# CSL PEST RISK ANALYSIS FOR *Nysius huttoni*

## STAGE 1: PRA INITIATION

### 1. What is the name of the pest?

*Nysius huttoni* White, Heteroptera, Lygaeidae, wheat bug

Notes on taxonomy:
An extremely variable species, with three inter-breeding forms based on the extent of wing development (Aukema *et al.*, 2005).

### 2. What is the reason for the PRA?

Aukema *et al.*, (2005) reported that *N. huttoni* had been present in the Southwest of the Netherlands (Zeeland) and the adjacent North-western part of Belgium (West and Oost Vlaanderen and Brabant) since 2002. EPPO placed this species on their Alert List in February 2006.

### 3. What is the PRA area?

The United Kingdom.

## STAGE 2: PEST RISK ASSESSMENT

**4. Does the pest occur in the PRA area or does it arrive regularly as a natural migrant?**
No.

**5. Is there any other reason to suspect that the pest is already established in the PRA area?**
No. However, there are very few specialists who would recognise this species as new to the UK.

**6. What is the pest's status in the Plant Health Directive (Council Directive 2000/29/EC[1])?**
Not listed.

[1] http://europa.eu.int/eur-lex/en/consleg/pdf/2000/en_2000L0029_do_001.pdf

**7. What is the pest's status in the European and Mediterranean Plant Protection Organisation (EPPO)?** (www.eppo.org)

| EPPO List: | A1 regulated pest list | | A2 regulated pest list | | Action list | | Alert list | √ |
|---|---|---|---|---|---|---|---|---|

**8. What are the pest's host plants?**
EPPO (2006) reports that "*N. huttoni* is a polyphagous species which feeds on a large number of weeds and crops. In New Zealand, it is mainly reported as a pest of wheat and Brassicaceae, but it can feed on many plant species. It can attack: *Brassica* spp., *Medicago sativa* (lucerne or alfalfa), *Trifolium dubium, T. pratense, T. repens* (clovers), and Poaceae such as: *Avena sativa* (oat), *Bromus*, *Hordeum sativum* (barley), *Lolium*, *Secale cereale* (rye), *Triticum aestivum* (wheat). The following weeds have been reported as hosts: *Anagallis arvensis*, *Calandrinia caulescens*, *Capsella bursa-pastoris*, *Cassinia leptophyla*, *Chenopodium album, Coronopus didymus*, *Hieracium*, *Polygonum aviculare, Rumex acetosella, Senecio inaequidens, Silene gallica, Soliva sessilis, Spergularia rubra, Stellaria media*. It is also suggested that the presence of mosses (e.g. *Ceratodon, Sphagnum, Polytrichum* spp.) may be crucial for the overwintering period." Aukema *et al*. (2005) found this species on *Senecio inaequidens* and in association with dead remains and seeds on *Polygonum maculosa*. He *et al*., (2002) found that sunflower seeds (*Helianthus annuus*) enhanced sexual maturation and egg production, and significantly increased adult body weight, fecundity and the number of viable offspring produced. The detection on lettuce by the USDA (1962) suggests that this can also be a host.

Gurr (1957), Ferro (1976) and Scott (1984) suggest that strawberry and raspberry are also attacked but Farrell and Stufkens (1993) consider the presence of adults on strawberries and kiwifruit to be simply a contamination problem. It is stated that it is not a pest of apples although it has been found in consignments (Birtles *et al*., 1992; AFFA, 2004; CABI, 2006). However, AFFA (2004) refers to a New Zealand Horticulture and Food Research Institute 1999 publication at a web site that has now changed when stating that "there is limited evidence that wheat bug damages fruit in commercial orchards, particularly in Canterbury. Fruit damage is characterised by a pimple, often within a shallow depression. More severe fruit distortion is suspected if the wheat bugs cause damage during the flowering period."

Sweet (2000) noted (a) that there are no confirmed records on native New Zealand species, (b) that, although *N. huttoni* can feed on many species, it is not clear whether some species are critical for completing its life cycle and (c) the surprising paucity of records on grasses other than wheat.

From the above, it would seem that, as a highly polyphagous bug, *N. huttoni* may have preferred host plants but can feed on a very large number of species, including fruit, if it happens to become included in shipments.

 

## 9. What hosts are of economic and/or environmental importance in the PRA area?

Wheat, Brassicaceae (especially rape, turnip, swede and cabbage), clover, and lucerne. Fruit (strawberries, raspberries, kiwifruit and apples) may also be injured.

## 10. If the pest needs a vector, is it present in the PRA area?

No vector is required. This is a free-living organism.

## 11. What is the pest's present geographical distribution?

| **Table 1: Distribution of *Nysius huttoni*** | |
|---|---|
| North America: | Absent – no records |
| Central America: | Absent – no records |
| South America: | Absent – no records |
| Europe: | Belgium (West and Oost Vlaanderen and Brabant), Netherlands (Zeeland) |
| Africa: | Absent – no records |
| Asia: | Absent – no records |
| Oceania: | New Zealand (North and South Islands, Stewart Island, Chatham Island and Three Kings Island) |

Sources: Aukema *et al.*, 2005; Eyles & Ashlock,1969

## 12. How likely is the pest to enter the PRA area?

| Very Unlikely | Unlikely | Moderate likelihood | Likely | Very Likely |
|---|---|---|---|---|
| | √ | | | |

As a polyphagous species that often shelters in dark places, *N. huttoni* could enter the UK in packaging or consignments of plants and produce from: (a) New Zealand or (b) the Netherlands or Belgium. Both pathways are **unlikely**.

Although *N. huttoni* has colonised the Netherlands and Belgium and has been intercepted in very low numbers over the years in fruit by the USA and Australia, there is a very low probability that adults will pass successfully through all steps in such pathways from New Zealand.

At present, the Dutch and Belgian populations of *N. huttoni* are confined to dry, warm waste ground and roadsides with sparse vegetation. One abandoned agricultural field in Belgium had very high densities (84 males and 78 females in two square metres). A survey will be carried out this summer (2006) to confirm its absence from crops (Wiebe Lammers, personal communication). Until this species is found in crops, there will be no clear pathway for entry to the UK. Although this species is found on the Belgian coast, is capable of local flight and the Belgian-Dutch findings may have all come from Antwerp (furthest distance from Antwerp recorded by Aukema et al., (2005) is de Panne, 200 km from Antwerp), spread is likely to have been by a series of short annual movements and there is no evidence that it is capable of the long sustained flight needed to cross the English Channel. From de Panne on the Belgian coast to Kent is 135 km.

Additional information on entry pathways is given below:

- The findings in the Netherlands and Belgium provide the only records that this species can enter and become established other countries. These locations are close to the port of Antwerp and it is suspected that this species entered through there on shipments from New Zealand (EPPO, 2006).
- No notifications of UK or EU interceptions on traded commodities have been located. Two live *N. huttoni* were found in a soil sample submitted to the Harpenden Laboratory for nematode testing in 1979. The samples were taken from a consignment of soil being sent to the Department of Soil Science at the University of Reading. The consignment was of a soil called 'Rangitoto' and originated in New Zealand (Motutapu Island). Due to the large numbers of nematodes, which were also found in the samples, it was decided that the main soil consignments were to be fumigated with methyl bromide before being sent to the UK.
- It has been intercepted by the USDA on apple and lettuce from New Zealand in 1955 and 1962 (USDA, annual reports). In 1981-1987, USDA intercepted *N. huttoni* 16 times, an average of about three a year, on kiwifruit, strawberry, peach, rosemary, anemone and *Lophomyrtus* (USDA annual reports). Between 1996 and 2000, Australia (AQIS) intercepted *N. huttoni* on 3 occasions (one each on persimmon, peach and nectarine) (New Zealand MAF, 2004).
- It has been seen at pre-clearance on apples destined for export to the USA from New Zealand (AFFA, 2004). New Zealand MAF (2004) stated that: "in 2002, 650 lots of fruit were exported and typically a sample of 250 cartons was inspected from each, i.e. approximately 16 million apple fruit inspected out of 400 million entering the programme, and only 3 wheat bug adults were detected. In 2000 the number was 5, and in 2001 it was 3." The Australian Import Risk Analysis for apples from New Zealand (AFFA, 2004) concluded that the probability of *N. huttoni* importation from one year of trade in apples was "very low" because:
    - *N. huttoni* generally lives on weeds close to the ground, very rarely damages fruit in commercial orchards and has a very low chance of being present in apple trees.
    - There is a low chance of fruit in bins awaiting sorting in pack-houses being contaminated
    - There is a very low chance of surviving washing, brushing, waxing, sorting, grading and packaging procedures, though it could remain dormant during temporary cold storage.
    - There is a negligible likelihood of *N. huttoni* being present in clean, packed fruit.
    - Any *N. huttoni* that remain in clean packed fruit have a high probability of survival and remaining undetected during palletisation, quality inspection, containerisation, transportation to Australia and inspection on arrival. However, when fully unpacked, detection is likely because the bugs are highly mobile and move when disturbed.

  However, New Zealand MAF (2004) commented that the risk of entry with apples should be reassessed as "extremely low" based on the rarity with which it is found in apple orchards and inspections of apples for export to the USA, packing house operations and the very low numbers of Australian (AQIS) interceptions on other fruits. *N. huttoni* was not considered further in the IRA for apples from New Zealand revised in 2005 because “Any risks associated with these contaminants would be managed under existing policies that already require inspection of imports and appropriate treatment” (AFFA, 2005).

**13. How likely is the pest to establish outdoors in the PRA area?**

| very Unlikely | Unlikely | Moderate likelihood | Likely | very Likely |
|---|---|---|---|---|
| | | | | √ |

Establishment is **very likely** because (a) the climate in the south-east of England is similar to that in southern Netherlands and Northern Belgium, (b) *N. huttoni* is found throughout New Zealand where many areas have a comparable climate to that in the UK and (c) *N. huttoni* is highly polyphagous and many host plants are present in the UK.

Further information on factors influencing establishment is given here:

- It is found throughout New Zealand from coastal locations up to 1830 m on the Kirkliston Range in South Island (Eyles & Ashlock, 1969). It has 2-3 generations per year; two generations occur in South Island (Farrell & Stufkens, 1993).

- It prefers hot, dry conditions where direct sunlight strikes the ground. Rain inhibits activity. The largest populations are found in the driest districts of New Zealand: South Canterbury and Central and North Otago and in dry years (Gurr, 1957).

- It overwinters as a diapausing adult in New Zealand, often in aggregations under vegetable debris, gorse hedges and pine bark and at the base of weeds and grass (Farrell & Stufkens, 1993). At least, in some parts of its range, true diapause does not seem to occur and the species may bask on warm days and can quickly complete its life cycle if brought into the warmth (Eyles, 1965).

- He *et al*. (2003) studied in detail the temperature requirements for development and reproduction. Although no bugs completed their life cycle at 15ºC, the low temperature threshold was estimated by linear regression to be 11.9ºC with 625 degree days needed above this threshold for each generation. The greatest egg and nymph survival was at 20ºC.

**14. How likely is the pest to establish in protected environments in the PRA area?**

| very Unlikely | Unlikely | Moderate likelihood | Likely | very Likely |
|---|---|---|---|---|
| √ | | | | |

Not recorded in protected environments.

**15. How quickly could the pest spread within the PRA area?**

| very Slowly | Slowly | Moderate pace | Quickly | very Quickly |
|---|---|---|---|---|
| | √ | | | |

There is no evidence that, by itself, *N. huttoni* flies further than short distances to find food or search for overwintering sites. Farrell & Stufkens (1993) studied flight activity to overwintering sites and into crops. Despite using the term “migration”, there is no evidence of long distance, directional movement. Rapid, long distance spread is therefore dependent on its being able to hitch-hike with the crop or packaging. Until it has been found associated with crops in Europe, it can therefore be assumed that *N. huttoni* will move **slowly** in the PRA area.

If *N. huttoni* arrived in Europe at the port of Antwerp, then it has moved up to 200 km (see 12. above). Although it was first found in 2002 (Aukema et al., 2002) we do not know when it first arrived in Europe and therefore how long its has taken to spread that distance.

**16. Without official control, what level of economic and/or environmental impact is the pest likely to cause in the PRA area?**

| minimal | minor | moderate | major | massive |
|---|---|---|---|---|
| | √ | | | |

Dutch and Belgian surveys to be carried out this year (Wiebe Lammers, personal communication) will confirm whether *N. huttoni* has invaded any crops. However, until now, European populations are confined to waste ground, roadsides and abandoned fields (Aukema et al., 2005). In New Zealand, *N. huttoni* is only a significant pest of wheat on average every ten years when dry conditions cause it to move from field margins and waste ground to the crop. Brassica seedlings (rape, swede, turnip, cabbage etc) are more vulnerable. No particular impacts on export markets appear to have occurred in New Zealand, the Netherlands or Belgium despite it being a quarantine pest at least in the USA and Mexico. However, partly because of *N. huttoni*, pre-clearance procedures for apples are required for the American market. Australia has now withdrawn this species from their import risk analysis for apples from New Zealand (AFFA, 2005), but this did not stop an outcry when news of *N. huttoni*’s arrival in Europe was picked up by the media (Anonymous, 2006).

While this judgement is highly uncertain, it would seem that *N. huttoni* would currently be a **minor** pest in the UK because:

- There’s as yet no evidence that it will invade crops in Europe
- Damage to wheat in New Zealand only occurs in hot, dry years which are likely to occur more rarely in the UK
- Young brassica crops will be vulnerable, but the high temperatures and dry conditions preferred by *N. huttoni* rarely occur in the UK and alternative weed hosts will always be plentiful.
- Export markets are unlikely to be affected.

Additional information is given below:

- "This insect does not normally feed on cereals but in drought conditions when their usual source of food is in short supply they will feed on wheat grain in the milk-ripe stage. The wheat bug has sucking mouthparts, which pierce through the glumes into the developing grain. When feeding, saliva is injected into the grain through one stylet and nutrients sucked out through the other. The saliva contains an enzyme, which can bring changes in the flour protein when the grain is milled. This enzyme rapidly breaks down the dough structure, producing a runny sticky mess that is quite unusable. Damaged grain therefore has a poor baking score. Only a very low percentage of the grain in a line needs to be damaged (3-4 grains/1000) to make the whole line unsuitable for baking" (Ferro, 1976). "As little as 1% of "bugged" wheat used in the production of flour has made it unusable for baking", though "bug damage does not seem to affect germination" (Gurr, 1957). "A 3% content is sufficient to produce poor-quality bread" (Sweet, 2000). Recently, Bonet *et al*., (2005) have managed to restore gluten functionality following bug protease induced gluten hydrolysis but the implications of this for wheat damaged by *N. huttoni* are uncertain.
- Early in the season, *N. huttoni* is mostly found on weeds but it moves to wheat when the grain is in the "milk-ripe" stage because most weeds have by then matured and died off. Since weeds are generally smothered by the crop as it grows, they are usually confined to the edges of wheat fields. The weed: crop ratio is therefore greatest in small plots, where damage is more noticeable (Gurr, 1957). Early ripening varieties, e.g. karamu, are most vulnerable (Ferro, 1976; Scott, 1984), though this variety often has weak dough properties, mimicking wheat bug damage (Swallow & Cressey, 1987). In 1970, 10,000 tonnes of wheat were damaged. Between 1936-1960 there were two major outbreaks and four major outbreaks between 1961-1986 (Swallow & Cressey, 1987).
- "*N. huttoni* also does considerable damage to young cruciferous crops. Feeding punctures are made around the stems of the seedlings at ground level and cause a cankerous growth of the tissue. This interferes with the sap flow and often results in the collapse of the plant" (Gurr, 1957). This growth may lead to ring-barking so the seedling stems break in high winds (Ferro, 1976; Scott, 1984). Seventy percent of swede seedlings have been lost through wind breakage associated with *N. huttoni* (He & Wang, 1999).

**17. What is the pest's potential as a vector of plant pathogens?**

There are no records of *N. huttoni* as a vector of plant pathogens.

**<u>STAGE 3: PEST RISK MANAGEMENT</u>**

**18. What are the prospects for continued exclusion from the PRA area?**

| Outdoors: | very Likely | | Likely | √ | Moderate likelihood | | Unlikely | | very Unlikely | |
|---|---|---|---|---|---|---|---|---|---|---|

| In protection | very Likely | √ | Likely | | Moderate likelihood | | Unlikely | | very Unlikely | |
|---|---|---|---|---|---|---|---|---|---|---|

Although conditions are highly suitable for establishment, entry is currently unlikely.

**19. How likely are outbreaks to be eradicated?**

| very Likely | | Likely | | Moderate likelihood | | Unlikely | √ | very Unlikely | |
|---|---|---|---|---|---|---|---|---|---|

As in Belgium and the Netherlands, first findings are likely to be away from the crop itself feeding on weeds in field margins, hedges, fallow and set-aside fields, waste ground and roadsides. Eradication in such areas would be extremely difficult.

**20. What management options are available for containment and control?**

It is notoriously difficult to control because it feeds on weeds not only in the crops but also in waste ground, roadsides etc (Sweet, 2000). Only starlings (*Sturnus vulgaris*) are reported as biological pest control agents, though chrysopids and coccinellids are potential predators (Sweet, 2000). Dicrotophos, trichloronate, chlorpyrifos and a mixture of omethoate and azinphos-ethyl gave equivalent control on brassicas (Sweet, 2000). Of these, only chlorpyrifos is available in the UK, and is used for controlling cabbage root fly for example.

Insecticides are used to control a variety of brassica pests in the UK, including aphids (*Brevicoryne brassicae* and *Myzus persicae*), moth and butterfly caterpillars (*Plutella xylostella, Pieris brassicae, P. rapae* and *Mamestra brassicae*) and whiteflies. A survey of pesticide usage on brassicas in the UK (Garthwaite *et al.*, 2003) found that crops received, on average, three insecticide sprays, with over half (53%) of the crops treated. Aphids were the main targets of insecticide applications, and two chemicals – lambda cyhalothrin and pirimicarb – were most commonly used. Other insecticides applied, included deltamethrin, triazamate and cypermethrin. Some brassicas were seed treated with insecticides, including chlorpyrifos (16% of total) and the systemic, imidacloprid (9%).

The specific aphicides, primicarb and triazamate, will provide no control of Nysius bugs, but the more broad-spectrum pyrethroid insecticides – particularly deltamethrin – would be expected to provide some control of this heteropteran. Likewise, the chlorpyrifos seed treatments would be expected to provide control in brassica seedlings, although the majority of crops do not treated in this way.

The same range of insecticides listed above is also used for controlling pests such as the cabbage root fly (*Delia radicum*) and brassica flea beetles (*Phyllotreta* sp.) on root crucifers such as Turnips and Swedes. Typically, two insecticides sprays are applied on average to these potential hosts for *N. huttoni*, and those containing deltamethrin and chlorpyrifos would be expected to provide some protection against this invasive species..

Cultivars differ in resistance and there is hope that resistance varieties can be developed (Sweet, 2000).

**Further work that would reduce uncertainties**

| **Area of PRA** | **Uncertainties** | **Further work that would reduce uncertainty** |
|---|---|---|
| **Taxonomy** | None | |
| **Pathway** | Movement with New Zealand commodities | Comprehensive collection of European interception data |
| **Distribution** | Situation in the Netherlands, Belgium and neighbouring countries | Surveys |
| **Establishment** | Test the assumption that distribution in the UK will be affected more by summer degree days and prolonged wet weather than overwintering temperatures. | Climatic modelling and mapping, experiments. |
| **Spread** | How rapidly it can spread without man's assistance. | Capture-mark-recapture experiments in NL, BE. |
| **Impact** | 1. Whether movement into crops can be expected in Europe.<br>2. Whether populations can reach sufficient densities to become injurious to brassica seedlings and wheat.<br>3. Injuriousness to fruit. | 1. Further surveys.<br>2. Population modelling. Comparisons of temperature and rainfall in New Zealand in years when populations are damaging with UK/Europe climate.<br>3. Additional host range experiments. |
| **Management** | Efficacy of insecticides, especially aphicides, available in the UK. | Testing |

## 21. Summary & Conclusions

Even though conditions are highly suitable for *N. huttoni* to establish, it currently poses a **minor** risk to the UK because it is unlikely to enter and only minor risks to crops can be expected. This is primarily based on the situation in the Netherlands and Belgium, where it is currently confined to waste ground, roadsides and abandoned fields. If that changes, the PRA needs to be revised. Brassica crops in locations where there are few weed species during very hot, dry years will be most vulnerable. Such situations are currently rare.

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**Name of Pest Risk Analyst:** Richard Baker, Ray Cannon

**Address:** Central Science Laboratory, Sand Hutton, York, YO41 1LZ UK.

| **Date** | **<u>What was changed / edited</u>** |
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| 14/07/2006 | 1st Draft |