, presenting a shorter duration in number of days, about 42. After the first collection, there was a significant increase in the number of adult specimens, the maximum curve flight for this generation being between 21 and 28 July, followed by a continuous and obvious population decline until the end of the collection period. We have to mention that the second generation has registered just a single curve flight.

The climatic conditions of this period, the very high temperatures and the lack of precipitation, have greatly influenced the *Cydia pomonella* L. population dynamics.

Our results is in agreement with the results of BEȘLEAGĂ et al. (2013), the first generation has two curves of flight and for the second generation just one.

SUMEDREA et al, (2009, 2015) demonstrated that codling moth, presents in the climatic conditions of the Pitești - Mărăcineni area, two curves of flight for the first generation,

and two curve of flight for the second generation. Also, GHEBAN et al. (2014) showed that in the climatically condition of Hunedoara, the codling moth, presents two curve of flight for both generation.

Cydia pomonella L. is known to produce more damage, in old apple orchard that in the young one, in Europe (SCHUMACHER, 1997; VOIGHT, 1999). Judging from trap collected data, codling moth was the most abundant tortricid moth in Săliștea (Alba County) apple old orchard during the study year. There was a higher variation in the number of adults caught/ day in the apple orchard containing old trees than in orchard with young trees (table 1).

Table 1.

Descriptive analysis of specimens' number captured according to trees ages

Descriptives

	Tree age			Statistic	Std. Error
Number of individuals	3.00	Mean		3.5556	1.09133
		95% Confidence Interval for Mean	Lower Bound	1.2531	
			Upper Bound	5.8581	
		5% Trimmed Mean		3.2284	
		Median		1.0000	
		Variance		21.438	
		Std. Deviation		4.63011	
		Minimum		.00	
		Maximum		13.00	
		Range		13.00	
		Interquartile Range		9.00	
		Skewness		.968	.536
		Kurtosis		-.715	1.038
	6.00	Mean		11.3611	2.16177
		95% Confidence Interval for Mean	Lower Bound	6.9725	
			Upper Bound	15.7497	
		5% Trimmed Mean		9.6111	
		Median		8.5000	
		Variance		168.237	
		Std. Deviation		12.97063	
		Minimum		.00	
		Maximum		64.00	
		Range		64.00	
		Interquartile Range		13.00	
		Skewness		2.400	.393
		Kurtosis		7.453	.768

Among the three experimental plots, there was a significant difference in the abundance of adults' number captured according to trees ages (figure 3). There was a higher infestation (number of adults caught/day) on apples trees 6 years old (11,39 adults/day) then on apple trees 3 years old (3 adults/day).

The presence of codling moth adults in an old or young apple orchard is related to the codling moth female choice of eggs laying behavior. This choice can be influenced by many factors related to the characteristics of the host plant. It has been shown that the codling moth females prefer 6 old year apple orchard to lay their eggs because of the large quantity of apples produce by that orchard compared with the quantity of apple produced by an young 3 year old orchard.

Thus, many authors (BRAHIM ET AL., 2013; YAN, 1999) have pointed out that the presence of fruits is indispensable for the laying of normal eggs due to the olfactory system of the moth female.

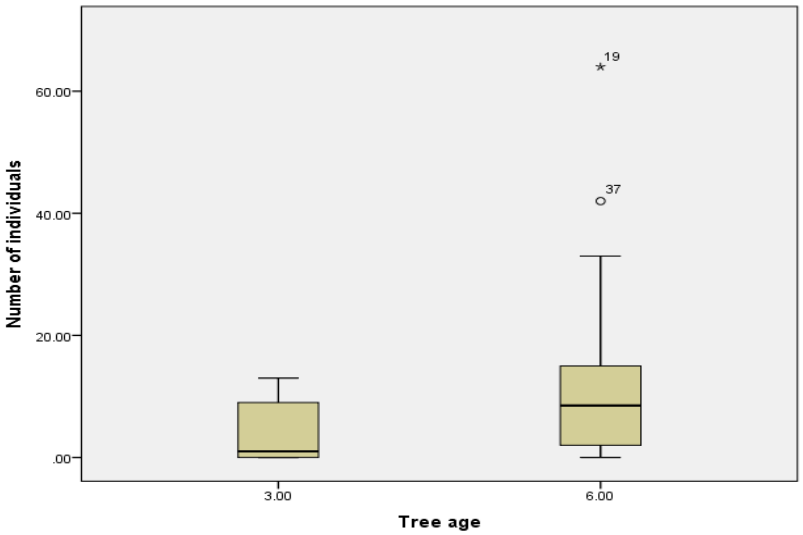

Figure 3. Box-Plot diagram associated with catches by age of trees

The percentage of adults caught/ day varies significantly depending on the age of apple trees (ANOVA; F = 6,080, p = 0.017)

The results are in line with those reported in other studies (BLOMEFIELD et al., 1997; MACLELLAN, 1962) that the codling moth prefer to attack old apple orchard.

CONCLUSIONS

Cydia pomonella L. due to the large number of adults, the average daily catch of 8.75 specimens, can be considered one of the most important pests of apple orchard in Alba County.

In the Salistea area (Alba), codling moth recorded two generations/year, presenting three maximum curve flights.

The flight of the first generation started on April 27 and the first maximum of the curve flight was recorded between May 12 and 19.

The flight of the second generation began on July 14, the maximum curve flight for this generation being between 21 and 28 July.

The percentage of adults caught/ day varies significantly, the highest number of adults being caught on the 6 year old apple orchard, 11,39 adults/day.

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