The mini-Caterpillar of the horse chestnut tree – a new tree devastator in the city

Sylvie Augustin

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Introduction

The invasive horse-chestnut leaf miner, Cameraria ohridella Deschka and Dimiã (Lepidoptera: Gracillariidae) is a new pest of the European horse-chestnut, Aesculus hippocastanum L. The origin of this species is uncertain. It was first found near the Ohrid lake in Macedonia and was described as a new species by Deschka and Dimiã in 1986. In 1989, it was found in Austria, from where it rapidly spread through Central and Western Europe over the last 20 years (Sefrová & Lastuvka, 2001). Since 2002 it has been reported from United Kingdom, Spain, Denmark, Lithuania, Sweden, Turkey, Ukraine, Moldova, Belarus and Russia. Larvae of C. ohridella mine the leaves of its main host species, the white flowering horse chestnut A. hippocastanum, endemic to the Balkans and one of the most planted trees in European urban areas. Severely damage leaves turn brown and heavily infested trees can lose most of their leaves before the end of summer. The invasive success of this species relates to high rate of population growth and high rate of spread. Once established, populations reach outbreak densities a few years only after its arrival as it develops various generations per year and the impact of natural enemies is low. In addition, even after many years, no decrease in populations has been observed in European towns and cities, and the damage greatly impairs the visual appearance of horse-chestnut trees.

Dispersion

C. ohridella has subsequently invaded much of central and western Europe over the last 20 years at an approximate rate of 60 km per year (Sefrová & Lastuvka 2001); in France, it was observed for the first time in 2000 in the eastern part and near Paris and, since 2006, has reached all parts of this country. The invasion pattern was studied in Germany and France using a stochastic simulation model showing that the best description of the observed spread was obtained using a stratified dispersal model (Gilbert et al. 2005). This model combined short-distance and long-distance dispersal events, with the probability of long-distance establishment varying according to human population density. The arrival of C. ohridella firstly in big cities does not allow inferring dispersal means because in cities the higher density of horse chestnut trees increase the probability of establishment and the higher population rate also increases the risk of passive transportation of adults or infested leaves by cars and other vehicles. C. ohridella is presumably dispersed passively by wind or by transportation by vehicles.

Within cities where the infested leaves are generally removed from the ground during winter, population gradients are observed from trees located in green areas where the removal is impracticable towards trees located in the city streets (Gilbert et al. 2003). The active dispersal ability seems to be very short (approx. 100m), and it is suggested that the largest part of the dispersal could be the result of infested leaves (or fragments) blown from the population source during the winter.

Host species and impact

The main host species of C. ohridella is A. hippocastanum but the oviposition and the development of larvae is also possible on other Aesculus species such as A. turbinata, A. octandra (=flava) or A. pavia. C. ohridella also attacks Aesulus x carnea. However, the larvae usually die soon after emergence, thus the impact caused by the moth on this species of Aesculus usually is much lower (Freise et al 2003). In addition, C. ohridella is occasionally found attacking and

developing on maple trees (Acer pseudoplatanus and A. platanoides), when they are close to horse chestnut tree with high population levels and damage may be quite as important as on horse chestnut. It cannot be excluded that a host shift is possible, especially if selection pressures are high.

Although the aesthetic damage of this pest is severe, studies carried out by the European programme CONTROCAM (http://www.cameraria.de) showed that damage caused by C. ohridella is rather an aesthetical problem than plant health problem in urban area. It was showed in Italy that C. ohridella does not affect the survival of the trees and neither, growth rates nor physiological factors indicate an immediate dieback risk for A. hippocastanum (Salleo et al, 2003). However, in more northern climates, C. ohridella is suspected to cause the decline of horse chestnut because defoliation induces a second flowering, decreasing frost hardness (Balder et al., 2004). It is also possible that interactions with other pests and diseases (e.g. with a new disease present in the Netherlands in 2002) might lead to a greater impact on horse chestnut. In the Balkans where the horse chestnut is endemic, the environmental impact of C. ohridella is important. Indeed, studies have shown that fruit and seed size is negatively affected by C. ohridella, (Thalmann, 2003), and as seed weight is of major importance for the requirement in horse chestnut, the permanent outbreaks may endanger the long term persistence of A. hippocastanum in those rare endemic forests.

Control

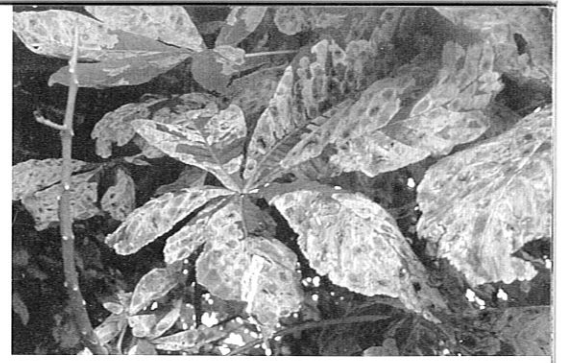
In the infested cities, the aesthetic damage is so drastic, that measures to control this pest are needed and represent an important additional cost for the municipalities.
The aerial spraying of diflubenzuron or bifenthrine and the injection of systemic insecticides are efficient but chemical treatments have negative impact on the environment and technical problems arise from the spraying of big trees in cities; in addition chemical treatments are not well perceived by the public. Pheromones trapping is a highly specific monitoring tool and is useful to assess the correct timing for insecticide applications. However, mass trapping methods do not provide satisfying control for Cameraria as they are hampered by the very high densities of C. ohridella.

The removal of dead leaves in which pupae over-winter is the most extensively used and favoured method for the control of C. ohridella. When the exhaustive removal of leaves below the trees and in the neighbourhood is feasible, leaf removal provides a sufficient level of control by itself. The elimination of bushes at the base of the tree (if it is possible) will facilitate removal. Leaves can be removed at any time before spring. The leaves can be handled on private compost heaps properly covered by soil, other leaves, or plastic; it will avoid burning or carrying to big compost places (Kehrli et al. 2005).

The replacement of trees has already started in many regions. In forest and park where leaf removal is not possible the cutting of trees with low ornamental interest, which can act as reservoir, should be considered to protect the highly valuable trees in the park and along the avenues. It should be recommended to use native species as replacement.

These methods are not sustainable. They are expensive, have to be repeated every year, and chemical treatments give rise to environmental problems. To develop biological control methods C. ohridella parasitism was investigated in many European countries during the CONTROCAM programme. Leaf miner parasitoids are highly polyphagous and invasive leaf miners are generally recruited by indigenous parasitoids that may results in the control of the pest. C. ohridella has been adopted by a complex of indigenous parasitoid species, but parasitism remains low, even in locations infested for 30 years. Kehrli et al. (2005) have developed a system to augment parasitism at a local scale. It consists of storing in winter dead leaves with over-wintering moths in a mass emergence device that allow the parasitoids to escape without their host. Increased parasitism rates were observed in experiments, but no effect on moth populations was detected. The improvement of this method is underway and if successful it could be used in urban environments. Nevertheless, in the long term, unless a native European natural enemy improves its capability of controlling the moth, the only sustainable solution to the C. ohridella problem is classical biological control but it is necessary to locate the origin of the moth or to look for parasitoids of other Cameraria spp. to release a specific natural enemy.

Sylvie Augustin
Unite de Zoologie Forestiere



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