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THE OUTBREAK OF *SPILONOTA OCELLANA* (DENIS & SCHIFFERMÜLLER), THE EYE-SPOTTED BUD MOTH ON APPLE TREES IN BISTRIȚA REGION

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Abstract

In the period 2019-2020 at the Fruit Research & Development Station Bistrița observations have been made constantly in apple and other fruit trees orchards. As a consequence, besides the usual apple pests and diseases such as: the codling moth, the San Jose scale, woolly apple aphid, scab, powdery mildew and brow rot, new threatening pests were detected. They are a part of the Lepidopterae order and did not represent a major problem in the past. Male adults of Spilonota ocellana (eye-spotted bud moth) were caught on pheromone traps placed in a nearby plum orchard, for monitoring the flight of Cydia funebrana, in the years 2019-2020. The number of captures was 53 in 2019 and 159 in 2020 per trap. In 2019 the damage was sporadically encountered both on leaves and fruits but in 2020 the damage was significantly higher. On some apple cultivars the fruits were damaged up to 23,23%. Data suggest the need for control measures to be taken especially in the second part of the summer.

Key words: *Spilonota ocellana, apple, damage, flight pattern .*

INTRODUCTION

The climatic conditions are globally changing and so they do in Bistrița area, leading, alongside the modifications in the life cycle of the traditional pests of the apple orchards, to some new damaging insects to appear. *Spilonota ocellana* (Denis & Schiffermüller) (Figure 1) is a well-known defoliator of different trees and shrubs, but up until now, has not been a significant threat for fruit trees at Fruit Research & Development Station Bistrița (F.R.D.S.B.).

Figure 1. Adult male of the eye-spotted moth on pheromone traps, F.R.D.S. Bistrita, 2020

Spilonota ocellana sin. *Tmetocera ocellana* is an insect of the Torticidae family, *Spilonota* genus that can be encountered in all cultivation regions of the apple in the northern hemisphere throughout the vegetative growing stage (Figure 2). It is a highly polyphagous species that has a lot of host plants both cultivated or spontaneous. Some of the host plants genus are: *Alnus* spp., *Querqus* spp., *Juglans* spp., *Larix* spp., *Crataegus* spp., *Malus* spp., *Prunus* spp., *Pyracantha* spp., *Pyrus*., *Rubus* spp., *Sorbus* spp., *Salix* spp., while in orchards it prefers apples (*Malus*) and also sweet cherry (*Prunus*). (http://idtools.org/id/leps/tortai/Spilonota_ocellana.htm)

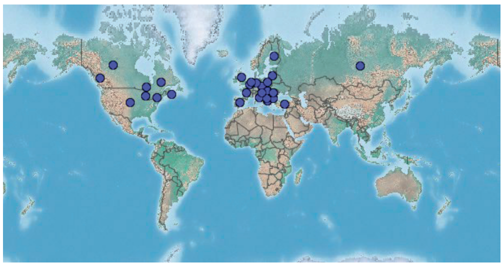

Figure 2. Distribution map of the eye-spotted moth. Source https://www.cabi.org/isc/datasheetreport/51015

There have been studies that underline the possible problems that this pest can cause in different fruit tree species. In the 1970-1971 seasons the eye-spotted bud moth caused up to 45 % damage to the pear and peach untreated orchards in Saragossa province in Spain (Cabezuelo Perez & Hernandez Esteruelas, 1975). But the same study reveals that in treated orchards the damaged buds represented only 3.5%. In Romania the damage on buds previously recorded was around 15% (Perju, 2002) and we found no data on the damage on fruits. More recent studies have been made in Canada, the Okanagan and the Sinukameen regions on apples as a consequence of some Spilonota ocellana outbreaks (Swain, 2016; Swain et al., 2017)

The entomologic literature mentions that the eye-spotted moth completes one generation per year, the adults being present in orchards from June to August (Perju, 2002). The female lays the eggs on leaves and the new born larvae feed primarily on it. The pest usually overwinters as fifth and sixth instar larvae, sometimes fourth instar (Mcbrien & Judd, 2004), that constructs a hibernaculum, often in a spur crotch. In spring they emerge and resume feeding on fruiting buds, flowers and leaves. They form tubular chambers by rolling leaves or by webbing the space between two leaves. By webbing the leaves, the larvae form their pupation nest near the feeding spot. In apples, damage can also occur on fruits in different growth stages, the larvae externally feeding on them. Late instar larvae are approximately 9-14 mm long with a grey to dull reddish-brown abdomen. The head and prothoracic shield are reddish-brown to black, sometimes with dark mottling. Prothoracic legs are dark brown (Figure 3).

Figure 3. *Spilonota ocellana* larvae.

MATERIALS AND METHODS

Weekly readings of the captures of adult males on pheromone traps (Figure 4) were performed, in order to obtain the flight curve for *Spilonota ocellana*.

Figure 4. Captures of adult males of the eye-spotted moth on pheromone traps, 2020

The pheromone used was produced by the Research Institute in Chemistry Raluca Ripan in Cluj and is composed by 2 components: Z8-dodecen-1-yl acetate and E8-dodecen-1-yl acetate. This combination is used for capturing *Cydia funebrana* adult males. The pheromone traps were placed in a plum orchard adjacent to two apple orchards in which the damage was evaluated at the end of the season 2019 and 2020. The eye-spotted moth being a pest the records have been registered although it was not the main concern in that particular orchard. Data recorded along the two years (2019 and 2020) were grouped on seven days intervals, so it can be compared using graphic representation.

During the flight period of the eye-spotted bud moth there were 8 insecticide sprays on each year (Table 1), in the treated orchard and none in the untreated control orchard where the damage was assessed.

The meteorological data has been recorded daily with the aid of a computerised system so that the appearance of the adults and the flying curve were corelated with the evolution of temperatures and rainy days through the vegetative season.

At the end of the season 300 fruits/orchard and 200 leaves/orchard from the two apple orchards were analysed to determine the frequency of the attack of the eye-spotted bud moth.

The significance of the differences between the years was analysed by Oneway Anova test and graphic analysis.

Table 1. Treatments with insecticides made in 2019 and 2020 in the treated orchard

Spray	2019		2020	
	Data	Active ingredient (concentration)	Data	Active ingredient (concentration)
T1	09.05	Dimetoat 400 g/l	07.05	Acetampirid 200 g/kg
T2	22.05	Lambda cihalothrine 50 g/l	20.05	Dimetoat 400 g/l
T3	04.06	Tiacloprid 480 g/l	30.05	Deltametrin 250 g/kg
T4	17.06	Chlorpyriphos metil 225 g/l	18.06	Acetampirid 200 g/kg
T5	01.07	Chlorpyriphos metil 225 g/l	06.07	Dimetoat 400 g/l
T6	18.07	Dimetoat 400 g/l	16.07	Spirotetramate 100g/l
T7	06.08	Lambda cyhalothrin 50 g/l	27.07	Acetampirid 200g/kg
T8	22.08	Tiacloprid 480 g/l	18.08	Tiacloprid 480 g/l

RESULTS AND DISCUSSIONS

The readings of the pheromonal traps in 2019 show a low level of flight throughout the summer with an increase in number of moths during the warmer months. as the Figure 5 shows.

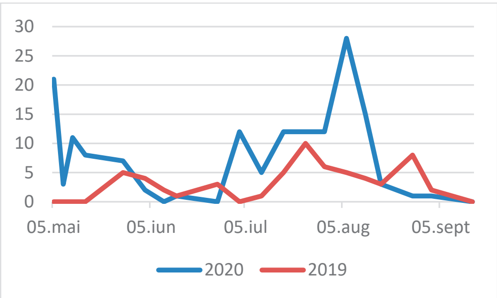

Figure 5. The flight of male adult moths caught in the summer of 2019 and 2020

We used a combination of pheromones that we usually use to capture *Cydia funebrana* adult males with very good results. The pheromone traps Atrafun seem to be very efficient for *Spilonota ocellana* too, which is interesting and suggests that one of the two compounds is attractant for both these species. The distribution of the captures was also very different in the 2 years (Figures 6 and 7). This is an aspect that indicates that the evolution of this pest is quite different in different years. The number of adult moths caught in the two years in May and June varied very much. While in May 2019 the number of the captures represented just 9% from the total number of male moths caught that season, in 2020, 33% of the total number of moths were caught in May. It is also very interesting that the adults appeared very early in May 2020 and continued to fly all through the summer until 02.09.2020. This indicates a large amount of variability of the distribution of overwintering instars or even a second generation considering the fact that the diapause necessity has been less studied.

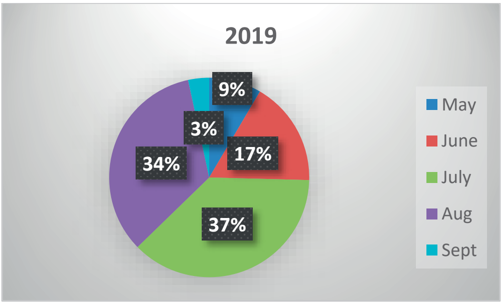

Figure 6. Distribution of the male adult moths caught in the summer of 2019

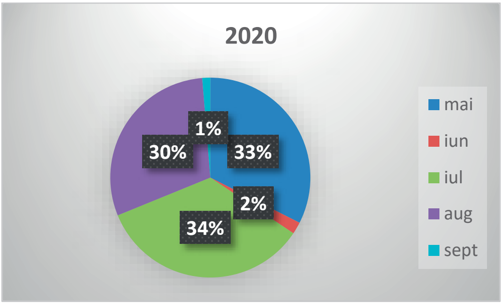

Figure 7. Distribution of the male adult moths caught in the summer of 2020

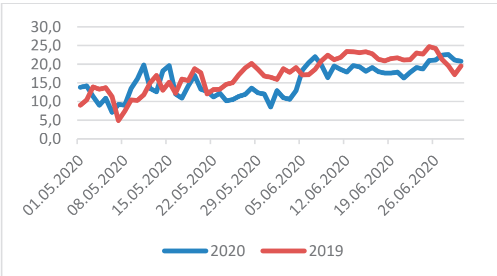

Figure 8. Evolution of average temperatures in May-June in the years 2019 and 2020

In June, on the other hand, 17% of the moths were caught in 2019 and only 2% in 2020. The situation in June corelates to the evolution of the meteorological conditions in the two years. Even though the differences are not statistically significant for the average temperature, they are statistically significant for the number of rainy days ($Fcalc \leq Fcrt$; $Fcalc. = 0.72$; $Fcrt. = 18.51282051$ $Df = 3$, $\alpha = 0.05$) (Table 2). As a consequence of the big number of days with rain the number of moths caught was significantly smaller on one hand and on the other it was impossible to enter the orchard to apply the necessary insecticide treatments from 29.05.2020 to 18.06.2020.

Table 2. Average temperatures and number of rainy days in May and June 2019 and 2020

Year	Average temperatures		Rainy days	
	May	June	May	June
2019	13.74	20.89	16	10
2020	12.64	18.28	17	19

The meteorological conditions in June, however were probably very suitable for the evolution of the eggs laid by the females that appeared in May.
On July and August, the distribution is not significantly different but the number of moths caught in 2020 was much higher than in 2019. Their number was much higher in the summer of 2020 when we compared the number of the moths caught on each summer month as the Table 3 shows.

Table 3. Number of individuals caught on the pheromone traps in 2019 and 2020

Month	2019	2020
May	5	50
June	10	3
July	22	53
Aug	20	46
Sept	2	2
Total	**59**	**154**

The increased number of moths active in the orchards on the second part of the summer of 2020 leaded to a big number of larvae that produced a lot of damage both on leaves and on fruits. They usually web leaves together and feed on the them (Figure 9).

Figure 9. *Spilonota ocellana* damage on Generos apple leaves, 2020

Or they web a leaf on a fruit and feed on the fruit staying well protected by the leaf. An obvious discolouration of the fruit occurs at the spot where the leaf was attached and there are multiple feeding spots that diminish the quality of the crop (Figures 10, 11).

Figure 10. Florina apple fruits damaged by the eye-spotted bud moth larvae, 2020

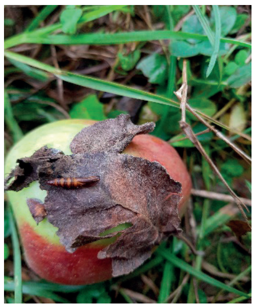

Figure 11. Florina apple fruit and leaves webbed together and eye-spotted bud moth pupae, 2020

The frequency of the damaged leaves and fruits was much higher in 2020, the year of the outbreak, than in 2019 (Figures 12, 13).

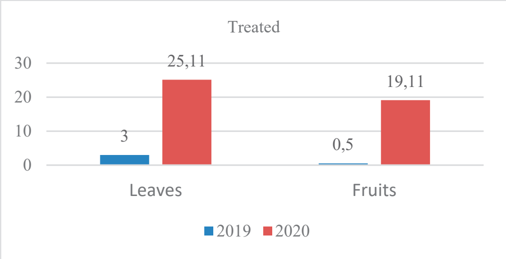

Figure 12. Percentages of damage frequency in the treated plot in 2019 and 2020

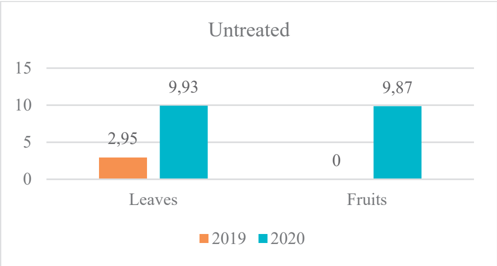

Figure 13. Percentages of damage frequency in the untreated plot in 2019 and 2020

The frequency of the damaged fruits and leaves were higher in the treated orchard than in the untreated orchard in both years. The attack on fruits in the treated orchard was very small, while in the untreated orchard was not even spotted on 2019, with significant presence in the year of the outbreak, 2020. The smaller frequency of the damage in the untreated plot could be possibly due to the mechanisms of regulation of the ecosystems in untreated environments or to the higher presence of other Tortricidae moths such as *Cydia pomonella*, *Hedya nubiferana* and *Choristoneura* spp. It is also possible that the smaller frequency of damage in the untreated orchard is because the eye-spotted bud moth has increased in numbers in the last two years and the future evolution could be quite different. This is an aspect that will be further evaluated in future studies.
The damage was highest on Florina apples and leaves but had an important negative impact on all the other varieties (Figure 14).

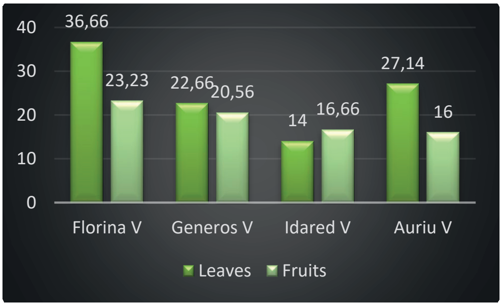

Figure 14. Percentages of damage frequency on the apple varieties from the treated plot at F.R.D.S. Bistrita, in 2020

The increased damage frequency in 2020 in spite of the insecticide sprays indicates that the substances used or the timing of the sprays was not suitable for controlling *Spilonota ocellana*. But we must consider the fact that this species was not a target due to the sporadic damage caused in 2019 and to the fact that it was not a threat for apples in this region.

CONCLUSIONS

In 2020 a new challenge for the protection of crops appeared in two of the apple orchards of Fruit Research-Station Bistrița.
The damage caused by the eye-spotted bud moth had a significant negative impact on the quality of the fruits. Therefore, a specific and integrated pest management program for this species must be developed and applied.
In the years that follow the study should continue in order to clarify the aspects concerning the pheromones that attract Spilonota ocellana and the ecologic mechanisms that make the untreated biotops more resilient to the outbreaks of this pest.

ACKNOWLEDGEMENTS

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REFERENCES

Cabezuelo Perez, P. & Hernandez Esteruelas, P. (1975) Observations on the biology of the bud moth (*Spilonota ocellana* F.) in Saragossa. *Boletin Informativo de Plagas, 108*, 3–6.

Mcbrien, H.L. & Judd, G.J.R. (2004). Emergence of overwintered larvae of eye-spotted bud moth, *Spilonota ocellana* (Lepidoptera: Tortricidae) in relation to temperature and apple tree phenology at Summerland, British Columbia. *Journal of Entomology Soc. British Columbia, 101,* 15-28.

Perju, T. (2002). *Dăunătorii organelor de fructificare și măsurile de combatere integrată: plante lemnoase*. Cluj-Napoca, RO: AcademicPres.

Swain, A.J. (2016). *Impact of temperature and relative humidity on the eye-spotted bud moth, Spilonota ocellana (Lepidoptera: Tortricidae): a climate change perspective.* Master of Science Thesis, Simon Fraser University, Department of Biological Sciences Faculty of Science, spring 2016.

Swain, A.J., Judd, G.J.R. & Cory, J.S. (2017) *Cold tolerance of the spring-feeding larvae of the eyespotted bud moth, Spilonota ocellana (Lepidoptera: Tortricidae)* The Canadian Entomologist 149 (3) 291-299.

http://idtools.org/id/leps/tortai/Spilonota_ocellana.htm

https://www.cabi.org/isc/datasheetreport/51015