First observation of the whitefly *Aleurochiton acerinus* and armoured scale insect *Aspidiotus hedericola* in the Netherlands (Hemiptera)

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This study presents two species new to the Dutch fauna: the whitefly *Aleurochiton acerinus* and the armoured scale insect *Aspidiotus hedericola*. This raises the known number of species of *Aleurochiton* in the Netherlands to three. They are all three predominantly monophagous on three different *Acer* species. *Aspidiotus hedericola* is a monophagous Mediterranean species, feeding on *Hedera helix*. Climate change and import of plant material may have contributed to their colonisation of the Netherlands.

Introduction

During a botanical meeting at Kasteel de Berckt at Baarlo (province of Limburg) on September 8, 2018, two species of Hemiptera were found for the first time in the Netherlands: the whitefly *Aleurochiton acerinus* Haupt, 1934 (family Aleyrodidae) and the armoured scale insect *Aspidiotus hedericola* Lindinger, 1920 (family Diaspididae). On September 5, 2019 the second author observed a large population of *Aleurochiton acerinus* on smaller trees growing alongside the Roevoetsweg at Valkenburg (province of Limburg). This is a park-like area with many trees and shrubs next to an allotment complex. These new records raise the number of species of whiteflies to 14 (Jansen 2011) and species of scale insects to 72 (Jansen 2009) that can survive in the field (outside greenhouses and other buildings) in the Netherlands.

Aleurochiton acerinus

Dutch findings

Dozens of summer pupal cases (figure 1) and winter puparia (figure 2-3) of *Aleurochiton acerinus* were found on both sides of the leaves of the old *Acer campestre* trees growing alongside the road next to the castle. At the Valkenburg locality, about the same number of puparia was observed on green leaves which were still hanging on the trees and also on recently fallen yellow leaves. Almost all puparia were found on warm sunny leaves on a height of 50-200 cm. The winter puparia on both localities were quite variable: it included dark specimens and specimens covered with white wax. All specimens were dark at certain parts of the margin and were mostly found on lower branches. Although the middle and upper leaves of the trees were not inspected, it were obviously large populations. The dry and hot summer of 2018 might have contributed to the population growth.

The genus *Aleurochiton*

In Europe, the genus *Aleurochiton* consists of three species. They can be identified by their microscopic structures of the puparia, following the key of Martin *et al*. (2000). There were already two species known to exists in the Netherlands: *Aleurochiton pseudoplatani* Visnya, 1936 that lives on *Acer pseudoplatanus* and *Aleurochiton aceris* (Modeer, 1778) that can be found on *Acer platanoides* (Jansen 2011). Besides these European species, there are also two Asian species known. The five *Aleurochiton* species can be identified by the key presented by Wang et al. (2016). For identification purposes, the more easily observed winter puparia are usually used, which are relative easily to be observed. A key to the three European species of the genus *Aleurochiton* is given by Iaccarino & Tremblay (1977) for both winter and summer puparia. In addition, an extensive and detailed description of the puparial microscopic morphological structures (figure 4) is given by Rapisarda (1982). In contrast to *A. aceris* and *A. acerinus* which have two generations within a year, *A. pseudoplatani* usually has one generation due to their relative slower developmental time (Müller 1962).

Host plants

Aleurochiton acerinus is considered a monophagous feeding on *Acer campestre*. However, it is also recorded feeding from other *Acer* species. Kozár & Bink-Moenen (1988) observed puparia on *A. tataricum* in Bulgaria and Hungary, Evans (2008) documented *A. insigna* as a host, and phytosanitary interceptions in the United States were made on *A. platanoides* on plant material originating from Hungary and on *A. saccharinum* originating from the United Kingdom (Evans 2008).

Distribution

Although *A. acerinus* occurs in many European countries, there is only a restricted number of known localities (Zahradnik

1. *Aleurochiton acerinus*, summer puparium. Kasteel de Berckt, Baarlo (province of Limburg), 8.ix.2018. Photo: Maurice Jansen
1. *Aleurochiton acerinus*, zomerpop. Kasteel de Berckt, Baarlo (Limburg), 8.ix.2018.

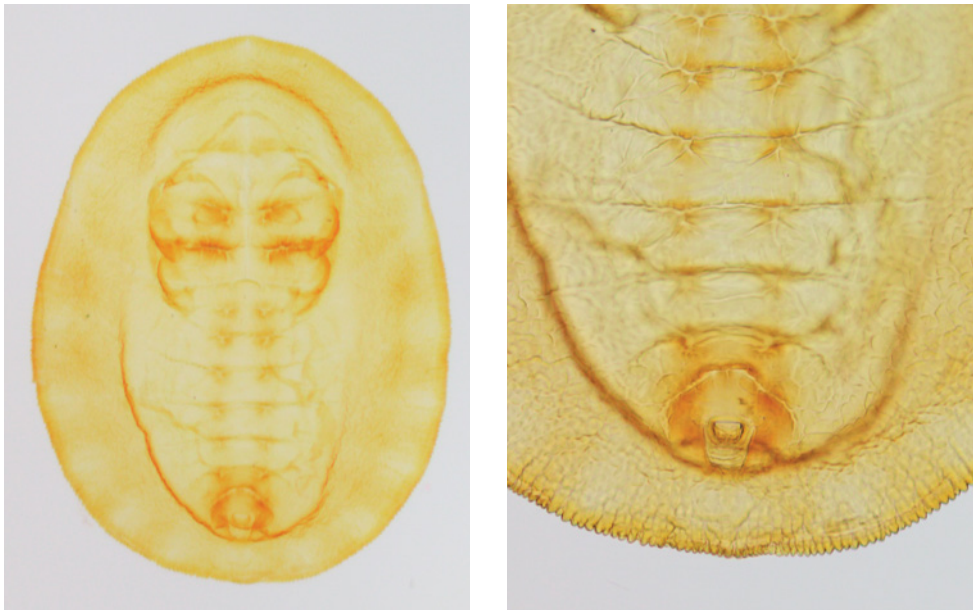
1991). The species is apparently more common in the warmer southern parts of Europe than in the northern ones (Martin *et al*. 2000). It is reported to occur in Austria, Bulgaria, Croatia, the Czech Republic, England, France, Sardinia, Germany, Hungary, Iran, Italy (including Sardinia and Sicily), Poland, Rumania, Serbia and various countries of the former USSR (Danzig 1964, Dobreanu & Manolache 1969, Dolling & Martin 1985, Evans 2008, Haupt 1934, Iaccarino & Tremblay 1977, Rapisarda 1982, Šimala 2008, Zahradnik 1963). The discovery of *A. acerinus* is in line with the range expansion of other insect species associated with *Acer campestre* and other host plants such as *Stigmella louisella* (Sircom, 1849), *S. aceris* (Frey, 1857) (Van Nieukerken et al. 2006) and *Psallus (Hylopsallus) assimilis* Stichel, 1956 (Aukema & Hermes 2014) that recently moved and established in Western Europe. The host plant *Acer campestre* is native to the Netherlands, and occurs alongside the rivers Maas and IJssel, the province of Limburg and the regions Twente and Achterhoek, (Weeda *et al*. 1988). The spread of insects feeding on this host may have occurred due to the planting of *Acer* trees in public green and private gardens in the Netherlands. Moreover, climate change may have contributed to the ability of *A. acerinus* to survive in the Netherlands, since the species is more common in southern parts of Europe.

Life cycle

Aleurochiton acerinus has two generations. The adults emerge at the end of July - early August and the second generation emerges in September. During winter, it survives as robust 'winter puparia' on senescing and fallen leaves from which the adults emerge in May. The puparia of the first generation (figure 1) are present in July and those of the second generation (figure 2-3) are present in September and overwinter. The puparia of the first generation are therefore called summer puparia and those of the second generation winter puparia. The morphology of puparia of the genus is unusual in showing marked puparial dimorphism. The summer puparia have a thin and pale cuticle, whereas the overwintering ones are robust and more sclerotic and have a thick coating wax, which is absent in summer forms. Müller (1962) observed the life-cycle during a two-year period and found not only many summer puparia around mid-July as expected, but also found that 12-18,5% of the puparia were winter puparia. Also, among the winter puparia in September, he found that 1.4% of them were summer puparia. He suggested an earlier development of certain individuals in May and June which causes an overlap in summer and winter puparia later in the season.

2. *Aleurochiton acerinus*, variation in the colorization of winter puparia. Kasteel de Berckt, Baarlo (province of Limburg), 8.ix.2018. Photos: Maurice Jansen
2. *Aleurochiton acerinus*, variatie in de kleur van de winterpoppen. Kasteel de Berckt, Baarlo (Limburg), 8.ix.2018.

3. *Aleurochiton acerinus*, variation in the colorization of winter puparia. Valkenburg (province of Limburg), 5.xi.2019. Photos: Wietse den Hartog
3. *Aleurochiton acerinus*, variatie in de kleur van de winterpoppen. Valkenburg (Limburg), 5.xi.2019.



4. *Aleurochiton acerinus*, microscopic view of a winter puparium: (a) overall view; (b) detail of abdomen. Kasteel de Berckt, Baarlo (province of Limburg), 8.ix.2018. Photos: Maurice Jansen
4. *Aleurochiton acerinus*, microscopisch beeld van een winterpop: (a) het gehele beest; (b) detail van het achterlijf. Kasteel de Berckt, Baarlo (Limburg), 8.ix.2018.

5. *Aspidiotus hedericola* scales of adult females on a leaf of *Hedera helix*. Kasteel de Berckt, Baarlo (province of Limburg), 8.ix.2018. Photo: Maurice Jansen
5. *Aspidiotus hedericola*, schildjes van volwassen vrouwtjes op een klimopblad. Kasteel de Berckt, Baarlo (Limburg), 8.ix.2018.

6. *Aspidiotus hedericola* microscopic view of an adult female. Kasteel de Berckt, Baarlo (province of Limburg), 8.ix.2018. Photo: Maurice Jansen
6. *Aspidiotus hedericola* microscopisch beeld van een volwassen vrouwtje. Kasteel de Berckt, Baarlo (Limburg), 8.ix.2018.

Aspidiotus hedericola

Dutch findings

A large population of the diaspid *Aspidiotus hedericola* was found on the leaves of *Hedera helix*, growing on a wall at the courtyard of Kasteel De Berckt at Baarlo (province of Limburg). The female scale is flat, yellowish white, circular and with central exuvia (figure 5). Thirty Diaspididae are listed from *Hedera helix* worldwide (García-Morales *et al.* 2016). The species is identified using the descriptions and keys of microscopic morphological structures (Balachowsky 1948, Ferris 1946). The species resembles *Aspidiotus nerii* Bouché, 1833 but the pygidial ducts of *A. hedericola* are much longer and only half as long as the distance from the bases of the anal lobes to the anus (figure 6). Another difference compared to the related *A. nerii* is the last plates (P4) which are relative wide in *A. hedericola* but slender in *A. nerii*. In addition, the perivulvar pores of *A. hedericola* are situated more towards the cephalic margin of the pygidium than in *A. nerii* (Bodenheimer 1952). Little is known about its biology and phenology and how it propagates (Schmutterer & Hoffmann 2016).

Host plants

Aspidiotus hedericola lives almost exclusively on *Hedera helix* and was only once recorded from *Laurus nobilis* (Kaydan *et al.* 2013).

Distribution

The species is known to occur in eight Mediterranean countries: Croatia, Cyprus, Greece (only from the mainland), Italy, Lebanon, Malta, Spain and Turkey (García Morales *et al.* 2016). In addition, Schmutterer (2016) recorded two sites in Germany, one in the South of Germany at Windsheim (Bayern) and the other at Bochum (Nordrhein-Westfalen) which is at about similar latitude and about 80 km to the East from the Dutch locality. In some countries the species may have been overlooked. In Croatia it is only known from old literature records and could not be traced during years of intensive searching (Masten Milek 2007). It is unknown how the species has spread to the German and Dutch localities.

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Samenvatting

Eerste waarneming van de wittevlieg *Aleurochiton acerinus* en de schildluis *Aspidiotus hedericola* in Nederland (Hemiptera)

In 2018 zijn de wittevlieg *Aleurochiton acerinus* Haupt, 1934 en de schildluis *Aspidiotus hedericola* Lindinger, 1920 voor het eerst in Nederland waargenomen. Beide soorten werden aangetroffen tijdens een botanische excursie op en langs Kasteel de Berckt te Baarlo, Limburg. Tientallen winter- en zomerpoppen van *Aleurochiton acerinus* werden aangetroffen op de bladeren van veldesdoorn *Acer campestre* die daar langs de weg staan. Daarnaast werd deze soort ook in het openbaar groen aangetroffen in Valkenburg, Zuid-Limburg. Er zijn in Europa drie soorten van het genus *Aleurochiton* bekend, waarvan er twee al gemeld waren uit ons land. Deze derde is een Midden-Europese soort, die zijn areaal dus heeft uitgebreid. De schildluis *Aspidiotus hedericola* werd aangetroffen op klimop *Hedera helix*. Het is een mediterrane soort die al twee keer in Duitsland was aangetroffen, met Bochum (Noordrhein-Westfalen) als noordelijkste vindplaats. Beide soorten kunnen waarschijnlijk nu in Nederland gedijen vanwege de gemiddeld warmere zomers van de laatste jaren. Door deze vondsten komt het aantal soorten wittevliegen dat buiten in ons land voorkomt op 14 en het aantal schildluizen op 72.

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