

## THE OCCURRENCE AND HARMFULNESS OF *ERYSIPHE FLEXUOSA* AND *CAMERARIA OHRIDELLA* ON *AESCULUS* SPP.<sup>1</sup>

M. Werner, L. Irzykowska and Z. Karolewski

### Abstract

Trees of *Aesculus* spp. are severely damaged by the fungus *Erysiphe flexuosa* as well as the pest *Cameraria ohridella*. Both invasive species have spread throughout Europe and they became also serious for horse chestnuts in Poland. The damage caused by *E. flexuosa* and *C. ohridella* was assessed and the susceptibility of individual specimens grown in Poznań was compared. Trees least seriously damaged by the pathogen and pest were identified. Powdery mildew occurred on both *Aesculus* species but significant variation of tree susceptibility was found. *Cameraria ohridella* attacked exclusively the common horse chestnut causing premature leaf browning and dropping. However, it was possible to identify *Ae. hippocastanum* trees with leaves damaged by *C. ohridella* to a lesser degree.

**Key words:** *Aesculus* spp., powdery mildew, horse-chestnut leaf miner, epidemiology

### Introduction

*Erysiphe flexuosa* (syn. *Uncinula flexuosa*) frequently causes powdery mildew on different species from the genus *Aesculus* in North America. Symptoms of the disease were described on that continent for *Ae. arguta*, *Ae. georgiana*, *Ae. glabra*, *Ae. hippocastanum*, *Ae. pavia* and *Ae. ×carenea*. *Erysiphe flexuosa* was also found on horse chestnuts in Eastern Asia in the Russian Far East (Braun 1987). In 2000 the occurrence of this fungus was reported in Europe, where it proved to be a highly invasive pathogen and rapidly spreading in many countries, also in Poland (Ale-Agha et al.

---

<sup>1</sup>This study was partly supported by the Town Council of Poznań in the framework “The academic and scientific Poznań”.

2000, Bolay 2000, Ing and Spooner 2002, Piątek 2002, Kiss et al. 2004, Stankeviciene et al. 2010). Presently powdery mildew is found in all regions of Poland (Adamska 2002, Werner 2007, Werner et al. 2009, Karolewski et al. 2010). Initial symptoms include small patches on leaves and then fungal colonies expand and cover the upper and the lower leaf surfaces. Both young and old leaves are usually infected. Severe infection of trees causes premature leaf drop leading to plant vigour loss.

Common horse chestnut was one of the first alien trees, which starting from the 17<sup>th</sup> century has been planted in Poland as an ornamental tree. At present it is commonly met in forest margins, also extensively planted in different green plantings, often in cultivars, and it has become a frequent element among tree species popularly found in Poland. Additionally, the hybrid of *Ae. hippocastanum* and *Ae. pavia* named red horse chestnut (*Ae. ×carnea*) also is planted in parks, avenues and greens.

Serious concerns related to the future of common horse chestnuts have resulted from the threat posed by a pest, horse-chestnut leaf miner (Wiech et al. 2001, Baranowski et al. 2002, Dzięgielewska et al. 2005). *Cameraria ohridella* (Lepidoptera: Gracillariidae) has spread throughout Europe over the last two decades (Augustin et al. 2009). *Cameraria ohridella* develops three generations per year in Poland. The moth overwinters as pupae in dry dropped leaves. Damages are caused by larvae feeding inside leaves. Leaf damage by *C. ohridella* and epidemic occurrence of powdery mildew on horse chestnuts constitute an important problem and thus a strategy of horse chestnut protection against both pathogen and pest needs to be developed.

The aim of this study was to assess the tree infestation rate by *E. flexuosa* in selected plantings and to evaluate the intensity of damage caused by *C. ohridella*, to facilitate a comparison of the susceptibility of individual specimens and identification of trees least seriously damaged by the analyzed pathogen and pest.

## Material and methods

Horse chestnuts selected for analyses were growing in different Poznań localities: parks (Moniuszki, Wieniawskiego, Marcelin, the park in osiedle Chrobrego), street plantings (Wielkopolska avenue, Chopina, Wojska Polskiego, Staszica) and urban greens at Dąbrowskiego street, Wołyńska street and in the housing districts osiedle Chrobrego and osiedle Jagiełły. A total of 169 trees includes 152 *Ae. hippocastanum* and 17 *Ae. ×carnea*. In the years 2008–2011 the incidence of powdery mildew was assessed on all trees growing in those localities. Moreover, in 2011 tree infestation rate by *E. flexuosa* was also determined. The evaluation was conducted on 10 randomly selected leaves from each tree and it was performed in a 4-point scale (1 – leaves with no damage symptoms, 2 – single clusters of coatings on leaf surface, 3 – single leaf fragments not covered by coatings, 4 – the entire leaf surface covered by mycelium). Moreover, in the same year leaf damage by the pest

*C. ohridella* was also estimated. Ten leaves from each tree were selected randomly and assessed according to the 5-point scale given by Baranowski et al. (2004). The mean infestation degree of leaves was calculated according to the Townsend-Heuberger formula (Puntener 1981).

## Results and discussion

Statistically significant differences in susceptibility to *E. flexuosa* and *C. ohridella* between particular trees were found. Observations conducted in 2008–2010 on the spread of powdery mildew on horse chestnuts in different green areas of Poznań showed that the disease was found more frequently on red horse chestnuts, while trees of this species were not damaged by the horse-chestnut leaf miner (Fig. 2). This is in concordance with earlier observations when 80 *Ae. ×carnea* trees were observed (Werner et al. 2009). In the successive years of study the mildew occurrence ranged from 49.4% in 2008 to 76.8% in 2010 of trees examined, however in 2011 it was slightly lower (Table 1, Fig. 1). Among the analyzed red horse chestnuts there were trees not suffering from the disease (no. 1), trees diseased every year (13–15) and diseased only in some years (1–8, 11–12).

The results indicate that only a few trees of *Ae. ×carnea* did not suffer from the powdery mildew. This concurs with earlier reports (Milevoj 2004, Werner et al. 2009). However, more extensive studies during successive years are necessary to confirm the health status of trees, since an increasing infection pressure on one hand and weather conditions (particularly during disease development) on the other may lead to overcoming the infection resistance, while trees not suffering from the disease may prove to be valuable maternal material.

On the contrary, in the population of common horse chestnuts only few trees infested with *E. flexuosa* were found in individual localities. In process of time their number was increasing and depending on the year and locality. The number ranged

**Table 1**

Infestation of red horse chestnuts by *Erysiphe flexuosa* in Poznań (2008–2011)

Observation site	Tree code (no.*)	Trees infested (%)			
		2008	2009	2010	2011
Szamarzewskiego street	14	33.3	33.3	33.3	33.33
Wołyńska street	1–8	62.5	75.0	100.0	87.5
Moniuszki park	13	100.0	100.0	100.0	100.0
Dąbrowskiego street	9	0	100.0	100.0	100.0
Staszica street	1	0	0	0	0
Wielkopolska avenue	15	100	100.0	100.0	100.0
Wojska Polskiego street	11–12	50	100.0	100.0	0
Annual mean		49.4	72.6	76.18	60.15

\*Trees selected for the assessment of infestation rates.

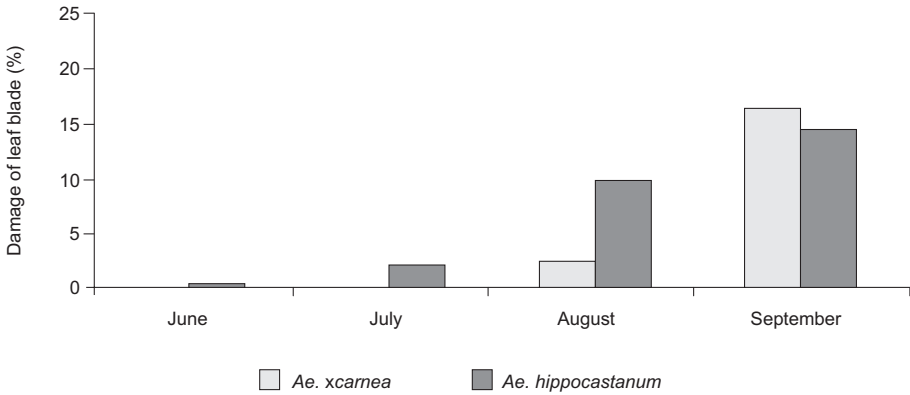


Fig. 1. The degree of *Aesculus* leaves infestation caused by *Erysiphe flexuosa* in Poznań during 2011

from 7.4% in 2008 to 45.4% in 2010, while in 2011 it did not exceed 39.1% (Table 2). However, irrespective of the disease intensity trees diseased already in the first year of the analyses were also infested next years.

First symptoms of *C. ohridella* activity were visible earlier on the *Ae. hippocastanum* trees growing in parks where fallen leaves with overwintering pupa were not removed. This is in concordance with previous studies focused on cultural control (Pavan et al. 2003, Kukuła-Młynarczyk and Hurley 2007). Damages caused by larvae feeding inside leaves were growing gradually from May to September. The time in which highly infested trees were able to assimilate photosynthetic products was drastically shortened. Yellowing and browning leaves were starting to drop in the second decade of August. Highly infested trees produced smaller seeds what is consistent with the findings of Selleo et al. (2003). Similarly, Thalmann et al. (2003) observed seed weight reduction of infested by *C. ohridella* common horse chestnut trees.

Although common horse chestnuts were infested by horse-chestnut leaf miners, it was possible to differentiate visually between specimens with leaves almost completely damaged by the pest and the leaves significantly lesser damaged, indi-

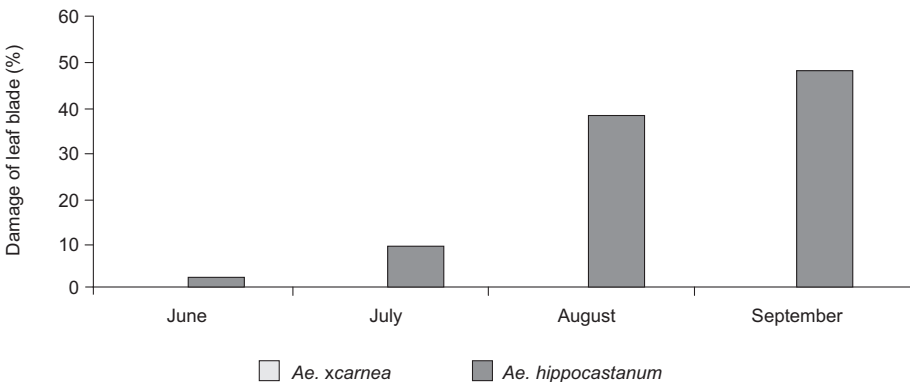


Fig. 2. The degree of *Aesculus* leaves damage caused by *Cameraria ohridella* in Poznań during 2011

Table 2

Infestation of common horse chestnuts by *Erysiphe flexuosa* in Poznań (2008–2011)

Observation site	Tree code (no.)*	Trees infested (%)			
		2008	2009	2010	2011
Chopina street	–	7.6	15.3	15.3	15.3
Moniuszki park	16	0	7.1	14.3	0
Wieniawskiego park	31, 32, 33, 34, 35	7.4	14.8	14.8	11.1
Os. Chrobrego (park)	22, 23, 24, 25, 26, 27, 28, 29, 30	8.7	17.4	43.5	39.1
Os. Chrobrego	–	0	12.5	18.7	0
Os. Jagiełły	21	0	20.0	20.0	0
Stary Browar (park)	–	–	–	–	–
Marcelin (park)	–	0	0	0	0
Wojska Polskiego street	36, 37, 38, 39, 40	0	20.8	37.5	4.2
Dąbrowskiego street	18, 19, 20	0	27.3	45.4	36.4
Dendrological Garden, the Poznań University of Life Sciences	–	0	0	0	0
Wołyńska street	17, 41	0	0	0	0
Annual mean		2.8	13.77	20.6	10.6

\*Trees selected for the assessment of infestation rates.

cating some variation in susceptibility of trees to *E. flexuosa* and *C. ohridella*. Mean infestation rates of trees selected from each locality are presented in Table 2.

The assessment of *E. flexuosa* spread conducted over the period of four years as well as the analysis of data shown in Figure 1 indicate a variation in susceptibility to infestation both between two *Aesculus* species and between individual specimens. It was possible to identify *Ae. hippocastanum* trees damaged by *C. ohridella* to a lesser degree and resistant to powdery mildew. Selection of such trees as maternal trees, particularly for production of young trees by grafting, may be one of the potential methods to reduce damage caused by the pathogen and pest.

## Streszczenie

### WYSTĘPOWANIE NA KASZTANOWCACH ORAZ SZKODLIWOŚĆ *ERYSIPHE FLEXUOSA* I *CAMERARIA OHRIDELLA*

Kasztanowce są silnie uszkodzane zarówno przez *Erysiphe flexuosa*, powodującego mączniaka prawdziwego, jak i przez szkodnika *Cameraria ohridella*. Obydwa inwazyjne gatunki rozprzestrzeniły się w całej Europie i stały się niebezpieczne również dla kasztanowców w Polsce, zwłaszcza dla *Aesculus hippocastanum* i *Ae. ×carnea*. Celem badań była ocena nasilenia uszkodzeń powodowanych przez *E.*

*flexuosa* i *C. ohridella*, aby porównać podatność poszczególnych drzew i zidentyfikować te, które są najmniej niszczone przez patogen i szkodnika. Mączniak prawdziwy występował na obu gatunkach kasztanowca, chociaż zaobserwowano znaczące różnice w podatności drzew. *Cameraria ohridella* atakował wyłącznie kasztanowca zwyczajnego, powodując przedwczesne żółknięcie i opadanie liści. Jednakże możliwe było zidentyfikowanie drzew *Ae. hippocastanum* z liśćmi uszkodzonymi przez szkodnika w mniejszym stopniu.

## Literature

- Adamska I., 2002: Grzyby pasożytnicze roślin ozdobnych i ziół Szczecina. Acta Agrobot. 55, 1: 7–15.
- Ale-Agha N., Braun U., Feige B., Jage H., 2000: A new powdery mildew disease on *Aesculus* spp. introduced in Europe. Cryptog. Mycol. 21: 89–92.
- Augustin S., Guichard S., Heitland W., Freise J., Svatos A., Gilbert M., 2009: Monitoring and dispersal of the invading Gracillariidae *Cameraria ohridella*. J. Appl. Entomol. 133: 58–66.
- Baranowski T., Parus A., Fajfer B., 2002: Występowanie szrotówka kasztanowcowiaczka (*Cameraria ohridella* Deschka & Dimić) na kasztanowcach w Poznaniu w latach 2000–2001. Prog. Plant Prot. / Post. Ochr. Rośl. 42, 2: 654–657.
- Baranowski T., Skoczylas A., Makulska K., 2004: Ocena stanu zdrowotnego kasztanowca białego (*Aesculus hippocastanum* L.) na terenie miasta Poznania. Prog. Plant Prot. / Post. Ochr. Rośl. 44, 2: 591–593.
- Bolay A., 2000: L'odium des marronniers envahit la Suisse. Rev. Suisse Vitic. Arboric. Hortic. 32: 311–313.
- Braun U., 1987: A monograph of the Erysiphales (powdery mildews). Beih. Nova Hedwigia 89.
- Dzięgielewska M., Kaup G., Adamska I., 2005: The co-occurrence of *Cameraria ohridella* Deschka & Dimić and the parasitic fungi on *Aesculus* ssp. Prog. Plant Prot. / Post. Ochr. Rośl. 45, 2: 637–640.
- Ing B., Spooner B., 2002: The horse chestnut powdery mildew *Uncinula flexuosa* in Europe (new British Record 210). Mycologist 16: 112–113.
- Karolewski Z., Werner M., Andrzejak R., Kosiada T., 2010: Rozprzestrzenienie epidemii mączniaka prawdziwego (*Erysiphe flexuosa* U. Braun & S. Takamatsu) na kasztanowcach w Wielkopolsce. Prog. Plant Prot. / Post. Ochr. Rośl. 50, 4: 1797–1800.
- Kiss L., Vajna L., Fischl G., 2004: Occurrence of *Erysiphe flexuosa* (syn. *Uncinula flexuosa*) on horse chestnut (*Aesculus hippocastanum*) in Hungary. Plant Pathol. 53: 245.
- Kukuła-Młynarczyk A., Hurley M., 2007: Incidence, harmfulness and some elements of the horse chestnut leafminer (*Cameraria ohridella* Deschka & Dimić) control on white horse chestnut (*Aesculus hippocastanum* L.). J. Plant Prot. Res. 47, 1: 53–63.
- Milevoy L., 2004: The occurrence of some pests and diseases on horse chestnut, plane tree and Indian bean tree in urban areas of Slovenia. Acta Agric. Slov. 83: 297–300.
- Pavan F., Barro P., Bernardinelli I., Gambon N., Zandigiacomo P., 2003: Cultural control of *Cameraria ohridella* on horsechestnut in urban areas by removing fallen leaves in autumn. J. Arboric. 29: 253–258.
- Piątek M., 2002: *Erysiphe flexuosa*, a new for Poland powdery mildew causing disease of *Aesculus hippocastanum*. Phytopathol. Pol. 24: 67–71.
- Puntener W., 1981: Manual for field trials in plant protection. Agricultural Division, Ciba-Geigy, Basel, Switzerland.
- Selleo S., Nardini A., Raimondo F., Lo Gullo M.A., Pace F., Giacomich P., 2003: Effects of defoliation caused by the leaf miner *Cameraria ohridella* on wood production and efficiency in *Aesculus hippocastanum* growing in north-eastern Italy. Trees 17: 367–375.
- Stankevičienė A., Snieskiene V., Lugauskas A., 2010: *Erysiphe flexuosa* – the new pathogen of *Aesculus hippocastanum* in Lithuania. Phytopathologia 56: 67–71.
- Thalmann C., Freise J., Heitland W., Bacher S., 2003: Effects of defoliation by horse chestnut leafminer (*Cameraria ohridella*) on reproduction in *Aesculus hippocastanum*. Trees 17: 383–388.

- Werner M., 2007: The first report on powdery mildew caused by *Erysiphe flexuosa* (syn. *Uncinula flexuosa*) on *Aesculus* in Poznań. *Phytopathol. Pol.* 45: 71–72.
- Werner M., Karolewski Z., Andrzejak R., 2009: Mączniak prawdziwy (*Erysiphe flexuosa* U. Braun & S. Takamatsu) nowym zagrożeniem dla kasztanowców. *Prog. Plant Prot. / Post. Ochr. Rośl.* 49, 2: 759–762.
- Wiech K., Górską A., Cichoń S., 2001: Obserwacje występowania szrotówka kasztanowcowiaczka (*Cameraria ohridella*). *Prog. Plant Prot. / Post. Ochr. Rośl.* 41, 2: 446–449.

**Authors' address:**

**Dr. hab. Maria Werner, Dr. Lidia Irzykowska, Dr. hab. Zbigniew Karolewski**, Department of Phytopathology, Poznań University of Life Sciences, ul. Dąbrowskiego 154, 60-594 Poznań, Poland, e-mail: irzyk@up.poznan.pl

*Accepted for publication: 11.08.2012*