Occurrence, ecology and potential impact of the New Zealand wheat bug *Nysius huttoni* White (Hemiptera: Lygaeidae) in Belgium

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Title

Occurrence, ecology and potential impact of the New Zealand wheat bug *Nysius huttoni* White (Hemiptera: Lygaeidae) in Belgium

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Abstract

In 2002 the New Zealand wheat bug *Nysius huttoni* White was observed for the first time in the Netherlands and Belgium. The introduction of *N. huttoni* to our regions presumably occurred via overseas transport of apple and kiwi fruits from New Zealand. Laboratory experiments showed that both eggs and adults of *N. huttoni* were capable of surviving cold conditions similar to those in overseas transportation. Specimens were sampled in Belgium and the Netherlands, and a DNA sequence analysis indicated a 100% similarity with *N. huttoni* material collected in Christchurch, New Zealand. The distribution of the lygaeid in Belgium in 2008 was studied based on a systematic sampling at 105 locations. The bug had been able to spread over most of the Belgian territory, with the exception of the most southern and eastern provinces. Given the poor flight capacity of Belgian *N. huttoni* populations, other methods of dispersal may be involved. *N. huttoni* occurred primarily in ruderal habitats, and its weedy host plants belong to very common plant families. Several observations support *N. huttoni* not being a threat for agricultural crops in Belgium under the present conditions of climate and soil usage.

Text

The New Zealand wheat bug, *Nysius huttoni* White 1878, is endemic to New Zealand and occurs there throughout the country from sea level up to an altitude of 1800 m (Gurr, 1957; Eyles & Ashlock, 1969). It is a very polyphagous insect (Gurr, 1957) and can feed on almost any cultivated herbaceous plant, as well as on a variety of weeds (Eyles, 1965). In New Zealand, the pest has been noted to be capable of causing severe economic damage to various agricultural crops, including wheat (*Triticum aestivum* L.) (Swallow & Cressey, 1987) and brassica crops (Ferguson, 1994). *Nysius huttoni* appears to only migrate to these crops in extremely dry years, occurring approximately once every ten years in New Zealand (Swallow & Cressey, 1987). The insect has frequently been reported as a hitchhiker in commercial apple consignments for export (Birtles *et al.*, 1992; Lay-Lee *et al.*, 1997), posing a major quarantine risk to countries that trade with New Zealand (He *et al.*, 2003). In 2002, this exotic lygaeid bug was observed for the first time in the southwest of The Netherlands. A year later the first individuals were found in the

adjacent north-western part of Belgium (Oost-Vlaanderen) on weeds (Aukema *et al.*, 2005). In 2006 the insect was added to the EPPO Alert List, but the pest is currently not regulated in Europe.

Adults of *N. huttoni* are characterised by the long erect pubescence of the pronotum, scutellum, corium and clavus and by the double row of punctures along the claval suture (Eyles & Ashlock, 1969; Aukema *et al.*, 2005). A more detailed description of the species is given by Eyles (1960) and Eyles & Ashlock (1969). There is a large phenotypic variability in this species, with regard to body length (males: 2.47 - 4.34 mm; females: 2.38 - 3.86 mm), colour and pubescence. Further, three morphs have been described based on wing morphology: macropterous, submacropterous and brachypterous individuals (Eyles, 1960; Eyles & Ashlock, 1969). Given the variable morphology of *Nysius huttoni* and since other *Nysius* spp. are known to occur in our area (Smit *et al.*, 2007), the identity of the Belgian populations was confirmed using genetic markers. Based on a fragment of the cytochrome oxidase subunit I gene of the mtDNA (Simon *et al.*, 1994), a polymerase chain reaction (PCR) analysis was carried out. The DNA sequence analysis showed a 100% similarity between *N. huttoni* material from Christchurch, New Zealand, and *Nysius* specimens sampled in several Belgian provinces and in Hulst, The Netherlands.

Based on a systematic sampling at 105 Belgian locations in 2008, it was clear that the bug had been able to spread over the entire region of Flanders, with the exception of Limburg, and into the provinces Hainaut and Brabant Wallon in the Walloon region since it was first recorded in 2003 (Fig. 1). It is assumed that the species will continue to spread in Belgium and the neighbouring areas. *Nysius huttoni* was likely introduced to our area via overseas transport of apple and kiwi fruits originating from New Zealand. However, its exact point of entry is not known and the bug was never intercepted during phytosanitary inspections in Belgium. Laboratory experiments indicated that 84.4% of adults and 36.8% of eggs of *N. huttoni* were capable of surviving conditions similar to those in overseas transportation (i.e. complete darkness at 0° C) for 5 weeks.

The bug usually hibernates in Belgium as an adult from October-November to March. In order to find sufficient shelter, *N. huttoni* overwinters in acrocarpous mosses (Aukema *et al.*, 2005), litter, under stones (Eyles & Ashlock, 1969) and behind the bark of trees (e.g. *Platanus* sp.). Temporal overlap of different generations occurs (Wei, 2008) and the number of generations depends on the local temperature as affected by soil type and microclimate conditions. While 2 to 4 generations of *N. huttoni* occur each year in New Zealand, the Belgian climate limits its number of annual generations to 2 to 3. During monitoring in Belgium in 2008, several population characteristics of the species were determined. The sex ratio of 576 *N. huttoni* adults, collected in Kallo, Oost-Vlaanderen, was 1:0.79 (male:female). Despite its rapid spread in Belgium, only 19.1% of the collected adults were macropterous and thus capable of flying. In contrast, data collected from several locations in New Zealand indicate that over 90% of the adults were macropterous (Wei, 2001). As wing morphology depends on temperature and day length (Wei, 2001), these results suggest that the Belgian climate is not optimal for full wing development of *N. huttoni*. Moreover, flight initiation reportedly requires temperatures of around 30° C (Wei, 2001), which are less common in Belgium. Thus, only for a small fraction of the population spread can be attributed to flight capacity of adults and other methods of dispersal may be involved.

During this study, no natural enemies of *N. huttoni* were observed. Equally, no natural enemies have been described in New Zealand, except for occasional predation by starlings (*Sturnus vulgaris* L.) (Lobb & Wood, 1971).

Ecosystems in which *N. huttoni* have been located include dry habitats containing mosses, pebble substrates and habitats with limited ground cover containing common weedy host plants. These often represent ruderal habitats like abandoned or building sites, parking sites, driveways, road taluses and street sides. There is a long list of host plants recorded in Belgium, although most of those belong to the following plant families: Asteraceae, Poaceae, Caryophyllaceae, Geraniaceae, Brassicaceae and Leguminosae. Because these are all very common plant families in Belgium, especially in ruderal habitats, it can be concluded that the availability of host plants does not restrict the habitat choice of *N. huttoni*. The presence of acrocarpous and pleurocarpous mosses, on the other hand, appears to be preferred, mainly because they provide shelter for this ground dwelling insect throughout the year.

Several arguments support *N. huttoni* not being a threat for agricultural crops in Belgium at present:

- Only 14% of the locations where *N. huttoni* was found were situated near agricultural fields, suggesting that arable land does not belong to its preferred habitats. Moreover, no observations of the wheat bug were made in the crops.

- In laboratory experiments, mangel-wurzel (*Beta vulgaris* L.), rapeseed (*Brassica napus* L.) and wheat (*T. aestivum*) only suffered damage at high densities of *N. huttoni* which are unlikely to occur in Belgium.

- In summer the species can acquire sufficient food when solely exploiting common weeds.

However, the conclusions on the potential plant health impact of *N. huttoni* only apply to its current population densities in Belgium. Shifts in soil usage and climate change may influence the future abundance and distribution of the bug, necessitating the continued monitoring of this exotic species in our area.

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Distribution of *N. huttoni* in Belgium in 2008

Figures