Scientific Papers. Series B, Horticulture. Vol. LXVI, No. 1, 2022
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

THE INFLUENCE OF CHANGES IN CLIMATIC CONDITIONS ON THE BIOLOGY OF THE APPLE WORMS LEPIDOPTERA - TORTRICIDAE

Cristina Ionela TURCU[1], Mihai TĂLMACIU[2], Nela TĂLMACIU[2], Monica HEREA[2], Simona-Mihaela CHELARU[1], Ionel PERJU[1]

[1]Research Station for Fruit Growing Iași, Romania
[2]University of Life Sciences Iași, Romania

Corresponding author email: simona.chelaru17@gmail.com

Abstract

The pest Cydia pomonella L. is present in all countries where the apple tree is grown (CABI 2021), the damage done by this species being considerable.The lower threshold of development of the species under study is 9°C that influences the appearance in apple plantations of butterflies, it was recorded in the analyzed area on May 9 in 2019 and May 1 2020, a period during which the sum of the temperature degrees did not meet the thermal constant (K) of the species worth 624°C (Rosca I. et al., 2011). The research was carried out between 2019-2020 at the Research Station for Fruit Growing Iasi, Romania using AtraPom traps (ICCRR Cluj-Napoca) to determine the biological cycle of the Cydia pomonella L. species in correlation with the influence of changes in climatic conditions.

Key words*: apple, traps, biological cycle, thermal constant.*

INTRODUCTION

Climatic and environmental conditions have contributed to the emergence and development of the studied pest agent confirming its presence in 36 countries (CABI, 2021) causing damage especially to the apple crop but also to the crops of pear, plum, quince, peach, apricot and walnut.

Although the insecticides used can combat this pest, they must be applied taking into account the biology of the pest in order to have the desired effectiveness, the apple worm having a spread flight throughout the growing season of the trees, representing a danger to the harvest.

The pest is very dangerous when insecticides are not used, with damage of up to 80%, causing damage from the first to the last generation (Mitrea I. et al., 2010) this causes increased attention in apple plantations.

The aim of this work is to follow the biological cycle of the species according to climatic conditions, so that we can determine the time when the pest occurs and its period of activity, with a significant change in recent years, due to mild winters and higher temperatures. The moment of the pest occurrence and the period of its activity give us the possibility to apply the phytosanitary treatments precisely.

MATERIALS AND METHODS

The studies were carried out within the Research and Development Station for Fruit Growing Iasi on its plantations for a period of two years (2019-2020) in which researches were carried out on the *Cydia pomonella* L. species.

The experience took place on a batch of 5 ha of apple trees that includes several varieties (Idared, Jonagold, Generos) where AtraPom traps marketed by the "Raluca Ripan" Institute of Chemistry Cluj-Napoca (Figure 3) were placed in order to determine the flight curve of the affected agent pursued.

The recording of climate data was carried out using the Adcon Telemetry weather station addVANTAGE A840, the processing of the data in the field being highlighted with the help of the Microsoft office package.

The actual temperature favorable to the appearance and development of *Cydia pomonella* L. in 2019 and 2020 was analyzed according to the method used in plant protection (Săvulescu A., 1978).

RESULTS AND DISCUSSIONS

The biological cycle of the apple worm is conditioned by the fulfillment of the lower development threshold of 9 ^{0}C of the species, it varies depending on the climatic conditions of each year, so in 2019 it was reached on March 8 and in 2020 on March 3.

The activity of adult insects is influenced by the thermal constant (K) which in the apple worm is worth 624^{0}C identified in the two years of study at different dates, so in 2019 it was recorded in June and in the year 2020 in July. The actual temperature amount of 2019 totaled 1707.3^{0}C allowing the development of two full.

generations of *Cydia pomonella* L. and an incomplete one. In the year 2020 it reached the sum of 1931.4^{0}C, which signifies the development of two complete generations and an incomplete one resulting in a reserve of pests for the following year.

The sum of the actual temperatures is different from one year to the next so during the same period of the year from April to October, the value was 1707.3^{0}C in 2019 and in 2020 the value being 1931.4^{0}C which indicates a different climatic situation from year to year influencing the biological cycle of the species. This can also be seen in the evolution of the average monthly temperatures that in 2019 were between 10.5^{0}C and 21.8^{0}C and in 2020 between 11.5^{0}C and 23.6^{0}C.

The overall temperature sum for Miroslava is $\Sigma(t_n-t_0)$ = 4143.62^{0}C in 2019 and $\Sigma(t_n-t_0)$= 4428.7^{0}C in 2020 (Figure 1).

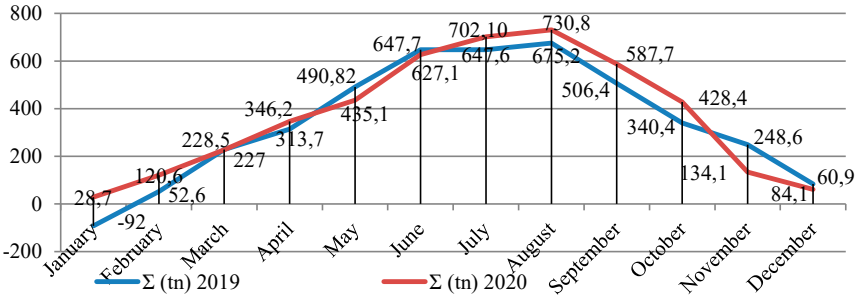

Figure 1. The sum of the actual and non-effective average monthly temperatures of 2019 and 2020

According to the biological threshold 9^{0}C of the apple worm the overall amount of temperature is represented by the sum of the actual and non-effective temperature. In this case, in 2019, the global sum of temperatures is made up of the effective sum of temperatures of 1707.3^{0}C and the sum of the non-effective temperatures of 2436.32^{0}C compared to 2020 when the effective sum of temperatures is 1931.4^{0}C and the sum of the non effective temperatures of 2497.3^{0}C.

Analyzing Figure 2, in 2019 the first catches were recorded on May 9, the traps being placed on May 3. On May 9, when the first butterflies were captured, the sum of the temperature degrees was 105^{0}C, the fulfillment of the thermal development constant K= 624^{0}C being achieved on June 30.

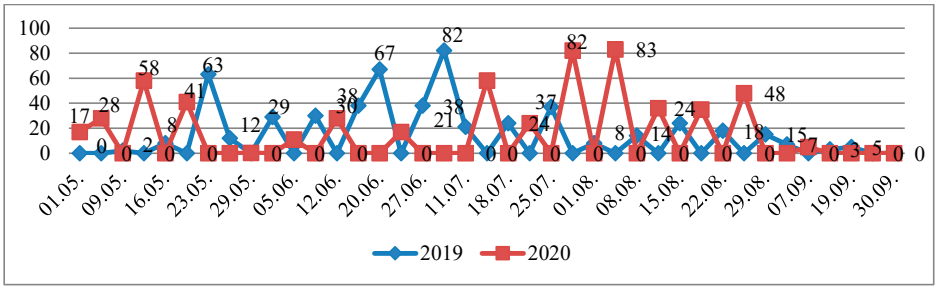

Figure 2. Flight curve

Figure 3. Trap AtraPom (original photo)

During this period (May 9-June 30) the maximum flight curve was reached on May 23, the flight of the first generation being for a period of 52 days, after June 30, the flight of the second generation began with the maximum of the flight curve on July 4, the second generation meeting the thermal constant (K) on August 12, the flight is for a period of 43 days. From 12 August to the last recorded catches on 19 September, 300.1^{0}C have accumulated. The cessation of the appearance of the pest is carried out at the sum of 1548.1^{0}C. The thermal constant does not favor the development of a complete generation, instead achieving a third generation incomplete.

In 2020, pheromone traps to monitor the appearance of the pest were placed on 22 April and the first catches were recorded on 01 May. The fulfillment of the K=624^{0}C thermal constant of the pest's development took place on July 3 when the first complete generation of the species was realized, with a maximum of the flight curve on May 15 (Table 1). In the case of the first generation of the apple worm, the butterflies had a sleazy flight over 64 days. The evolution of the stages of the biological cycle of the second generation lasted until August 16, when 1248^{0}C accumulated. The flight of the second generation was over a period of 44 days.

Table 1. Effective temperature in 2019 and 2020 for Research Station for Fruit Growing

Month	No. of days	Temperature (t_n) 2019	t_n-t_0	Σ(t_n-t_0) partial*	Σ(t_n-t_0) cumulated	Temperature (t_n) 2020	t_n-t_0	Σ(t_n-t_0) partial*	Σ(t_n-t_0) cumulated
January	**31**	-3,0	-	-	-	0,9	-	-	-
February	**28**	1,9	-	-	-	4,2	-	-	-
March	**31**	7,4	-	-	-	7,3	-	-	-
April	**30**	10,5	1,5	43,8	43,8	11,5	2,5	76,2	76,2
May	**31**	15,8	6,8	211,7	255,5	14,0	5,0	156,2	232,4
June	**30**	21,6	12,6	377,7	633,2	20,9	11,9	357,0	589,4
July	**31**	20,9	11,9	368,6	1001,8	22,7	13,7	423,2	1012,6
August	**31**	21,8	12,8	396,2	1398,0	23,6	14,6	451,7	1464,3
September	**30**	16,9	7,9	236,4	1634,4	19,6	10,6	317,7	1782,0
October	**31**	11,4	2,4	72,9	1707,3	13,8	4,8	149,4	1931,4
November	**30**	8,3	-	-	-	4,5	-	-	-
December	**31**	2,7	-	-	-	2,0	-	-	-

*)=values of this column rezult from **(t_n-t0)**×no. of days of each month, where: -t_n=montly average temperature; -t_0=biological threshold (9^{0}C)

The activity of the apple worm did not cease until September 7, when 1538.2^{0}C was achieved, signifying an incomplete third generation because the thermal constant of 624^{0}C is not met with a value of 290^{0}C, the pest being active for a period of 22 days, during this period presenting a danger of attack, especially since it synchronizes with the ripening period of the fruit.

CONCLUSIONS

In 2019 the pest *Cydia pomonella* L. had an activity carried out over 131 days while it

started its activity on May 9 and the sum of the annual temperature degrees reached the value of 4143,62^{0}C. During the period in which the worm activated the sum of the temperature degrees totaled 1548.1^{0}C, which according to the thermal constant developed two complete generations and an incomplete one not meeting only 300.1^{0}C, which signifies a prolonged activity of the pest due to climatic conditions.

In the second year of study the sum of the annual temperature degrees was 4428.7^{0}C and the number of days of activity was 130, starting its activity on May 1st and ceasing on September 7th when the sum of the effective temperature degrees was 1538.2^{0}C which favored the development of two full and third incomplete generations.

In the two years of study, climatic conditions favored the development of an incomplete third generation, which took place over 36 days in 2019 compared to 22 days in 2020. In terms of the sum of the actual temperature degrees, there is no view, a difference being in the amount of 290^{0}C in 2019 and 300.1^{0}C in the year 2020 although the number of days in which they have added up is inversely proportional to the value of $\Sigma(t_n-t_0)$.

We can conclude that in both years of study the pest represented a danger in the plantation throughout the vegetation period, a good knowledge of the pest's biology is important in order to apply the phytosanitary treatments rationally and at the right time.

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