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DEVELOPMENT OF HORSE CHESTNUT LEAFMINER (*CAMERARIA OHRIDELLA* DESCHKA & DIMIC) ON RED HORSE CHESTNUT

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Abstract: Observations on the development of the horse chestnut leafminer on red horse chestnut (*Aesculus x carnea* H.) were carried out in Wrocław, Lower Silesia, Poland, in 2001–2003. Three generations of the pest were recorded to lay eggs on the red horse chestnut leaves. Although females of each generation deposited eggs abundantly, the hatching larvae died after a short period of feeding in the plant's leaves and the species did not complete its development on this tree. Mostly L_1 and L_2 larvae were found inside the leaf mines. The observed leaf damage was, therefore, negligible.

Key words: *Cameraria ohridella* Deschka & Dimic, horse chestnut leafminer, *Aesculus x carnea* H., red horse chestnut, development, damage

INTRODUCTION

Until recently, the horse chestnut leafminer, *Cameraria ohridella* Deschka & Dimic, was considered a monofagous herbivore feeding exclusively on white horse chestnut, *Aesculus hippocastanum* L. (Hrubik and Juhasova 1998). However, observations carried out during last few years indicate that *C. ohridella* is capable of feeding on other plants of the genera *Aesculus* and Acer. This takes place when the white horse chestnut plants have been already heavily infested within a particular area and damaged by the larvae of this pest and the adults are not able to find a suitable site to lay the eggs (Avtiz and Avtiz 2002). Laying eggs by *C. ohridella* was observed on *Aesculus parviflora* Walk., *Aesculus x carnea* H., and on *Aesculus glabra* Walk. Nevertheless, the larvae died soon after hatching on these species of *Aesculus* (Skuhravy 1998).

Our objective was to study the development of the horse chestnut leafminer and the pest's infestation on the red horse chestnut (*Aesculus x carnea* H.) within the urbanized parts of Wrocław, Lower Silesia, Poland.

MATERIALS AND METHODS

The observations at several sites of red horse chestnut were carried out in Wrocław, in 2001–2003. No white horse chestnut was found near the studied red horse chestnut trees at any of the sites. At each site on the trunks of five trees, square areas of 400 cm^2 (20 x 20 cm) were drawn using white paint, 1.5 m above the ground level. Adults of *Cameraria ohridella* were counted weekly within these squares. Mean of five counts was used as a measure of adult pest density at the particular site.

Densities of eggs, larvae and pupae, as well as the extent of leaf damage, were determined as means of 10 "single" leaves from each site, i.e. from single 10 leaf blades detached from 10 different compound leaves sampled from the studied trees of *A. x carnea.* Eggs, larvae and pupae were counted, and the leaf damage was estimated visually and recorded as percentage of the leaf covered with mines relative to the entire area of the leaf blade.

RESULTS

Flight dynamics of moths

Moths of overwintering generation of the pest were found on tree trunks at the beginning of May in 2001, whereas in 2002 and 2003 they occurred already in the 3rd decade of April (Fig. 1). Adults of the first generation appeared in mid-June (2002, 2003) or at the beginning of July (2001). The second generation was found on trunks from the second half of August in 2001, and at the beginning of August in 2002 and in 2003. Three generations of *C. ohridella* adults were observed every year on the red horse chestnut. They were the most abundant in 2001. Altogether, 81 insects/trunk were found in that year with the maximum of 17.5 moths per trunk in the second half of August.

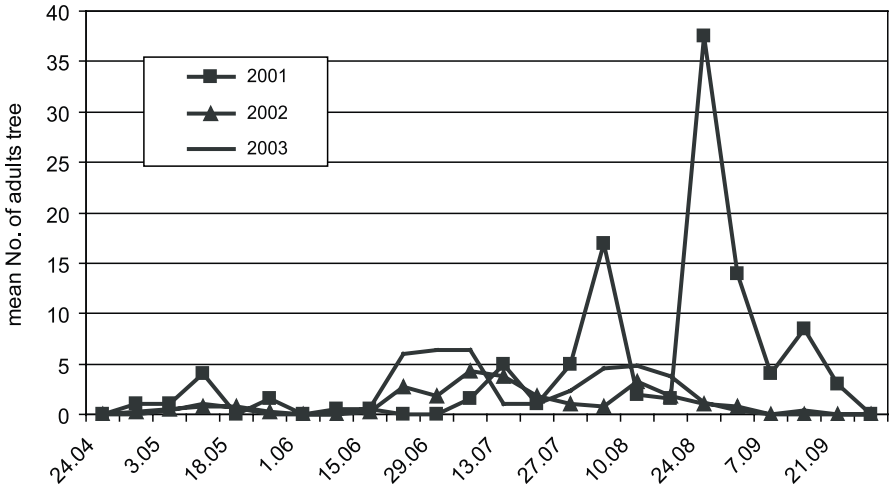

Fig.1. Flight dynamics of *Cameraria ohridella* on the red horse chestnut; Wrocław 2001–2003

Pest development

Females started to lay eggs on *A. x carnea* in the second half of May every year (Fig. 2). The number of laid eggs increased in the consecutive generations. The maximum density of eggs on leaves was observed in the first and the second decades of September, every season.

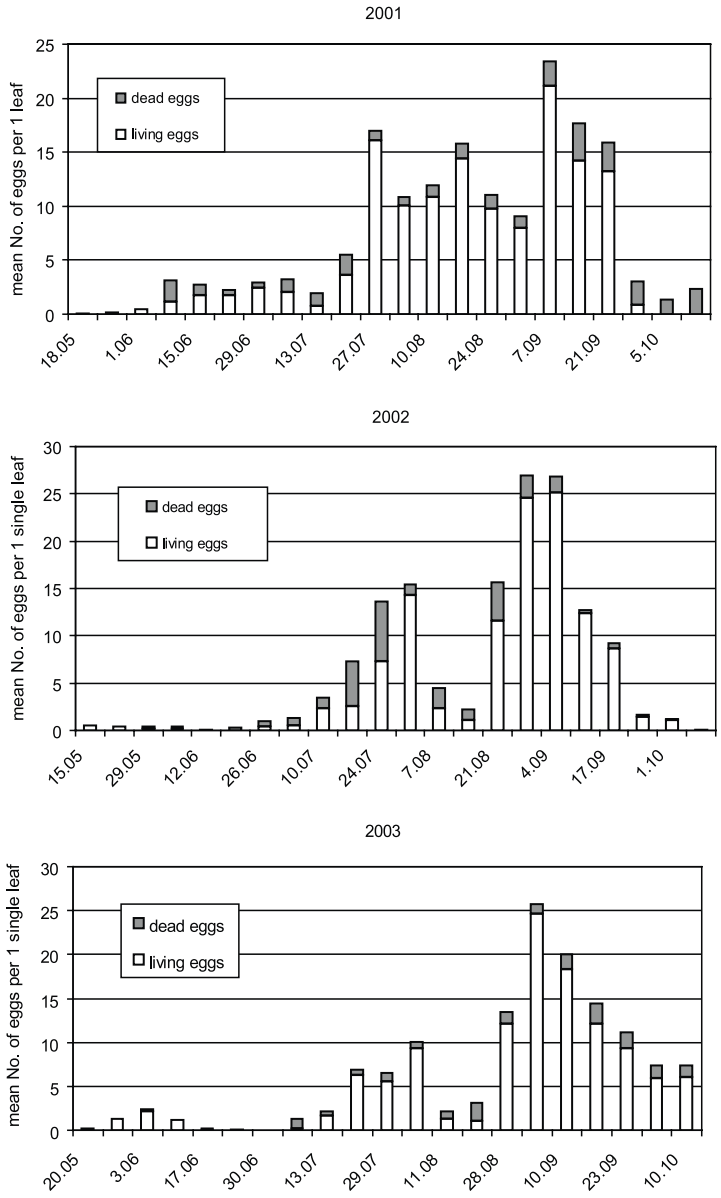

Fig. 2. Mean number of eggs on the leaves of the red horse chestnut. Wrocław, 2001–2003

During the whole study period, a certain proportion of eggs was found dead. In 2001 dead eggs made up 22% of all laid eggs (a maximum in the 3-year study), and in 2003, the proportion was 13.5% (a minimum).

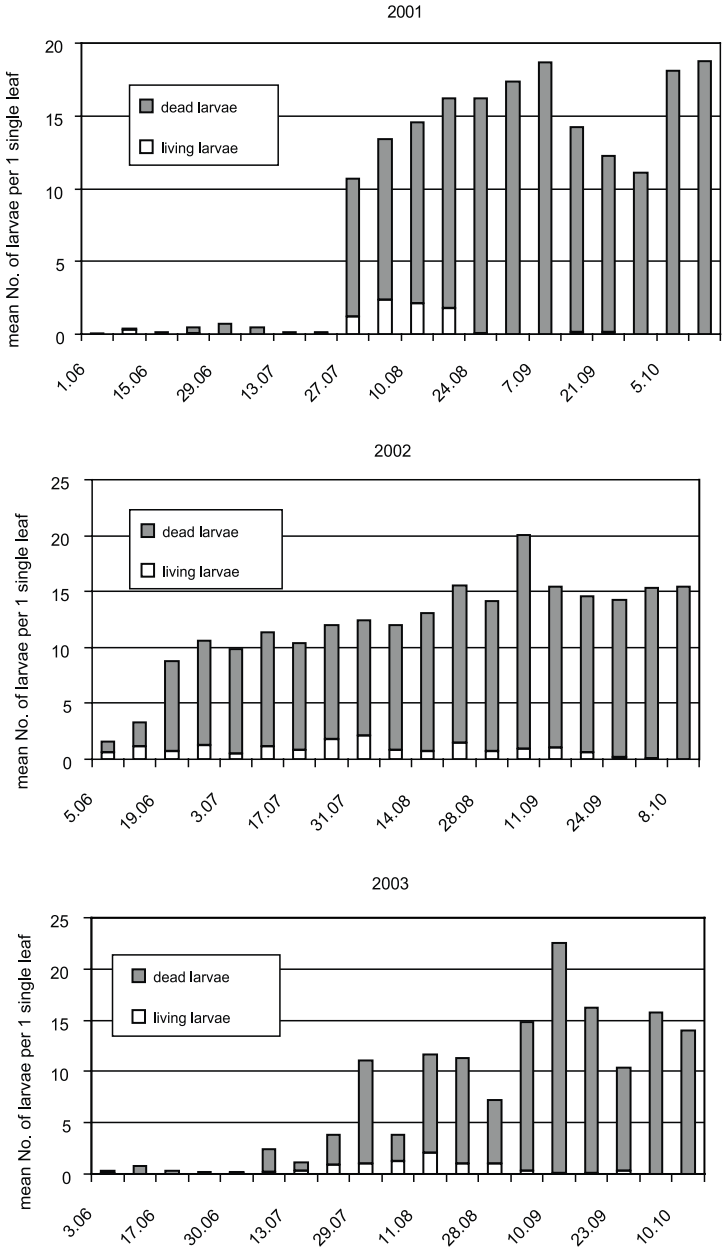

Fig. 3. Mean number of larvae in the leaves of the red horse chestnut, Wrocław, 2001–2003

In the years 2001–2003, the larvae of the first generation of *C. ohridella* started feeding inside the leaves at the beginning of June. Later in the season, the number of larvae increased slowly. Usually, the greatest number of larvae occurred in the second half of September. Mortality in the sampled larvae population was always high. Dead larvae made up ca. 95% of all found individuals (Fig. 3). Most often they were L_1 and L_2 larvae. It seems that despite of the substantial egg number per leaf, in most cases the infestation was unsuccessful. The hatching larvae died shortly after they had bitten into the leaf mesophyll. In none of the study years pupae were recorded inside leaves of the red horse chestnut. It may be thus concluded, that the herbivore development on this plant species was never completed.

Leaf damage

The leaf damage developed in a fairly similar way every year, therefore we have chosen to present the 2003 data as the most clear example of the damage dynamics (Fig. 4). The first mines were usually found in leaves at the beginning of June. They were small and, therefore, the leaf area covered at that time was never greater than 0.5%. Next observations were always showing gradual increase of mine number, but not of the area of individual mines. As the feeding larvae were demonstrated to die early in their development, the affected leaf area never exceeded 5% until the end of each vegetation season.

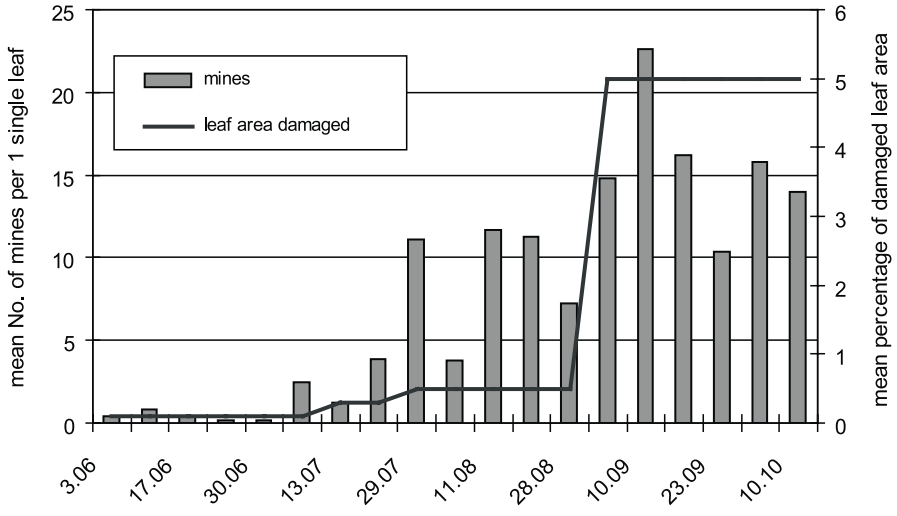

Fig. 4. Mean number of mines and percentage of damaged leaf area of the red horse chestnut, Wrocław 2003

DISCUSSION

The adults of *Cameraria ohridella* visit the red horse chestnut trees before mid-May, and they lay eggs on the leaves of that plant as they do on the white horse chestnut, *Aesculus hippocastanum*. However, the larvae hatching on red horse chestnut die shortly after they start feeding in the leaf mesophyll. The mortal-

ity of the larvae feeding in red horse chestnut leaves often exceeds 90% and the dead individuals are the youngest larvae – L_1 and L_2. Therefore, the observed leaf damage on the red horse chestnut is very limited as compared to that on its more common relative, white horse chestnut. Skuhravy (1999) and Freise et al. (2004) have made similar observations: their results also showed that larvae of *C. ohridella* died after they bite into the leaves of *A. x carnea*. The cause of the high larval mortality remains unclear. *Aesculus x carnea* is a crossbred of *A. hippocastanum* and *A. pavia* L. Its leaves show thicker and more creased epidermis which may pose some kind of mechanical barrier for the larvae trying to bite into the mesophyll. According to Dąbrowski (1988), the morphology of a plant and its organs, as well as the chemical content of its tissues, determines the plant resistance to herbivore attack. Most often a particular nutritional balance between compounds found in insect diet determines and enables its proper development, whereas a too high concentration or deficiency of one or more diet components may result in ceased feeding and, consequently, in the insect's death (Morewood et al. 2004). Furthermore, the attacked plant may deploy its chemical defences, producing compounds that are toxic to the feeding herbivore and capable of killing it instantly, or substances that show deterrent action against it. Such relation between the plant and the herbivore is a commonly found phenomenon, called antibiosis (Simmonds 1987; Morewood et al. 2004).

Preliminary results of the research being currently carried out in collaboration with Chemistry Department of the Agricultural University at Wrocław indicate that the chemical composition of leaf tissues is more complex in the crossbred species of *A. x carnea* than in *A. hippocastanum*. The chemical analyses showed much higher (3.5-fold) contents of saponins in extracts from leaves of *A. x carnea*. The analyses also indicated a higher amount of eugenol and α-terpineol in extracts from leaves of this tree. The relatively higher resistance of red horse chestnut against *Cameraria ohridella* may be a result of insecticidal activity of these compounds (Szumny et al. 2005).

CONCLUSIONS

1. Three generations of adults of *Cameraria ohridella* were recorded on the red horse chestnut every year. Females laid eggs abundantly on the plants leaves.
2. Larvae of the pest died shortly after they had started feeding in the leaves of the plant. This is probably the reason that the observed leaf area damage is negligible.
3. No pupae were found in leaves of the red horse chestnut – the herbivore did not complete its life cycle on this plant.
4. The cause of the high larval mortality is unknown. However, based on the preliminary (ongoing) research, the differences in biochemical composition of leaf tissues between the white and the red horse chestnuts appear as one of possible reasons.

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POLISH SUMMARY

ROZWÓJ SZROTÓWKA KASZTANOWCOWIACZKA (*CAMERARIA OHRIDELLA* DESCHKA & DIMIC) NA KASZTANOWCU CZERWONYM

Badania dotyczące rozwoju szrotówka kasztanowcowiaczka na kasztanowcu czerwonym prowadzono w latach 2001–2003 na terenie miasta Wrocławia. Na kasztanowcu czerwonym odnotowano obecność trzech pokoleń szrotówka. Samice składały na liściach liczne jaja, z których wylęgały się larwy. Po krótkim okresie żerowania larwy jednak zamierały. Owad ten nie odbywał pełnego rozwoju na kasztanowcu czerwonym. W efekcie zniszczenie powierzchni blaszek liściowych było minimalne. W liściach tego kasztanowca obserwowano bardzo duże ilości martwych larw. Stanowiły one 90% całej populacji gąsienic. Najczęściej były to larwy L_1 i L_2.