Electronic Journal of Polish Agricultural Universities is the very first Polish scientific journal published exclusively on the Internet, founded on January 1, 1998 by the following agricultural universities and higher schools of agriculture: University of Technology and Agriculture of Bydgoszcz, Agricultural University of Cracow, Agricultural University of Lublin, Agricultural University of Poznan, Higher School of Agriculture and Teacher Training Siedlce, Agricultural University of Szczecin, and Agricultural University of Wroclaw.

ELECTRONIC JOURNAL OF POLISH AGRICULTURAL UNIVERSITIES

2004
Volume 7
Issue 1
Series HORTICULTURE

WOJCIECHOWICZ-ŻYTKO E., JANKOWSKA B. 2004. THE OCCURRENCE AND HARMFULNESS OF *Phyllonorycter robiniella* (Clem.), A NEW LEAFMINER OF *Robinia pseudoacacia* L. TREES **Electronic Journal of Polish Agricultural Universities**, Horticulture, Volume 7, Issue 1.
Available Online http://www.ejpau.media.pl

THE OCCURRENCE AND HARMFULNESS OF *Phyllonorycter robiniella* (Clem.), A NEW LEAFMINER OF *Robinia pseudoacacia* L. TREES

Elżbieta Wojciechowicz-Żytko, Beata Jankowska
Department of Plant Protection, Faculty of Horticulture, Agricultural University of Cracow, Poland

ABSTRACT

The North American species – *Phyllonorycter robiniella* (Clem.) – which mines the leaves of *Robinia pseudoacacia* L. was reported from Europe in 1993 for the first time. It was discovered in Poland in 1999. Caterpillars feeding cause premature leaf fall due to its desiccation, which negatively influence the aesthetic appearance of the trees.

This paper provides new data on the occurrence and harmfulness of *Phyllonorycter robiniella* in Kraków area.
Key words: *Robinia pseudoacacia, Phyllonorycter robiniella*

INTRODUCTION

Black locust (False Acacia) – *Robinia pseudoacacia* L. – is native to North America and was introduced to Europe in the early 17th century as an ornamental tree and now became an important tree in forest plantations in France, Italy, Hungary, Romania and Poland. Is planted extensively for its nitrogen fixing abilities, as a source of nectar for honeybees, and excellent wood for firewood. It is also used for erosion control and mine soil reclamation.

R. pseudoacacia is being valued element of green areas of Kraków. It is situated individually, in loose groups or rows in parks or near streets. It has very limited soil requirements as well as high resistance to city and industrial pollution and dry periods.

Phyllonorycter robiniella (Clem.) is the main pest of *R. pseudoacacia* leaves. It comes from the eastern and central western part of the USA [4]. It was first time reported from Europe in Basle (Switzerland) in 1983 and from it extended to Central Europe – France, Germany, northern Italy (1988), Austria (1989), Czech Republic and Slovakia (1992). It spread gradually through Austria, reaching Hungary in 1996 [3, 6, 7, 10]. In 1999 it was first recorded in Poland (Katowice, Opole, Wrocław) and it occupied the southern region of Poland to 2000 [2]. In 2001 it was found in Józefów near Warszawa [9].

P. robiniella causes premature leaf drop due to its desiccation and negatively influence the aesthetic appearance of the *R. pseudoacacia* trees.

Regardless of the mass attack of *R. pseudoacacia* by *P. robiniella* only a limited number of papers has been published so far [1, 3, 4, 5, 6, 7, 8].

This paper provides new data on the occurrence and harmfulness of *Phyllonorycter robiniella* in Kraków area.

MATERIALS AND METHODS

The observations were carried out in Krakow, in September in 2002 and from June to September, in month intervals, in 2003, on *Robinia pseudoacacia* and *Robinia pseudoacacia "Umbraculifera"* trees. Six trees growing in the parks, alleys and near the street traffic were chosen for the study.

Site A – *Robinia pseudoacacia* – park site – (group of trees),
Site B – *Robinia pseudoacacia* – green area in the centre of the city (individual tree),
Site C – *Robinia pseudoacacia* – green area in housing estate-(few trees),
Site D – *Robinia pseudoacacia* – row of trees along the street (high traffic),
Site E – *Robinia pseudoacacia* "*Umbraculifera*"– row of trees along the street (high traffic),
Site F – *Robinia pseudoacacia* "*Umbraculifera*" – street site (high traffic) (individual tree).

From each tree 20 pinately compound leaves (each possessed 7-19 leaflets) were collected and the infestation by the *P. robiniella* (the presence of mines) were estimated. Later, these leaves were divided on the single leaflets, and the number of leaflets of all compound leaves from each site was counted, and infestation by *P. robiniella* was noted. Subsequently, the 100 leaflets from the each tree were evaluated on the occurrence of the *P. robiniella* caterpillars, pupae, moth's, and its parasitoids.

RESULTS AND DISCUSSION

Bionomics of *Phyllonorycter robiniella* (Clem.)

The adults hatched from the collected pupae were tiny moths with a wingspread of about 5-6 mm. Wings were brownish with golden – beige pattern (phot. 1, 2).

Photo 1. The moth of *Phyllonorycter robiniella*

Photo 2. The adult of *Phyllonorycter robiniella*

According to Šefrová [7] eggs are elongate, bright grey-greenish and the larval development comprises 5 instars. Based on the analysis of the leaves it was noted that the first caterpillar instars were yellowish, whereas the last was greenish (phot. 3, 4). Šefrová [7] working on the morphology of *P. robiniella* caterpillars noted that first three instars were flat, with reduced legs, and last two instars had normal shape legs.

Photo 3. The first caterpillar instar

Photo 4. The caterpillar of *Phyllonorycter robiniella*

On the observed *R. pseudoacacia* trees, the females have oviposited on the underside surface of the leaf and the caterpillar initially formed a narrow tunnel, which next became flat and white spot (phot. 5, 6). The final mines have combined and occupied whole underside surface of the leaf and sometimes also appeared on the upperside of the leaves. In these mines it was possible to found even 8-12 caterpillars. The pupation followed in a circle, thick, silky cocoon (phot. 7, 8).

Photo 5. The initial mina on the robinia leaf

Photo 6. The final mina on the robinia leaf

Photo 7. The pupa of *Phyllonorycter robiniella*

Photo 8. Silky cocoons of *Phyllonorycter robiniella*

According to Šefrová [7] *P. robiniella* develops 2-3 generations during the vegetation period in central Europe (the complete development lasts 5-11 weeks), whereby the last generation moths hibernate.

Based on our observations the hibernating moths have oviposited at the end of May after the full foliation of *R. pseudoacacia* and first mines of the 1st generation occurred in the beginning of June. Moths of this generation were observed in mid June.

The moths of summer generation appeared in mid-July. During the days the high amount of moths sitting on *R. pseudoacacia* leaves were observed.

Photo 9. Empty pupa of *Phyllonorycter robiniella*

The moths of next generation were flying in mid August, reaching their peak in the 3rd decade of August. During this time many empty pupae errected from *R. pseudoacacia* leaves were noted (phot. 9).

Probably the moths of this generation hibernated in the bark crevices, under the bark or in other similar places.

The occurrence of *Phyllonorycter robiniella* (Clem.) in Kraków area

The analysis of 120 in the autumn 2002 and in year 2003 – 480 compound leaves from the trees growing in the different parts of Kraków shown that the large amount of *P. robiniella* was noted on the all tested trees. In 2002 all compound leaves were infested by *P. robiniella,* and the mean infestation of the single leaflets was 94% (tab. 1), whereas in 2003 the infestation of the leaflets reached 15.7% in the spring and 92.8% in the autumn (tab. 3).

Table 1. Infestation of *R. pseudoacacia* leaves by *Phyllonorycter robiniella* (Kraków, September 2002)

Site	Number of collected compound leaves	Number of infested compound leaves	Infestation %	Number of leaflets	Number of infested leaflets	Infestation %
Robinia pseudoacacia						
A	20	20	100	415	367	88.4
B	20	20	100	265	265	100.0
C	20	20	100	280	275	98.2
D	20	20	100	228	200	87.7
Robinia pseudoacacia 'Umbraculifera'						
E	20	20	100	200	187	93.5
F	20	20	100	231	228	98.7
Total	120	120	100	1619	1522	94.0

Table 2. The occurrence and the parasitation of *Phyllonorycter robiniella* (Kraków, September 2002)

Site	Number of tested leaflets	Number of caterpillars	Number of moth's cocoons	Number of parasitoid's pupae	Total	Parasitation %
Robinia pseudoacacia						
A	100	393	1	4	398	1.01
B	100	93	198	155	446	37.75
C	100	254	50	16	320	5.0
D	100	28	81	64	173	36.99
Robinia pseudoacacia 'Umbraculifera'						
E	100	247	38	55	340	16.18
F	100	271	103	76	450	16.89
Total	600	1286	471	370	2127	17.40

Table 3. Infestation of *R. pseudoacacia* leaves by *Phyllonorycter robiniella* (Kraków 2003)

Date	Site	Number of collected compound leaves	Number of infested compound leaves	Infestation %	Number of leaflets	Number of infested leaflets	Infestation %
17.06 03	*Robinia pseudoacacia*						
	A	20	12	60	219	17	7.8
	B	20	19	95	279	46	16.5
	C	20	15	75	189	34	18
	D	20	13	65	263	30	11.4
	Robinia pseudoacacia 'Umbraculifera'						
	E	20	12	60	223	35	15.7
	F	20	17	85	239	60	25.1
	total	120	88	73	1412	222	15.7
16.07.03	*Robinia pseudoacacia*						
	A	20	9	45	271	13	4.8
	B	20	20	100	261	129	49.4
	C	20	12	60	262	28	10.7
	D	20	18	90	276	115	41.7
	Robinia pseudoacacia 'Umbraculifera'						
	E	20	19	95	262	106	40.5
	F	20	17	85	282	65	23.1
	total	120	95	79,2	1614	456	28.25
15.08.03	*Robinia pseudoacacia*						
	A	20	19	95	233	177	76
	B	20	20	100	341	311	91.2
	C	20	20	100	313	264	84.3
	D	20	20	100	304	289	95.1
	Robinia pseudoacacia 'Umbraculifera'						
	E	20	20	100	273	260	95.2
	F	20	20	100	237	232	97.9
	total	120	119	99,2	1701	1533	90.1
16.09.03	*Robinia pseudoacacia*						
	A	20	18	90	273	165	60.4
	B	20	20	100	277	271	97.8
	C	20	20	100	268	267	99.6
	D	20	20	100	292	292	100
	Robinia pseudoacacia 'Umbraculifera'						
	E	20	20	100	265	262	98.9
	F	20	20	100	262	262	100
	total	120	118	98,3	1637	1519	92.8

Table 4. The occurrence and the parasitation of *Phyllonorycter robiniella* (Kraków 2003)

Date	Site	Number of tested leaflets	Number of caterpillars	Number of moth's cocoons	Number of parasitoid's pupae	Total	Parasitation %
17.06.03	*Robinia pseudoacacia*						
	A	100	9	10	0	19	0
	B	100	84	109	4	197	2.1
	C	100	24	24	3	51	5.9
	D	100	18	31	1	50	2
	Robinia pseudoacacia 'Umbraculifera'						
	E	100	19	28	1	48	2.1
	F	100	38	48	0	86	0
	total	600	192	250	9	451	2
16.07.03	*Robinia pseudoacacia*						
	A	100	4	5	0	9	0
	B	100	92	128	11	231	4.8
	C	100	37	2	0	39	0
	D	100	99	39	1	139	0.7
	Robinia pseudoacacia 'Umbraculifera'						
	E	100	182	17	0	199	0
	F	100	106	2	0	108	0
	total	600	502	193	12	725	1.7
15.08.03	*Robinia pseudoacacia*						
	A	100	288	40	32	360	8.9
	B	100	202	54	194	450	43.1
	C	100	374	120	22	516	4.3
	D	100	106	78	166	350	47.5
	Robinia pseudoacacia 'Umbraculifera'						
	E	100	184	174	180	538	33.5
	F	100	254	390	254	898	28.3
	total	600	1408	856	848	3112	27.2
16.09.03	*Robinia pseudoacacia*						
	A	100	70	150	30	250	12
	B	100	210	134	198	542	36.5
	C	100	94	172	76	342	22.2
	D	100	4	170	262	463	56.6
	Robinia pseudoacacia 'Umbraculifera'						
	E	100	80	138	238	456	52.2
	F	100	80	240	203	523	38.8
	total	600	538	1004	1007	2549	39.5

Each mine contained caterpillars from 1st to 5th instars and also silky cocoons of *P. robiniella.* In the final mines the pupae of the parasitoids was also visible (phot. 10). The development of each stage, depended on the environmental conditions e.g. temperature, humidity and pollution [7], varied on different sites. The results are presented in table 2 and 4.

Photo 10. Parasitoid's pupae

In the year 2002 the highest number of *P. robiniella* caterpillars was recorded on the park site A (area outside of the city) whereas the largest amount of its pupae occurred on the site B (green area in the centre).

In the year 2003 the total infestation of the robinia trees also varied between the sites of observations (tab. 4). The highest number of caterpillars and pupae were found on the site B (green area in the centre) and on the site F (street site – big traffic).

During the vegetation season the maximum of caterpillar's occurrence were noted in August (fig. 1). In this time *P. robiniella* catterpillars formed oval – shaped mines also on the upperside of the *R. pseudoacacia* leaves. During this period due to the high infestation the premature leaf fall and the development of the young leaves from the winter buds were observed on sites A, B, E, F. In September the initial narrow mines on these leaves were found (phot. 5, tab. 5).

fig. 1. The population dynamics of *Phyllonorycter robiniella* (Kraków 2003)

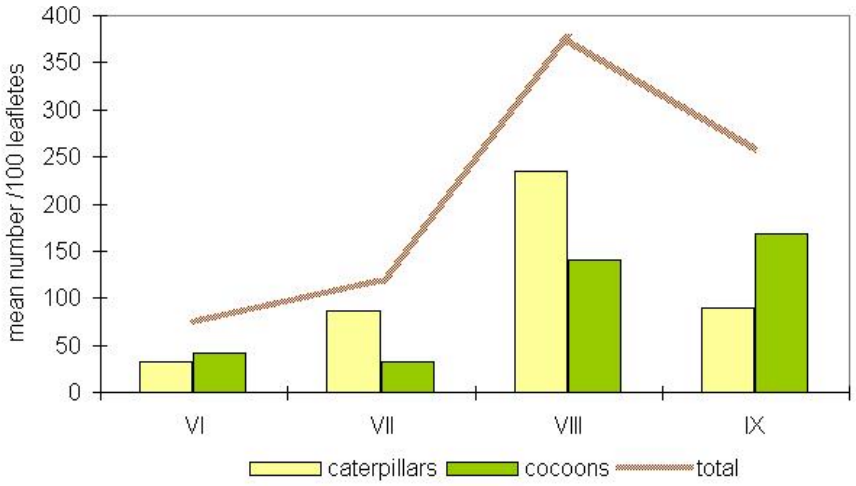

Table 5. The infestation of the young leaves developed from the winter buds (Kraków, September 2003)

Site	Number of compound leaves	Number of infested compound leaves	Infestation %	Number of leafletes	Number of infested leafletes	Infestation %	Number of initial mine	Mean number of mines / leaflet
Robinia pseudoacacia								
A	10	7	70	161	87	54	12	0,1
B	10	9	90	172	164	95.3	408	2.4
C	–							
D	–							
Robinia pseudoacacia 'Umbraculifera'								
E	10	10	100	144	58	40,3	123	0,9
F	10	10	100	151	123	81.5	60	0.4
total	40	36	90	628	432	68.8	603	0.9

In the year 2002 the parasitation reaching 37% was noted (mean 17.36%). The lowest number of parasitoids pupae was found on site A whereas the highest on the site B.

In the year 2003 the parasitation of *P. robiniella* varied from 2% in June to 39.5% in autumn.

The parasitoids were the little wasp species (phot. 11). Šefrová [7], working on the bionomics of *P. robiniella*, noted the parasitation from 10 to 30%. Whitebread [10], Deschka [4] informed of altogether 7 parasitoid species, all belonged to the *Eulophidae* and *Braconidae* families.

Photo 11. Parasitoid wasp reared from the *Phyllonorycter robiniella*

CONCLUSIONS

The above observations pointed out the importance of the *Phyllonorycter robiniella* as a new pest of *R. pseudoacacia* trees. Monitoring the next spread and density of this insect as a new member of the Polish insect's fauna appears to be important and useful. It is necessarily to continue above study by a bionomics, population dynamics and the natural regulation of abundance of this pest.

REFERENCES

1. Buszko J., Šefrová H., Laštůvka Z., 2000. Invasive species of Lithocolletinae in Europe and their spreading (Gracillariidae). XII European Congress of Lepidopterology SEL, Programme and Abstractcs, Białowieża (Poland), 91 pp.
2. Buszko J., Nowacki J., 2000. The Lepidoptera of Poland. A Dirtributional checklist. Polish Ent. Monogr. 1, 1-178.
3. Csóka G., 2001. Recent invasion of five species of leafmining Lepidoptera in Hungary. Proceedings: Integrated management and dynamics of forest defoliating insects, 1999 August 15-19, 31-36.
4. Deschka G., 1995. Schmetterlinge als Einwanderer Stapfia 37, zugleich Kataloge des OO. Landesmuseum N.F. 84, 77-128.
5. Hellrigl K., 1998. Zum Auftreten der Robinien- Miniermotte, *Phyllonorycter robiniella* (Clem.) und der Roßkastanien-Miniermotte, *Cameraria ohridella* Desch. & Dim. (Lep., Gracilariidae) in Südtirol. Anz. Schädlingskde Pflanzenschutz Umweltschutz, 71, 65-68.
6. Szabóki Cs., Csóka G., 1997. *Phyllonorycter robiniella* Clemens, 1859, new species of leafminers in Hungary. Növényvédelem (Plant Protection), 33 (11), 569-571.
7. Šefrová H., 2002. *Phyllonorycter robiniella* (Clemens, 1859) – egg, larva, bionomics and its spread in Europe (*Lepidoptera, Gracillariidae*). Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis (Brno), L, 3, 7-12.
8. Šefrová H., Skuhravý V., 2000. The larval morphology of *Cameraria ohridella* Deschka and Dimić compared with the genus *Phyllonorycter* Hübner (*Lepidoptera, Gracillariidae*). Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis (Brno), 48, 23-30.
9. Soika G., Łabanowski G., 2002. Minowce z rodziny kibitnikowatych (*Lepidoptera, Gracillariidae)* – szkodniki drzew i krzewów ozdobnych [Leafminers from the *Gracillaridae* family (*Lepidoptera*) – pests of the ornamental shrubs and trees]. Zeszyty Naukowe AR w Krakowie 387, 82, 321-325 [in Polish].
10. Whitebread S. E., 1990. *Phyllonorycter robiniella* (Clemens, 1859) in Europe (*Lepidoptera*, *Gracillariidae*). Nota Lepid. 12, 344-353.

Elżbieta Wojciechowicz-Żytko, Beata Jankowska
Department of Plant Protection
Faculty of Horticulture, Agricultural University of Cracow
Al. 29 Listopada 54, Cracow, Poland
tel: (+48 12) 662 52 57, fax: (+48 12) 662 52 66
e-mail: ewojcie@ogr.ar.krakow.pl

Responses to this article, comments are invited and should be submitted within three months of the publication of the article. If accepted for publication, they will be published in the chapter headed 'Discussions' in each series and hyperlinked to the article.
