Annals. Food Science and Technology
2015

RESEARCHES ON THE BIOLOGY AND FIGHT AGAINST THE APPLE BLOSSOM WEEVIL (*ANTHONOMUS POMORUM*)

Neagu Frăsin Loredana Beatrice

Valahia University of Târgovişte, Faculty of Environmental Engineering and Food Science,
Department of Environmental Engineering, Unirii Bld., 18-24, 130082, Târgovişte, Dâmboviţa County, Romania
E-mail: loredana_beatrice2003@yahoo.com

Abstract

The apple blossom weevil (Anthonomus pomorum L.) has one generation per year and hibernates as adult. The hibernating adults emerge early in spring, in March, before the opening of the buds, when the air temperature rises over 6.5^{0}C. In the first days after emergence, the weevils walk, then, when the temperature grows over 12^{0}C, they fly. After a preoviposition period ranging from 12 to 23 days, mating and eggs-laying occur. Eggs are laid in the flower buds, in small cavities dug by the females using their rostrum. The incubation takes from 20 to 24 days, the stage of egg lasting between 13 and 55 days, depending on the environmental conditions. The larvae that emerge feed on the internal organs of the flowers. After 14-17 days, the larvae reach their complete development and in the same place they turn into pupae. The larval stage takes from 32 to 44 days. The pupal stage may take from 10 to 27 days and may occur over a period of 31 to 36 days.

Under the conditions of the fruit-growing basin of Dâmbovița County, the adults appeared during the second half of May. They feeded for 14-25 days on the leaves'epidermis and parenchyma, after which they withdraw for the summer diapause, in different more shelthered places where they usually stay also during the winter; rarely, they migrate in autumn to other places for hibernation.The treatment warning takes place when in a tree's canopy one can notice 1-2 adults, around a value of the accumulated degree days ranging between 19.12^{0}C and 36.38^{0}C, when 0.5-1% of the flower buds have opened. Out of the entomophagous reducing the population of Anthonomus pomorum, the highest parasitation rate had the insect Habrocytus chlorogaster (6.2 %). For fighting against the apple blossom weevil it is recommanded to use insecticides with active ingredient dimethoate + cypermethrin or malathion.

Keywords: : *Anthonomus pomorum* L., biology, warning, control.

Submitted:18.06.2015 Reviewed:24.09.2015 Accepted:10.11.2015

1. INTRODUCTION

Anthonomus pomorum infests apple *Malus domestica Borkhausen*, and to a minor degree pear *Pyrus communis L.*, quince *Cydonia oblonga Miller*, and common medlar *Mespilus germanica L.*, throughout Europe (Alford, 2007).

The significance of the apple blossom weevil, *Anthonomus pomorum L.* (*Coleoptera: Curculionidae*), as a potential threat to apple, *Malus domestica Borkh*, has increased over the past two decades in many regions of Europe (Hausman et al., 2004).

The damage triggered by this insect in apple orchards in the subalpine regions may go up to 70-80% (Pașol et al., 2007).

Natural enemies, including birds, insects and fungi, are shown to play an important part in limiting the extent and distribution of the weevil (Miles, 2008). *Scambus pomorum* is the main larval parasitoid of the apple blossom weevil *Anthonomus pomorum* L. (Cross et al., 1999). There are strong fluctuations in parasitism among years, in which across-year parasitism levels were more similar for overall parasitism than for parasitism by the key parasitoid *Scambus pomorum* alone (Mody et al., 2011).

In point of the effectiveness of chemical insecticides, one can note those based on Thiacloprid, (2Z)-3-[(6-chloro-3pyridinyl)methyl]-1,3-thiazolidin-2-ylidenecyan-amide, active against various species of beetles - e. g. *Leptinotarsa decemlineata*, *Anthonomus pomorum*, *Lissorhoptrus oryzophilus* (Elbert at al., 2000).

2. MATERIALS AND METHODS

The research took place at the Phitosanitary Unit of Dâmbovița County, in laboratory and in field in the period of the years 2012 - 2014.
In order to appreciate the biology of this pest, a number of 15 apple trees - Jonathan cultivar were set aside, strongly infested since the previous years. The apple orchards are 22 years old. The plantation distances were 4.0 m between raws and 3.5 m between trees.
The biology of this insect was established in the orchard following the observations made in gauze sleeves put on the trees branches.
The observations were made in dynamics according to the climatic conditions and the plants phenological evolution. They consisted in collecting vegetal samples and analyzing them using binocular magnifying glasses. The samples, collected using shears, were put into tagged bags. The biological sheet renders every day by conventional signs the development stages.
To warn treatments against this pest, three criteria were considered: biological, ecological and phenological, the calculation of the accumulated degree days was made for each stage separately, by summing up the daily average temperatures bigger than the value of the insect's biological threshold, that is 6°C.
To control this pest, insecticides based on different chemical ingredients were tested.
To establish the effectiveness of the products used in our experiments, we made observations using the binocular magnifying glasses, and counting separately the viable and the dead individuals. The experimental variants included 3 trees in 5 repetitions. Results were presented percentually as mortality or effectiveness.
The effectiveness was calculated according to the Schneider-Orelli formula:

$$E(\%) = \frac{(T\%\_M\%)}{100 - M\%} \times 100 \qquad \text{where,}$$

T% = mortality of the larvae in the trated variant % (after the treatment);
M% = mortality of the larvae in the untreated variant %.

To identify the parasites, samples were isolated into separate test tubes and kept into the laboratory until the insects began to fly. To determine parasitism and pest density, capped blossoms (infested buds) were collected when approximately 75% of the weevils were in the pupal stage. At this time, oviposition by the parasitoids was supposedly completed but emergence of adult weevils had not yet started (Zijp et Blommers 2002).

3. RESULTS AND DISCUSSION

The apple blossom weevil has one generation per year and hibernates in the stage of adult in the bark cracks of the trees, under fallen leaves and sometimes in the soil at the base of the trees (Manolache at al., 1957; Isac, 1967,1968).
In the climatic conditions of Dâmbovita County, the hibernating adults wake up early in spring, in March, before the opening of the buds, when the air temperature rises over 6^0C.
The sequence of the biological stages of the apple blossom weevil in the year 2012 is as follows: it hibernated in the adult stage in the soil, around trees, a low number of adults being present in the bark, on the lower third of the trunk. The first weevils appeared in the canopy on 15 March, 6 days before the buds began to grow getting ready to open.
After a feeding period of 23 days, the adults began to lay eggs. The beginning of the mating season corresponded to the mouse-ear stage, while the eggs laying took place over a period of 13 days. The incubation occurred in 24 days. The larvae remained inside the floral buds and feeded on their internal organs. The development of the larvae lasted for 17 days, and that of pupa took 10 days.
The date of appearance for the first summer adults was 27 May 2012, when the accumulated degree days were 498.6^0C.The adults feeded for about 16 days on the leaves epidermis and then withdraw in different humid and cool shelthers, entering the diapause.
The treatment warning took place on 28 March 2012, when, on shaking the canopy, 1-2 adults were found on the tree; the tratment was to be

applied in maximum 6 days from this date. This interval corresponds, from a phenological perspective, with the opening of the floral buds at 10-15%.

The accumulated degree days corresponding to the warning treatment was in the year 2012 of 19.22^{o} C (table 1).

Biological stages of the apple blossom weevil *Anthonomus pomorum* L. in the year 2012

Table 1

Gen.	Biol. stage	Date	$T_n - 6$ (^{0}C)	Warning treatment issue date: 28.03
I	adult	15.03 - 25.04	9.9 - 66.4	
	egg	07.04 - 07.05	33.1 - 419.9	
	larva	01.05 - 01.06	157.6 - 563.1	
	pupa	18.05 - 02.06	400.3 - 589.5	
	adult	27.05 - spring	498.6 - spring	

In the year 2013 (table 2), the hibernating adults began to come out on 3 March, when the average air temperature reaches 6^{0}C, before the buds burst.

Biological stages of the apple blossom weevil *Anthonomus pomorum* L. in the year 2013

Table 2

Gen.	Biol. stage	Date	$T_n - 6$ (^{0}C)	Warning treatment issue date: 10.03
I	adult	03.03 - 21.04	9.0 - 156.3	
	egg	20.03 - 01.05	49.2 - 234.1	
	larva	10.04 - 13.05	100.6 - 360.2	
	pupa	26.04 - 28.05	204.6 - 542.2	
	adult	23.05 - spring	460.2 - spring	

Once the temperature begins to grow, the weevils spread throughout the orchard and after a preovipository period of 18 days, mating and eggs laying began. The mating occurred over a period of 41 days. The incubation lasted for 18 days. The larval stage took 16 days and ranged over a period of 32 days, while the pupal stage took 27days and occurred over a period of 31 days. On 23 May 2013 the new adults emerged. After a feeding period of 20 days, they withdrawn in the summer diapause.

In the year 2014, the adults began to appear on 9 March, about 4 days before the buds burst, they started eating and eggs laying in the floral buds. The eggs laying occurred over a period of 13 days. Hatching took place after 21 days, the pupal stage lasted for 10 days. The summer adults appeared on 17 May, they ate during a period of 14 days after which they entered their diapase (table 3).

Biological stages of the apple blossom weevil *Anthonomus pomorum* L. in the year 2014

Table 3

Gen.	Biol. stage	Date	$T_n - 6$ (^{0}C)	Warning treatment issue date: 11.03
I	adult	09.03 - 15.04	11.5 - 51.39	
	egg	21.03 - 03.04	69.3 - 216.6	
	larva	11.04 - 17.05	105.1 - 365.7	
	pupa	28.04 - 01.06	209.1 - 545.7	
	adult	17.05 - spring	365.7 - spring	

The warning rule was preserved as well in the years 2013 and 2014, namely when 1-2 adults were noticed in the canopy and at the phenological stage known as buds burst. Thus, in the year 2013, the warning bulletin was issued on 10 March, at the accumulated degree days of 23.30^{0}C, and the treatment was to be applied during the period 11-16 March.

In the year 2014, the issue of the warning bulletin was on 11 March ,and the optimal moment of treatament was considered the period 12-17 March. The effective temperature corresponding to the warning was 36.38^{o}C.

The main identified parasites and the average parasitism rate

Table 4

Crt. no.	Identified parasites	Parasited stage	Average rate of parasitism 2012-2014 (%)
1	Habrocytus chlorogaster	larval	6.2
2	Schambus pomorum	larval	3.7
3	Apanteles lacteus	larval + pupal	1.1
4	Caliptus sp.	larval + pupal	0.63

Considering the parasitism rate of the insect *Anthonomus pomorum* (table 4), 4 parasites were identified, the highest parasitism rate being recorded for *Habrocytus chlorogaster*, namely 6.2%. At the same time, one can notice a total parasitism rate of 11.63%, during the 3 years of observations.

From the analysis of table 5, it results that the products based on dimethoate + cypermethrin and those based on malathion are highly efficient, their effectiveness being over 95%. These active ingredients were applied at warning.

The main identified parasites and the average parasitism rate

Table 5

Crt. no.	Product	Active ingredient	Conc. (%)	Average efficacy 2012-2014
1	Sinoratox Plus	dimethoate 300g/l + cypermethrin 5g/l	0,075	95,30
2	Sinoratox Plus	dimethoate 300g/l + cypermethrin 5g/l	0,1	96,40
3	Pallas 50 EC	malathion 50%	0,3	95,60
4	Fyfanon 50 EC	malathion 500 g/l	0,3	95,30

4. CONCLUSIONS

Under the climatic conditions of Dâmbovița County, *Anthonomus pomorum* has one generation per year.

Adults appeared during the first half of the month of March, and after an average period of 18 days, the eggs were laid.

The average incubation period was 21 days, the larval stage lasted on average 16 days and the pupal stage, 14 days.

The treatment warning was applied when in the canopy of a tree were found 1-2 adults, around a value of the accumulated degree days of 26.3^{o}C, when the buds began to open.

Out of the etomomophagous insects regulating the *Anthonomus pomorum* population, the highest level of parasitism was that of *Habrocistus chlorogaster* (6.2 %).

To fight against *Anthonomus pomorum*, it is recommended to use products based on dimethoate + cypermethrin and those whose active ingredient is malathion.

5. REFERENCES

1. Alford, D.V. - Pests of Fruit Crops: A Colour Handbook. Manson Publishing, 2007, London
2. Cross J.V., Solomon M.G., Babendreier D., Blommers L., Easterbrook M.A., Jay C.N., Jenser G., Jolly R.L., Kuhlmann U., Lilley R., Olivella E., Toepfer S., Vidal S. - Biocontrol of pests of apples and pears in northern and central Europe: 2. Parasitoids, Biocontrol Science and Technology, 9 (1999), pp. 277–314
3. Elbert A., Erdelen C., Kuhnhold J., Nauen R., Schmidt H. W., Hattori Y. - Thiacloprid, a novel neonicotinoid insecticide for foliar application, The BCPC Conference: Pests and diseases, Volume 1. Proceedings of an international conference held at the Brighton Hilton Metropole Hotel, Brighton, UK, 13-16 November 2000, ISBN 1-901396-58-4,pp. 21-26
4. Hausmann C., Samietz J., Dorn S. - Significance of shelter traps for spring monitoring of *Anthonomus pomorum* in apple orchard,Entomologia Experimentalis et Applicata, 112 (2004), pp. 29–36
5. Isac G. - Cercetari privind prognoza şi avertizarea gărgaritei florilor de măr (*Anthonomus pomorum* L.), Anal. I.C.P.P., Bucureşti, 6, 1968, p. 393-407
6. Manolache C., Șuta Victoria, Oancea M. - Contributii la biologia și combaterea gărgaritei florilor de măr (*Anthonomus pomorum* L.), Bul. Șt., Seria Zool., 1957, 9, 2, 195 -211
7. Miles H.W. - Observations on the bionomics of the apple-blossom weevil, *Anthonomus pomorum*, linn.1, 26 feb 2008, DOI: 10.1111/j.1744-7348.1923. tb05683.x
8. Mody K., Spoerndli C., Dorn S. - Within-orchard variability of the ecosystem service 'parasitism': Effects of cultivars, ants and tree location, Basic and Applied Ecology**,** Volume 12, Issue 5, 2011, pp. 456–465
9. Paşol P., Dobrin Ionela, Frăsin Loredana Beatrice - Tratat de Entomologie specială, Editura Ceres, 2007, ISBN 978-973-40-0760-8
10. Zijp J.P., Blommers L.H.M. - Survival mode between the yearly reproduction periods, and reproductive biology of *Scambus pomorum* (*Hymenoptera*: *Ichneumonidae*: *Pimplinae*), a parasitoid of the apple blossom weevil *Anthonomus pomorum* (*Coleoptera*: *Curculionidae*), Entomologia Generalis, 26 (2002), pp. 29–46