MONITORING OF WOOD LEOPARD MOTH (*ZEUZERA PYRINA* L.) IN HIGHBUSH BLUEBERY (*VACCINUM CORYMBOSUM* L.) PLANTATION-CASE STUDY

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Abstract. *The aim of the paper is to present a case study regarding the incidence of the attack of the stem borer wood leopard moth (Zeuzera pyrina L.) caterpillar in a highbush blueberry (Vaccinium corymbosum L.) plantation from western Romania. The importance of the work is justified by the poor information from literature referring to the attack of this pest in plantations of highbush blueberry, this type of reference being useful both for the farmers and for the researchers from Romania interested in this topic and by the increase of the area planted with Vaccinium corymbosum L. in our country. Location of the blueberry farm is in Ghertenis (Caraş Severin County, Romania), the geographical coordinates being 45°25'48"N and 21°34'55"E. The plantation was set in 2015. The plantation has four highbush blueberry varieties Duke, Legacy, Hannah's choice and Elliott that covers different intervals of time due to different fruits ripening periods. There was analysed the incidence of the attack of the stem borer in two years in the condition of current application of the control works (pruning and chemical treatment). The results obtained showed an increase of the attack of wood leopard moth from a year to other in the plantation, even there were applied the current control works, except the variety Legacy that was less attacked in the second year of monitoring. Even the attack values registered during the two experimental years are low, the trend observed was the increase of the incidence of this pest species in the analysed plantation. This pest must to be kept under observation due to the potential of producing severe damages and economic loses in plantations and orchards as it was mentioned for many other ligneous species.*

Keywords*: Vaccinium corymbosum L., Zeuzera pyrina L., stem borer, caterpillar, attack.*

INTRODUCTION

The actual demand for berries on market influences the expansion of the surfaces planted with highbush blueberry (*Vaccinium corymbosum* L.) in numerous countries from Europe and other continents, even in countries that doesn't have tradition in the cultivation of this species. Great importance for the economically efficient cultivation of highbush blueberry has the varieties chosen and the applied technology (WARMAN, 1987; HOLZAPFEL *et al*., 2004; ESAU *et al*., 2019). There were created a series of valuable varieties that are suitable for different cultivation areas. First highbush blueberry plantation in Romania was set in 1968 and nowadays is a trend regarding the increase of the surface cultivated with this species motivated by the increasing demand of the market for the consumption of fresh fruits and the profitability in comparison with other fruits cultivated in our area (ASĂNICĂ *et al*., 2016).

In general berry fruits are rich in antioxidants (NOUR *et al.*, 2014), phenolic compounds and minerals (COSMULESCU *et al.*, 2017). The dietary importance of highbush blueberry fruits is given especially to the great content in anthocyanins, the greatest concentrations of those being derivates of malvidin, delphinidin, petunidin, cyanidin and peonidin (CHO *et al*., 2004; TUNDIS *e al.*, 2021), but in the same time they are a source of sugars (glucose and fructose) and vitamin C (AIRES *et al*, 2017).

The expansion of the cultivated areas with this species in different ecological conditions was possible doe to the cultivation in irrigated system and use of acids for soil pH manipulation (ASĂNICĂ *et al*., 2016), but with all of these the species is exposed to the attack of the specific pests from the area (PARASCHIVU M., 2020a), and to diseases that aren't common in the origin area of the plant (PARASCHIVU M., 2020b).

Zeuzera pyrina L. (wood leopard moth) caterpillar is a stem borer that attacks a wide range of trees and shrubs, according with some authors more than 150 spontaneous and cultivated ligneous species belonging to more than 20 genera are the host of this pest (CARTER, 1984; GATWICK, 1992).

The greatest damages in cultivated species in the area nearby our country were reported in Bulgaria in apple orchards, the greatest injuries being mentioned in young orchards (KUTINKOVA *et al.*, 2005).

The goal of this work is to present an overview on the infestation with wood leopard moth in a plantation of highbush blueberry from low hill area from western Romania. The importance of the topic is given by the small amount of accessible information for farmers and researchers from our country regarding this plant, the interest for planting highbush blueberry increasing in our country as the planted surfaces.

MATERIAL AND METHODS

The researches were developed in a highbush blueberry plantation from the locality Ghertenis (Caraș-Severin County), the geographical coordinated being 45°25′48″N and 21°34′55″E. The average altitude in the research area is 137 m a.s.l. The climate from Ghertenis area is characterised by an average annual temperature of 11.27 ºC and an average rainfall amount of 890.5 mm (Meteorological Station Oravița). The soil in the research area is brown forest type. The soil in the plantation has a content of 35-45% clay and 2.3 - 2.7 % humus. The features of the soil were modified according with the demands of the highbush blueberry, respectively before planting (2015) there was applied 21 t/ha acid peat and some manure and sulphur powder. In 2015 was added ammonium sulphate in irrigation water for the maintenance of the optimum value of the pH.

The plantation was set in the year 2015 on a surface of 22.07 hectares there being cultivated four highbush blueberry varieties Duke, Hanna's Choice and Legacy (early varieties) and Elliott (late variety). The applied cultivation technology is on raised beds, the distance between the rows being 3 meters and between the plants per row being 0.7 m. The water supply is provided by a drip irrigation system with two dripping lines placed under the agrotextile ground cover.

The field data were collected during two experimental years, respectively 2019 and 2020. The research was performed during the vegetation period of the highbush blueberry there being assessed the infestation with the caterpillar of wood leopard moth (*Zeuzera pyrina* L.).

The data were registered by monitoring and counting of the attacked plants by the stem borer caterpillar of wood leopard moth by observation of the appearance of the frass pellet like that accumulates at the base of the attacked plants and the holes appeared on the branches during the vegetations season (from April to October). After the determining of the infestation stage there were applied specific control measures consisting in the removal of the branches with obvious attack symptoms (Figure 1 and Figure 2). The treatment applied was injection of a solution of lambda-cyhalohrin (Karate Zeon 50 CS) in the galleries and the treatment of the cuts with copper oxychloride (Alcupral 50 PU) paste (Figure 3).

After the control actions (attacked branch removal and treatments) the pests were destroyed, but at the next surveys the attack had appeared every time on other plants.

On the base of the data collected in field there were calculated the following characteristics of the infestation with wood leopard moth of the highbush blueberry plantation: attack frequency, attack intensity and attack degree.

Attack frequency (*F%)* represents the ratio between the number of the attacked plants (*n*) and the total number of sampled plants (*N*) and is calculated with the formula: $F\% = (n \times 100) / N$ (1).

Attack intensity (*I%*) expresses the damage rate produced by the pest to the plant, leaves or other organs. The formula for calculation is $I\% = \sum (I \times f) / n$ (2) where *I* represents the rate of the class, *f* the number of attacked plants from every class and *n* the total number of plants analysed. For the facilitation of collection of a big volume of data there is used the 1 – 6 scale presented in Table 1.

Attack degree (*AD%)* was calculated with the formula: $GA\% = (F\% \times I\%)/100$ (3).

Fig. 1. Damage produced by *Zeuzera pyrina* L. on *Vaccinium corymbosum* L. (photo: original)

Fig. 1. Frass produced by *Zeuzera pyrina* L. on the base of stem of *Vaccinium corymbosum* L. (photo: original)

Table 1

Pest attack assessment scale 1-6 (IVAȘCU, 2009)

Scale	F%	I%
1 – without attack	-	-
2 – very low attack	0.1 - 3	3
3 – low attack	3.1 - 10	10
4 – moderate attack	10.1 – 25	25
5 – strong attack	25.1 – 50	50
6 – very strong attack	>50	>50

From every plot there were analysed 500 plants, except the plots 11 and 14 from the variety Elliot where were analysed 1000 plants, because these plots have a bigger surface.

The field data collection and sampling were performed in both experimental years according with the Table 2.

For the identification of the pest species there were done sections in the attacked branches to extract the caterpillar (Figure 4). The early symptoms of the leopard moth attack consisted in broken branches especially the young ones, with dry yellow leaves. The attacked old branches presented visible frass and excrements of the caterpillar pellet like at the base of the plants.

Table 2

Field data collection and sampling for the assessment of wood leopard moth attack in the highbush blueberry plantation from Ghermeniș (Western Romania)

Highbush blueberry variety	plot	Plants/plot	No. plants/ sample
Duke	1	5390	500
	2	6767	500
	3	6726	500
	7	6531	500
	8	6049	500
	Total	**31463**	**2500**
Hanna's Choice	4	5246	500
	5	5034	500
	6	6066	500
	Total	**16346**	**1500**
Legacy	9	7482	500
	Total	**7482**	**500**
Elliott	10	6564	500
	11	11265	1000
	12	8250	500
	13	10093	1000
	14	8182	500
	15	5594	500
	Total	**49948**	**4000**
Total per plantation		**105239**	**8500**

Fig. 3. Control of *Zeuzera pyrina* L. on *Vaccinium corymbosum* L. (photo: original)

Fig. 4. Caterpillar of *Zeuzera pyrina* L. on *Vaccinium corymbosum* L. (photo: original)

RESULTS AND DISCUSSIONS

In literature is a lack of information regarding the attack of *Zeuzera pyrina* L. on *Vaccinium corymbosum* L. in plantations, thus this case study brings in attention a potential damaging pest for the highbush blueberry plantations from the area where leopard moth is spread across. The infestation source is always the ligneous vegetation from the vicinity of the plantations.

The results of the observations from the year 2019 regarding the attack of wood leopard moth on the highbush blueberry plantation from Ghertenis are presented in Table 3. In this year the attack frequency was comprised between F% = 1.33% (Hanna's Choice) and F% = 7.2% (Legacy) and attack intensity was comprised between I% = 5.8% (Duke) and I% = 10% (Legacy). The variety Legacy was the most attacked from the four varieties of the plantation in this year, having AD% = 0.72% and the less attacked was the variety Hanna's Choice with AD% = 0.04%.

Table 3

Situation of the attack of wood leopard moth caterpillar on the highbush blueberry plantation from Ghertenis in 2019

Variety	plot	No. plants/ sample	No. of attacked plants	F %	I %	AD %
Duke	1	500	2	0.400	3	0.012
	2	500	3	0.600	3	0.018
	3	500	19	3.800	10	0.380
	7	500	17	3.400	10	0.340
	8	500	15	3.000	3	0.090
	Total/Average	**2500**	**56**	**2.240**	**5.8**	**0.168**
Hanna's Choice	4	500	6	1.200	3	0.036
	5	500	1	0.200	3	0.006
	6	500	13	2.600	3	0.078
	Total/Average	**1500**	**20**	**1.333**	**3**	**0.040**
Legacy	9	500	36	7.200	10	0.720
	Total/Average	**500**	**36**	**7.200**	**10**	**0.720**
Elliott	10	500	22	4.400	10	0.440
	11	1000	51	5.100	10	0.510
	12	500	13	2.600	3	0.078
	13	1000	32	3.200	10	0.320
	14	500	21	4.200	10	0.420
	15	500	17	3.400	10	0.340
	Total/Average	**4000**	**156**	**3.817**	**8.833**	**0.351**
Total/Average per plantation		**8500**	**268**	**3.648**	**6.908**	**0.320**

The results from 2020 of the infestation of highbush blueberry plantation from Ghertenis with wood leopard moth caterpillars are presented in Table 4.

The attack frequency was lowest at the variety Hanna's Choice (F% = 2.07%) and the highest value was registered in the variety Elliot (F% = 4.67%). The attack intensity of all the four analysed varieties in this year was I% = 10%. Attack degree, in comparison with the previous year was greater in the variety Elliot (AD% = 0.47%), but the lowest AD% was again registered in the variety Hanna's Choice (AD% = 0.21%). Except the variety Legacy the other three varieties of highbush blueberry were more attacked by the wood leopard moth in 2020.

In Figure 5 is presented a comparison between the results obtained in the two experimental years with standard deviation. There is obvious the increase of the attack degree for three varieties (Duke, Hanna's Choice and Elliot), but even the variety Legacy, that had a

decrease of the attack in 2020, it had relatively high values of the infestation in both years of monitoring, in comparison with the other varieties.

Tabel 4

Situation of the attack of wood leopard moth caterpillar on the highbush blueberry plantation from Ghertenis in 2020

Variety	plot	No. plants/ sample	No. of attacked plants	F %	I %	AD %
Duke	1	500	13	2.6	10	0.26
	2	500	13	2.6	10	0.26
	3	500	19	3.8	10	0.38
	7	500	26	5.2	10	0.52
	8	500	7	1.4	10	0.14
	Total/Average	**2500**	**78**	**3.12**	**10**	**0.312**
Hanna's Choice	4	500	12	2.4	10	0.24
	5	500	8	1.6	10	0.16
	6	500	11	2.2	10	0.22
	Total/Average	**1500**	**31**	**2.07**	**10**	**0.21**
Legacy	9	500	17	3.4	10	0.34
	Total/Average	**500**	**17**	**3.4**	**10**	**0.34**
Elliott	10	500	18	3.6	10	0.36
	11	1000	55	5.5	10	0.55
	12	500	31	6.2	10	0.62
	13	1000	33	3.3	10	0.33
	14	500	33	6.6	10	0.66
	15	500	14	2.8	10	0.28
	Total/Average	**4000**	**184**	**4.67**	**10**	**0.47**
Total/Average per plantation		**8500**	**310**	**3.31**	**10**	**0.33**

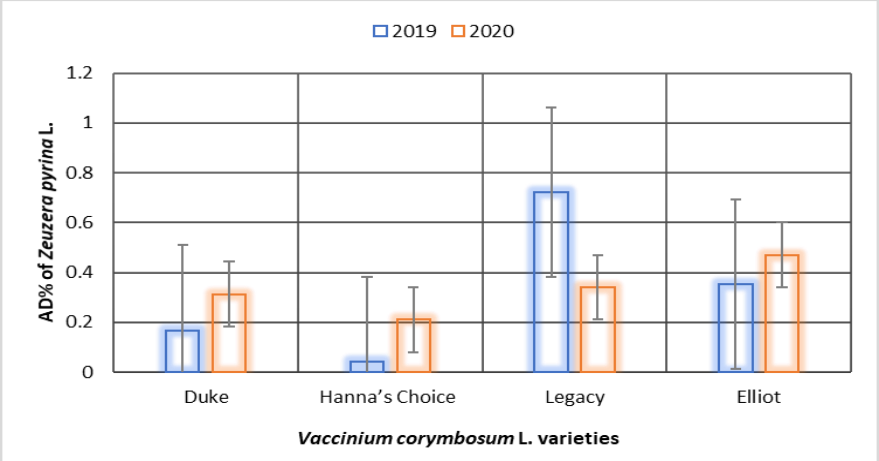

Figure 5. Comparison of the attack degree (AD%) of *Zeuzera pyrina* L. on the varieties of *Vaccinium corymbosum* L. from the plantation from Ghertenis from the years 2019 and 2020

Even the attack of this pest presents apparently low values of the attack in the studied highbush blueberry plantation, it must to be monitored and controlled because it had proved to have high damaging impact in the case of apple orchards (KUTINOVA *et al.*, 2006), olives orchoards (ULAȘLI *et* CAN CENGIZ, 2016) and other ligneous species.

CONCLUSIONS

The monitoring of the stem borer species *Zeuzera pyrina* L. from the highbush blueberry plantations is very important together with the application of the control works for the eradication of this pest. Both monitoring and control must to be a yearly activity, because even the pest is destroyed in a year it appears in the following year with a stronger attack due to the infestation sources from the surrounding area. The conventional control methods are not numerous, some of them being the pulverization of insecticides for the control of the first larvae development stage at budding stage of the plants, use of substances that are influencing the insect development, use of pheromone traps, ATPS lights *etc*, Thus, for the persons interested in organic fruit production, there are some biocontrol methods for this pest based on entomopathogenic nematodes and bacteria that can be used for the decrease of the population of these pests, but the efficiency of these methods are still insufficiently documented.

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