

Studies Regarding the Attack Dynamics of The Black Locust Leafminers in Covasna's Public Parks

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Abstract. The black locust trees from the Covasna resort spa's parks are losing their aesthetic value because of their foliage is attacked by the larvae of two leaf miner species, *Parectopa robinella* Clemens and *Phyllonorycter robiniella* Clemens. The attack of this species begins in June-July and persists until the end of September. In the last three years the attack frequency produced by these species is increasing. So in 2008 the attack frequency was 9,2 % in 2010 has reached 18,8%. The same trend is reported also for the attack intensity, increasing annually the mines reported on a leaf. The number of mines/leaf for *Phyllonorycter robiniella* Clemens rise from 2,9 in the year 2008 to 3,7 mines/leaf in the year 2010; and for *Parectopa robiniella* Clemens it lowered from 2,3 mines/leaf in 2008 to 2,1 mines/leaf in the year 2010.

Keywords: *Parectopa robiniella*, *Phyllonorycter robiniella*, attack frequency.

INTRODUCTION

Parectopa robiniella Clemens -1893 and *Phyllonorycter robiniella* Clemens -1859 are two species of black locust leaf mining moths, which are natives to North America. In Europe, *Parectopa robiniella* was signaled for the first time in the year 1970, in Italy, and *Phyllonorycter robiniella* was first reported in Europe in 1983, in Switzerland (Csóka, 2001; Dimic *et al.*, 2000; Szaboky and Csoka, 1997). In Romania, *Parectopa robiniella* was first recorded in 1989, in Mehedinți County, and *Phyllonorycter robiniella*, was first reported in 2002 at Păușa, on the left bank of the river Olt (Nețoiu, 1994; Nețoiu, 2003; Nețoiu and Tomescu, 2006).

The caterpillar of *Parectopa robiniella* Clemens consumes the palisadic tissue, developing a mine that ultimately extends in digitiform. The *Phyllonorycter robiniella* Clemens caterpillars after they hatch develop a mine on the black locust leaf's inferior side. At the beginning unlike the *Parectopa robiniella* Clemens caterpillar, the larvae consume the lacunar tissue until manages to detach the inferior epidermis from the mezophyll, and then penetrates toward the palisadic tissue eating the whole mezophyll. The inferior epidermis remains whitish and the superior and the vascular bundle is going to change its color to brown (Šefrova, 2002; Dombi și colab., 2010; Wojciechowicz-Żytka and Jankowska, 2004).

MATERIALS AND METHODS

In the 2008-2010 period, at the false acacia trees in Covasna central park, a monitoring of the two species of robinia leaf miners was done. For both species was determined the attack frequency, respectively the number of attacked leaves as the number of mines developed on a leaf. For these results annually 100 leaves were harvested from 10 trees

(a total of 1000 leaves). The sampling was made in 3 dates in the host plants vegetative season. Then in the laboratory the damaged leaves have been verified. The two robinia leaf miner species identification was made by the mine characteristics.

RESULTS AND DISCUSSION

In the number 1 chart are shown the results regarding the attack frequency determined by the two black locust leaf miner moths in the year 2008.

At the first observation, from the analyzed 100 leaves, 24 were attacked. *Phyllonorycter robiniella* was attacking 19 leaves; and *Parectopa robiniella* attacked 12 leaves. We conclude that from the attacked leaves, 7 were attacked by both species.

At the second observation, we observed a growth in the attack frequency this time 54 leaves been attacked. *Phyllonorycter robiniella* was observed on 29 leaves, and *Parectopa robiniella* on 26 leaves (for this species the attack frequency was tripled). We conclude that from the attacked leaves 11 leaves were concomitant attacked by both species.

At the observation made at the end of the leaf miners lifecycle, the attack frequency reached 9,2 %. From the 92 attacked leaves, *Phyllonorycter robiniella* Clemens was recorded on 72 leaves, and *Parectopa robiniella* Clemens on 46 leaves. On the attacked leaves 25 were recorded with mines developed by both species. In that interval *Phyllonorycter robiniella* Clemens had the highest growth rate for the attack level, being 2,73 times more.

Tab. 1

The attack frequency produced in 2008 by the black locust leafminer moths in Covasna

SPECIES	10.07 - 16.07		15.08 - 22.08		18.09 - 25.09	
	attacked leaves	%	attacked leaves	%	attacked leaves	%
<i>Phyllonorycter robiniella</i>	12	1,2	28	2,8	46	4,6
<i>Parectopa robiniella</i>	5	0,5	15	1,5	21	2,1
<i>Phyllonorycter robiniella</i> + <i>Parectopa robiniella</i>	7	0,7	11	1,1	25	2,5
SUM OF ATTACKED LEAVES	24	2,4	54	5,4	92	9,2

The attack frequency made by the false acacia leaf mining species under the conditions of 2009 in the city of Covasna is presented in the chart number 2.

In that year at the first observation, from the 1000 analyzed leaves, the attack was reported on 31 leaves. Compared with the previous year is reported an increase in the number of attacked leaves. *Phyllonorycter robiniella* was reported on 24 leaves, and *Parectopa robiniella* on 12 leaves. We find that from the attacked leaves, 5 were attacked by both species. Compared with the previous year's attack frequency was increased just for the *Phyllonorycter robiniella*.

At the second observation, it was reported, just like the previous year, a growth in the attack frequency, this time 60 leaves been attacked. *Phyllonorycter robiniella* was reported on 44 leaves, and *Parectopa robiniella* on 28 leaves. We conclude that 12 leaves were attacked by both species.

At the observation made between 18-25 September, by the end of the leaf miners biological cycle, the attacks frequency reached 9,9 %. Compared with the previous year the frequency's growth is insignificant, the last year's value been 9,2 %. From the 99 attacked leaves, *Phyllonorycter robiniella* was reported in 72 leaves, and *Parectopa robiniella* in 49

leaves. In this interval *Phyllonorycter robiniella* had the highest attack frequency growth rate. At this observation 21 leaves were attacked by both species.

Tab. 2

The attack frequency produced in 2009 by the black locust leafminer moths in Covasna

SPECIES	10.07 - 16.07		15.08 - 22.08		18.09 - 25.09	
	attacked leaves	%	attacked leaves	%	attacked leaves	%
<i>Phyllonorycter robiniella</i>	19	1,9	32	3,2	51	5,1
<i>Parectopa robiniella</i>	7	0,7	16	1,6	27	2,7
<i>Phyllonorycter robiniella</i> + <i>Parectopa robiniella</i>	5	0,5	12	1,2	21	2,1
SUM OF ATTACKED LEAVES	31	3,1	60	6,0	99	9,9

In the chart number 3 are presented the attack frequency monitoring results of the by the false acacia leaf mining moths, in Covasna 2010.

The year 2010 was very warm year, in which the yearly average temperature was with 0,4 °C above the multiannual average. Also, the precipitation level was above the multiannual average, allowing a good growth for the host plant.

At the first observation, from the 1000 analized leaves, the attack was reported from 42 leaves. *Phyllonorycter robiniella* was reported on 31 leaves, and *Parectopa robiniella* on 19 leaves. We conclude that from the attacked leaves 8 leaves were attacked by both species.

Tab. 3

The attack frequency produced in 2010 by the black locust leafminer moths in Covasna

SPECIES	10.07 - 16.07		15.08 - 22.08		18.09 - 25.09	
	attacked leaves	%	attacked leaves	%	attacked leaves	%
<i>Phyllonorycter robiniella</i>	23	2,3	42	4,2	95	9,5
<i>Parectopa robiniella</i>	11	1,1	19	1,9	34	3,4
<i>Phyllonorycter robiniella</i> + <i>Parectopa robiniella</i>	8	0,8	22	2,2	39	3,9
SUM OF ATTACKED LEAVES	42	4,2	83	8,3	168	16,8

At the monitoring made in August was reported, like the previous year, a growth in the attack frequency, this time being attacked 83 leaves, practically a duplication of the attack frequency. *Phyllonorycter robiniella* was reported on 64 leaves, and *Parectopa robiniella* on 41 leaves, both species having the same growing rate at population level. At this observation 22 leaves were attacked by both species.

At the last observation from this year, the attack frequency reached 16,8 %, being the year in which the highest attack frequency was reported. Compared with the last year the growth of the attack frequency is very considerable. From the 168 attacked leaves, *Phyllonorycter robiniella* was reported on 144 leaves, and *Parectopa robiniella* on 73 leaves. In this interval again the *Phyllonorycter robiniella* was the species that had the highest attack level growth rate. At this observation 39 leaves were attacked by both species.

At the black locust leafmining moths, beside the attack frequency monitoring, we proceed to determine the number of mines that they are developing on a leaf. This parameter

was followed on the leaves attacked by a single species and also on leaves attacked by both species. The results of this monitoring are presented in the chart number 4.

In the year 2008, at the first observations made on the attacked leaves, the average number of mines on an attacked leaf by a single species was 1,7 % mines/leaf for *Phyllonorycter robiniella* and 1,4 % mines/leaf for *Parectopa robiniella*, and when they both attacked it was 1,2 % mines/leaf for *Phyllonorycter robiniella* and 1,1 % mines/leaf for *Parectopa robiniella*.

In August, the number of mines developed on a leaf increased, in all cases, reaching 2,1 mines/leaf for *Phyllonorycter robiniella* and 1,6 mines/leaf for *Parectopa robiniella* when they attacked alone, and when both attacked it was 1,3 mines/leaf for *Phyllonorycter robinella* and 1,2 mines/leaf for *Parectopa robiniella*.

These indicators increased further, so by the end of evolutionary cycle it reached 2,9 mines/leaf for *Phyllonorycter robiniella* and 2,3 mines/leaf for *Parectopa robiniella*. When they attacked together it was 2,2 mines/leaf for *Phyllonorycter robiniella* and 1,8 mines/leaf for *Parectopa robiniella*.

At the first observation made in 2009, the average number of mines on an attacked leaf by a single species was 1,6 mines/leaf for *Phyllonorycter robiniella* (a slight decrease compared with the previous year) and 1,5 mines/leaf for *Parectopa robiniella* (an increase compared to previous year), and when they attacked simultaneously it was 1,4 mines/leaf for *Phyllonorycter robiniella* and 1,3 mines/leaf for *Parectopa robiniella*.

At the second observation, in August, the number of mines developed on a leaf grew in all cases, reaching 2,4 mines/leaf for *Phyllonorycter robiniella* and 1,9 mines/leaf for *Parectopa robiniella*. In both species, when they attacked separated, we saw a rising in the numbers of mines developed on a leaf, from the past observation and with 0,3 regarding the last year. On leaves attacked simultaneously by both species, 1,7 mines/leaf was reported for *Phyllonorycter robiniella* and 1,6 mines/leaf for *Parectopa robiniella*.

At the last observation from this year, the number of mines reached 3,3 mines/leaf for *Phyllonorycter robinella* and 2,2 mines/leaf for *Parectopa robiniella*, and when they attacked simultaneously it was 2,1 mines/leaf for *Phyllonorycter robiniella* and 1,7 mines/leaf for *Parectopa robiniella*. We conclude that, the number of mines/leaf has increased just for the *Phyllonorycter robiniella* from the previous year (in 2008 it was 2,9 mines/leaf and in this year 3,3 mines/leaf).

In the year 2010, at the first observation the average number of mines on an attacked leaf by a single species was of 1,3 mines/leaf for *Phyllonorycter robiniella* (being the year with the fewest mines, in all the years the monitoring was made) and 1,4 mines/leaf for *Parectopa robiniella* (in a slight decreasing compared with the last year). Even when the average number of mines/leaf is decreasing, the attacks degree is higher, whereas the attack frequency it was the highest in this year. When the leaf mining moths attacked a leaf simultaneously, the developed mines were 1,2 mines/leaf for *Phyllonorycter robiniella* and 1,3 mines/leaf for *Parectopa robiniella*.

At the second observation, that from August, the number of developed mines on a leaf increased in all cases, reaching 2,6 mines/leaf for *Phyllonorycter robiniella* and 1,8 mines/leaf for *Parectopa robiniella*. At both species, when they attacked segregated, we found a rising in the numbers of mines developed on a leaf, in comparison with the preceding observation, and for the *Phyllonorycter robiniella* a growth with 0,2 compared with the previous year. On leaves attacked by both species, it was recorded 1,9 mines/leaf for *Phyllonorycter robiniella* and 1,4 mines/leaf for *Parectopa robiniella*.

At the last observation from that year, the number of mines reached 3,7 mines/leaf for *Phyllonorycter robiniella* (this is the largest number of the monitored years, an increase of 0,8 compared with 2008 and 0,4 compared with 2009) and 2,1 mines/leaf for *Parectopa robiniella*, and when they both attacked it was 1,8 mines/leaf for *Phyllonorycter robiniella* and 1,6 mines/leaf for *Parectopa robiniella*.

Tab. 4

Dinamycs of the attacked leafs and the number of mines/leaf by the black locust leafmining moths between 2008-2010 in the city of Covasna

Species	10.07-16.07		15.08-22.08		18.09-25.09	
	attacked leaves %	average no. of mines/ leaf	attacked leaves %	average no. of mines/ leaf	attacked leaves %	average no. of mines/ leaf
YEAR 2008						
<i>Phyllonorycter robiniella</i>	12	1,7	28	2,1	46	2,9
<i>Parectopa robiniella</i>	5	1,4	15	1,6	21	2,3
<i>Phyllonorycter robiniella</i> + <i>Parectopa robiniella</i>	7	1,2 + 1,1	11	1,3 + 1,2	25	2,2 + 1,8
YEAR 2009						
<i>Phyllonorycter robiniella</i>	19	1,6	32	2,4	51	3,3
<i>Parectopa robiniella</i>	7	1,5	16	1,9	27	2,2
<i>Phyllonorycter robiniella</i> + <i>Parectopa robiniella</i>	5	1,4 + 1,3	12	1,7 + 1,6	21	2,1 + 1,7
YEAR 2010						
<i>Phyllonorycter robiniella</i>	23	1,3	42	2,6	95	3,7
<i>Parectopa robiniella</i>	11	1,4	19	1,8	34	2,1
<i>Phyllonorycter robiniella</i> + <i>Parectopa robiniella</i>	8	1,2 + 1,3	22	1,9 + 1,4	39	1,8 + 1,6

CONCLUSIONS

1. In the Covasna area the black locust trees main pests, which affects the trees foliage, is *Phyllonorycter robiniella* Clemens and *Parectopa robiniella* Clemens.
2. During the three years of monitoring it's observed a tendency in the increase of the attack frequency, both during the annual data gathering period of the biological cycle and form year to year.
3. At the pests life-cycles end, the attack frequency was 9,2 % in 2008, 9,9 % in 2009 and 18,8 % in the year 2010.
4. Its fund that the warm years are particularly favorable for the breeding of the false acacias leaf mining moths' population.
5. At the last observation of the attack intensity the number of mines/leaf for *Phyllonorycter robiniella* Clemens rise from 2,9 in the year 2008 to 3,7 mines/leaf in the year 2010; and for *Parectopa robiniella* Clemens it lowered from 2,3 mines/leaf in 2008 to 2,1 mines/leaf in the year 2010.

REFERENCES

1. Csóka, Gy. (2001). Recent invasions of five species of leafmining lepidoptera in Hungary. Proceedings „Integrated Management of Forest Defoliating Insects”. USDA General Technical Reports NE-277 pp. 31-36.
2. Dimic, N., Dautbaic, M., Magud, B. (2000). *Phyllonorycter robiniella* Clemens, nova vrsta minera lista u entomofauni Bosne i Hercegovine. Works Fac. Forest. Univ. Sarajevo, 1: 7-15.
3. Nețoiu, C. (1994). Cercetări privind bioecologia moliei miniere a salcâmului, *Parectopa robiniella* Clemens 1863 (*Gracillariidae*). Bucovina Forestieră 2(1):113-116
4. Nețoiu, C. (2003). O nouă molie minieră a salcâmului din România: *Phyllonorycter robiniella* Clemens, 1859 (*Lepidoptera_Gracillariidae*). Muz. Olteniei, Craiova, Studii și Comunicări, Științele Naturii, 19:154-156.
5. Nețoiu, C., R. Tomescu (2006). Moliile miniere ale salcâmului (*Parectopa robiniella* Clemens - 1863 și *Phyllonorycter robiniella* Clemens -1859, Lepidoptera, Gracillariidae), Analele ICAS, vol. 49, pag. 119-131.
6. Ors Pal, Dombi, I. Oltean, Florian Teodora, Bodiș Ilonka, M. Varga (2010). Moliile miniere ale salcâmului semnalate în localitatea Covasna, Agrobuletin AGIR, nr.6/2010, Timișoara, pag. 43-47.
7. Šefrova, H. (2002). *Phyllonorycter robiniella* (Clemens, 1859) – egg, larva, bionomics and its spread in Europe (Lepidoptera, Gracillariidae). Acta Universitatis agriculturae mendelianae Brunensis 50: 7-12.
8. Szaboky, C, G. Csoka (1997). A *Phyllonorycter robiniella* Clemens, 1859 akáclevél aknázómoly megtelepedése Magyarországon. Növényvédelem 33(11): 569–571
9. Wojciechowicz-Żytka, E., and B. Jankowska (2004). The occurrence and harmfulness of *Phyllonorycter robiniella* (Clem.), a new leafminer of *Robinia pseudacacia* L. trees. Electronic Journal of Polish Agricultural University, Horticulture 7(1): <http://www.ejpau.media.pl/series/volume7/issue1/horticulture/art-06.html>.