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The occurrence of *Cameraria ohridella* in Belgium (Lepidoptera: Gracillariidae)

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Samenvatting. Het voorkomen van *Cameraria ohridella* in België (Lepidoptera: Gracillariidae)

Sinds de ontdekking van *Cameraria ohridella* Deschka & Dimić, 1986 in België, heeft de soort een explosieve verspreiding gekend. Ze komt momenteel voor in alle provincies van het land, soms zeer talrijk, en daardoor veroorzaakt ze enorme schade aan de paardekastanjes (*Aesculus hippocastanum*), de voedselplant van de rups.

Résumé. L'occurrence de *Cameraria ohridella* en Belgique (Lepidoptera: Gracillariidae)
Depuis la découverte de *Cameraria ohridella* Deschka & Dimić, 1986 en Belgique, l'espèce a connue une dispersion explosive et maintenant elle est répandue dans toutes les provinces, souvent très nombreuses, et parfois causant de dégâts énormes aux *Aesculus hippocastanum*, la plante nourricière des chenilles.

Key words: *Cameraria ohridella* – faunistics – Belgium.

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Since the discovery in Belgium of *Cameraria ohridella* Deschka & Dimić, 1986 (De Prins & Puplesiene 2000), this species has spread over the whole territory of the country at an enormous speed. Within one year, its presence was established in all Belgian provinces, sometimes in very high numbers, causing panic reactions to some foresters and responsible persons for the plantations in parks and along roadsides. In some cases, it was decided to simply cut down all chestnut trees (*Aesculus hippocastanum*), the larval foodplant of *C. ohridella*, in the infested zone.

In order to establish the spread and current distribution in Belgium, both authors made several journeys to different parts of the country. Furthermore, a

lot of information was obtained from various persons. In this paper, the results of all the observations are summarised.

Despite the fact that in 1999 many chestnut trees (*Aesculus hippocastanum*) in all parks around Antwerpen (a.o. Te Boelaertpark, Boeckenbergpark, Ter Rivierenhof, Nachtegalenpark) were searched for the presence of leaf mines caused by the caterpillars of *C. ohridella*, not a single mine was found. Also chestnut trees in various parks, lanes and private gardens in the north and east of the province of Antwerpen (e.g. Arendonk, Dessel, Mol, Postel) proved to be free of leaf mines. The search for leaf mines by both authors was negative in the province of East Flanders where they visited a.o. Aalst, Gent, Kruibeke, and Wetteren. A drive along the North Sea coast early July 2000 from The Netherlands to France, with visits to Brugge, Duinkerke, Knokke, Nieuwpoort, Oostende, Veurne, ended also without any result. Later in the year 2000, some single leaf mines were reported from Brugge (D. De Meyere, pers. comm.).

In the summer of 2000, the distribution in Belgium of *C. ohridella* had quite extended towards the west. The species was observed in almost all localities visited in vain before, and it was furthermore recorded in different places by various entomologists who sent detailed information.

Antwerpen: Antwerpen-City, Beerse, Berchem, Boechout, Boom, Borgerhout, Brecht, Deurne, Edegem, Ekeren, Geel, Kalmthout, Kapellen, Kasterlee, Lier, Mechelen, Merksem, Mol, Mortsel, Nijlen, Oevel, Olen, Postel, Ranst, Tongerlo, Turnhout, Wechelderzande, Westerlo, Wijnegem, Willebroek, Wilrijk, Wommelgem, Zwijndrecht

Brussel: Brussel, Laken, Meise

Henegouwen: Charleroi, Mons, Mont-sur-Marchienne

Limburg: Beringen, Diepenbeek, Genk, Hasselt, Lommel, Opoeteren, Tessenderlo, Tongeren, Voeren

Luik: Luik, Visé

Luxemburg: Arlon, Virton

Namen: Belvaux, Denée, Han-sur-Lesse, Namen, Maredsous

Oost-Vlaanderen: Aalst, Assenede, Beveren, Dendermonde, Eeklo, Gent, Kruibeke, Kruishoutem, Lokeren, Ninove, Sint-Niklaas, Waasmunster, Wetteren, Zelzate, Zomergem

Vlaams-Brabant: Aarschot, Geraardsbergen, Hofstade, Kampenhout, Leuven, Oudergem, Sint-Lambrechts-Woluwe, Sint-Martens-Latem, Tervuren, Ukkel, Vilvoorde, Zaventem

Waals-Brabant: Braine-l'Alleud, Genappe, Jodoigne, La Hulpe, Louvain-la-Neuve, Nivelles, Ottignies, Perwez, Rixensart, Walhain, Wavre

West-Vlaanderen: Brugge, Damme, De Panne, Diksmuide, Ieper, Knokke, Kortrijk, Nieuwpoort, Oostende, Poperinge, Veurne

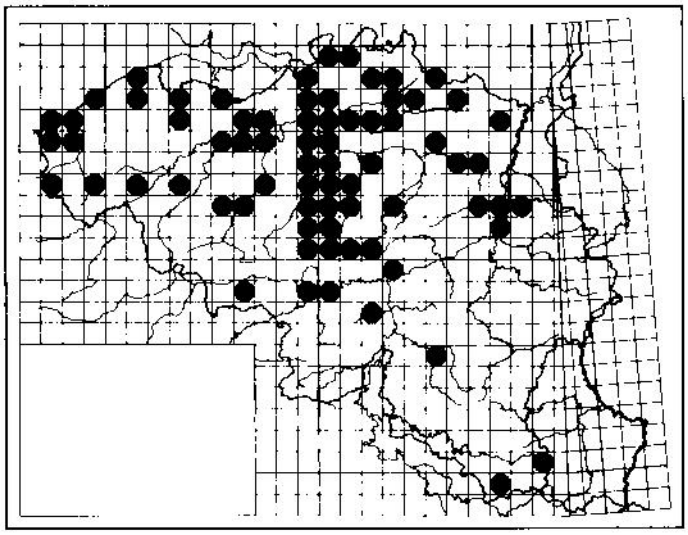


Figure 1: Distribution of *Cameraria ohridella* in Belgium (data until mid 2001).

Biology

Usually, *C. ohridella* is encountered only on *Aesculus hippocastanum*, although it has been recorded also from *Acer pseudoplatanus* and *A. platanoides* (Gregor et al. 1998, Krehan 1995, Pschorn-Walcher 1997, Hellrigl 1999). Sometimes, *Aesculus carnea* is also, though in a lesser degree, infested by *C. ohridella*. Probably due to high population density, the females of the summer generation have difficulties in finding suitable places for ovipositing. In such cases they might lay eggs on other species and races of *Aesculus* and even on other plant species, e.g. *Spiraea* sp., *Fraxinus* sp. and *Symphoricarpos* sp. (Skuhravý 1999, Stigter *et al*. 2000). The larvae on these plants, however, can not complete their development and all die.

In the National Botanical Garden of Meise, many leaf mines of *C. ohridella* were recorded from the cultivars "*Digitata*" and "*Pyramidalis*" of *A. hippocastanum*, but also on the hybrid *A.* × *plantierensis* (*A. hippocastanum* × *A. carnea*) and the Japanese species *A. turbinata* (D. De Meyere, pers. comm.). *A. californica* was infested in a much lesser degree, as were *A.* × *carnea* and its cultivars "*Briottii*" and "*Marginata*", as well as *A. indica*, *A. flava*, *A.* × *mutabilis* "*Induta*" and *A. pavia* "*Atrosanguinea*". On the contrary, *A. arguta*, *A. pavia* "*Humilis*", *A. splendens*, *A. parviflora*, *A. glabra* var. *sargentii* and *A. sylvatica* were not infested at all (D. De Meyere, pers. comm.).

The females oviposit about 30 single eggs on the upper side of chestnut leaves. The eggs hatch after about 10 days and the young larvae immediately

enter the leaf through the lower egg surface. The initial mines are comma-shaped and change to more or less rounded mines with an area of 4 to 8 cm² (Skuhravý 1998). The mines are visible as whitish to brownish blotches on the upper side of chestnut leaves, and by holding the leaf towards the sun one can easily check the presence of a *C. ohridella* larva. Older mines colour brown and especially in this stage they can easily be confused with the necrotic pattern caused by *Guignardia aesculi*, a fungal disease of the chestnut tree.

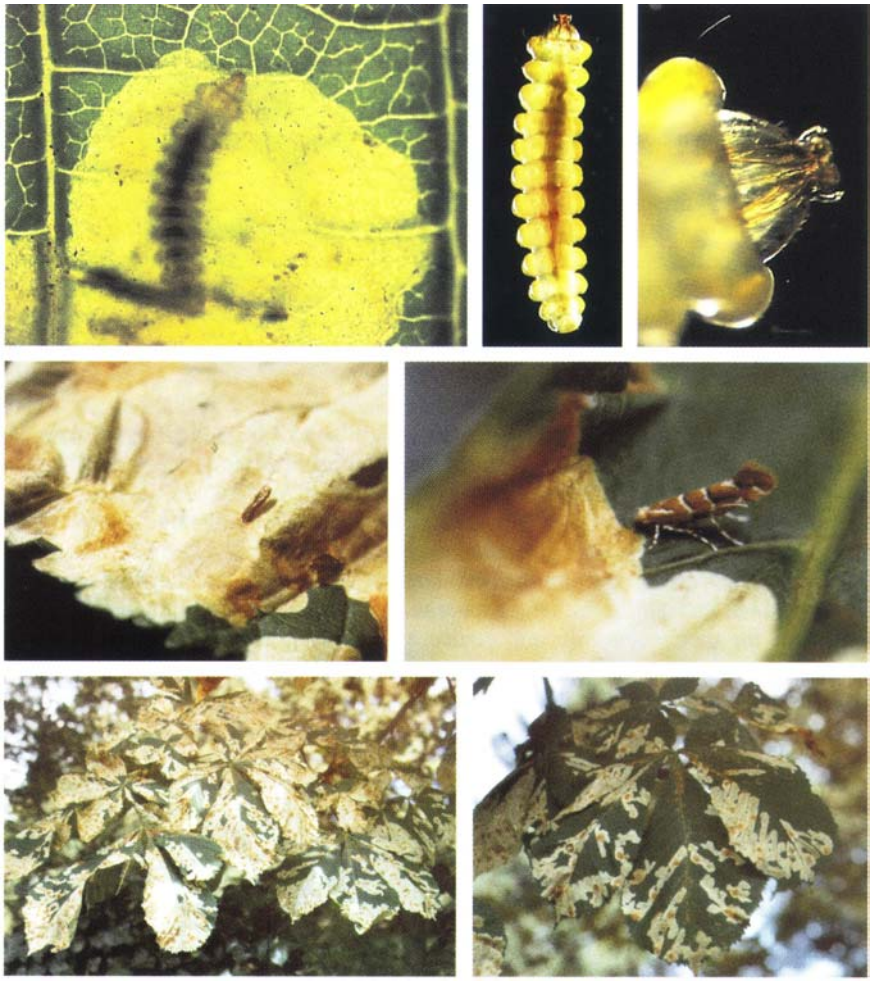
In normal circumstances, the mines do not cross the central nerves of the leaf, but when the population density is very high, they do, and they overlap with other mines. In this way, even the complete leaf surface can be covered with mines, not leaving any space for ovipositing females of the next generation. A larva has 6 instars, a prepupal and pupal stage. Before pupation, the larva constructs a round cocoon inside the mine. Especially the cocoon of the last overwintering generation is very apparently visible through the leaf and dark brown coloured.

In Central Europe, *C. ohridella* has 3 to 5 generations per year, according to the climatic circumstances. In Belgium, there are three generations per year. Adults are on the wing in April-May when the chestnut trees are blossoming. They can be found resting on tree trunks of preferably old trees. Mines are observed from the end of May till July, producing the second generation from the end of June till August. This generation is the most abundant. The moths of the third generation fly from the end of August till October. They are less common. The pupae produced by this generation hibernate in their cocoon inside the fallen leaves. In some favourable years, with warm temperatures in October-November, a (partial) fourth generation of *C. ohridella* can develop.

Parasitism

Parasitism rate is very low in *Cameraria ohridella* and this led to the assumption that *C. ohridella* is not native to the European fauna, although its type locality is Macedonia, but that it dispersed into the western Palaearctic from another area (Stigter *et al*. 2000, Šefrová & Laštůvka 2001). Anyway, some parasitoids have been recorded from *C. ohridella*, mainly species that are known to parasitise European *Phyllonorycter* species. Thus far, 19 species of Eulophidae, 1 Eupelmidae, 2 Pteromalidae and 2 Ichneumonidae have been mentioned in publications (Hellrigl 1999). In other European countries the parasitation rate is very low also. In Austria, no more than 1 to 5% of the larvae and pupae were parasitised in the studied populations of *C. ohridella,* which was established there already for 4 years. The most common parasites were *Pnigalio agraulus* Walker and *Minotetrastichus ecus* Walker (Lethmayer & Grabenweger 1997). In the Czech Republic, the parasitation rate was maximum 7% (Skuhravý 1999), which is also a very low number, taken into consideration that in most species of European *Phyllonorycter* the parasitation rate extends from 30% to well over 50% and sometimes even much higher as in the case of *Phyllonorycter leucographella* (Zeller, 1850), found at Antwerpen where about 100 mines produced the same amount of hymenopteran parasitoids.

Plate 1



1.– Last instar larva of *Cameraria ohridella* feeding inside mine on *Aesculus hippocastanum*. 2.– Last instar larva of *C. ohridella*. 3.– Head and mouthparts of last instar larva of *C. ohridella*. 4.– Mines of C. ohridella with protruding pupal skin. 5.– Adult *C. ohridella* resting near its mine. 6.– Heavily infested leaves of *Aesculus hippocastanum*. 7.– Mines of *C. ohridella* showing the larvae seldom cross the veins; brown dots are pupal chambers. All photographs were taken at Wilrijk (Belgium, prov. of Antwerpen) on 8 July 2001.

A hymenopteran species not yet recorded as a parasite of *C. ohridella*, is *Itoplectis alternans* (Ichneumonidae, Pimplinae, det. C. Zwakhals). A female specimen emerged after hibernation on 10.II.2000 from a leaf mine of *C. ohridella*, collected at Tervuren (Belgium, Vlaams-Brabant) in late autumn of 1999. The specimen of *I. alternans* was twice as small than usual sized specimens, because the caterpillar of *C. ohridella* contains much less nutritients than the normal hosts of this hymenopteran species. This case, however, shows that *C. ohridella* can be attacked by a variety of parasites normally not connected to it.

Damage and control measurements

Especially the second-generation larvae of *C. ohridella* cause a lot of damage to the leaves of *A. hippocastanum*. They can be so numerous –up to 200 mines per leaf– that the whole leaf area is covered. This causes the leaves to fall already in July, which in its turn is responsible for an important distortion of the tree's sap stream towards the buts and towards the root system (Stigter *et al*. 2000). Although "an apocalyptic extinction of the chestnut tree", as announced on several occasions in regional newspapers in Belgium, will probably never occur, while even after several years of heavy infestation in the Vienna area (Austria), no individual case of the death of a chestnut tree caused by *C. ohridella* has been fully documented, it is highly probable that old trees which are also infested by other diseases like *Guignardia aesculi*, die sooner when they are additionally infested by *C. ohridella*. But not just the death of the chestnut trees is the worry of the foresters, instead the esthetic aspect is. Chestnut trees are planted all over Europe not for their economic importance as fruit or wood producers, but for their majestic appearance in parks, gardens and lanes. It is exactly this esthetical importance that gets lost all together with the decolouration and contortion of the leaves and the early leaf fall.

Several measurements have been proposed to diminish the damage caused by *C. ohridella*. The use of insecticides has been put forward, but in many cases it has not been accepted as a desirable method, because of the secondary effects chemicals have on the environment. Indeed, many other organisms –not target species– are killed as well by most of the proposed insecticides and residual chemicals always end up in the upper earth layers, which is almost never taken into account by the decision making authorities. In Italy, for instance, different trials with products like imidacloprid (active ingredient of e.g. Admire, Confidor, or Orbid) and abamectin (active ingredient of e.g. Vertimec) were injected into the truncs of chestnut trees, giving very good results in the control of *Cameraria ohridella*, but these measurements raised at the same time a big clamour on the use of these endoxilematic methods. Similar tests with Confidor were carried out in Germany (Feemers 1997). Fortunately, in many areas in Belgium, e.g. the Brussels district, the use of chemicals against *C. ohridella* is completely prohibited.

A much nature friendlier method is the use of pheromones. The female sex pheromone of *C. ohridella* has recently been isolated (Svatoš *et al*. 1999a, 1999b) and it can now be used as an attractant for male specimens. *C. ohridella* imagos like to rest on tree trunks, mainly at lower altitudes (from 1 to 3 m), and by applying glue strips on the trunks, or by placing the pheromone capsules directly into pheromone traps which contain sticky cards, thousands of males can be collected and killed. It is improbable that with this method alone, the infestation rate of *C. ohridella* will decrease drastically. The immediate population density will decrease with the destruction of many males, but enough specimens will remain to fertilize the unaffected females. The use of pheromones is very useful to establish the flight period of the several generations.

The most successful method developed thus far is the removal of all chestnut leaves during winter and early spring. Together with the leaves, also the hibernating pupae of *C. ohridella* are removed. Compostation of the leaves or just putting them in large heaps causes the death of almost all pupae. Population density decreases with 90%, and according to studies at the University of Brussels even with 99% on the condition that all leaves are removed from the infested area. Until present, this removal of leaves is the most accurate method to keep *C. ohridella* at low densities, though it is rather labour-intensive.

Attempts to apply the use of natural enemies of *C. ohridella* have been unsuccessful thus far and the development of a commercial breeding system of parasitoids in large quantities takes a lot of time and energy. Anyway, a programme of the European Commission has been developed in order to co-ordinate all studies regarding this matter and attempts made to control the damage caused by *C. ohridella* on chestnut trees.

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