

**THE CURRENT STATUS OF THE SOUTHERN GREEN SHIELD BUG, *NEZARA VIRIDULA* (HEMIPTERA: PENTATOMIDAE), AN INTRODUCED PEST SPECIES RECENTLY ESTABLISHED IN SOUTH-EAST ENGLAND**

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ABSTRACT

In 2003 the southern green shield bug, *Nezara viridula* (L.) was found to be breeding in south-east England. The Royal Horticultural Society's members' advisory service first received outdoor records of this plant pest in 2004, and the Natural History Museum Insect Information Service in 2006. Both services have received verifiable reports of *N. viridula* each year since. Most post-2002 records of *N. viridula* have been of nymphs, reported in late summer or autumn, when plant damage from this insect is less likely to be serious. The current distribution, host range and potential pest status of *N. viridula* in the UK are discussed.

INTRODUCTION

The southern green shield bug (*Nezara viridula* (L.)) (Hemiptera: Pentatomidae) (Plate 4, Fig. 3), also known as the green vegetable bug, is highly polyphagous and a serious pest of food and fibre crops in many parts of the world (Todd, 1989). It has a cosmopolitan distribution, primarily in the tropical and subtropical regions, but has been established across large parts of Europe for some time (see CABI, 1998). Since at least 1930, *N. viridula* has been regularly intercepted in the UK by the plant quarantine service on a wide range of imported plants and produce, sometimes in large numbers. However, there were no known breeding populations of *N. viridula* in the UK before 2003 (Reid, 2006). In 2003, three breeding colonies of *N. viridula* were reported outdoors in London (Barclay, 2004; Shardlow & Taylor, 2004).

The adult of *N. viridula* is superficially similar to that of the UK native green shield bug *Palomena prasina* (L.), but at 11.0–15.0 mm long it is usually larger than *P. prasina* (12.0–13.5 mm) and has a clear membrane at the tips of the forewings, unlike the brown membrane of *P. prasina*. In addition *N. viridula* usually has three to five small white spots at the base of the scutellum, with a tiny black spot close to each corner and the punctuation is concolourous green, not black as in *P. prasina*. The nymphs are readily distinguished from other Pentatomidae present in the UK; fifth instars have four rows of white markings on the greenish abdomen, with pinkish red markings around the edge of the abdomen and pronotum. Earlier instars have a black abdomen with white spots, and red markings on the edge of the pronotum. A detailed description and notes on identification of *N. viridula* are provided by Barclay (2004).

The life history of *N. viridula* was reviewed by Todd (1989). In summary, the adults hibernate in sheltered places, with overwintering adults usually turning brown. Adults emerge in the spring and begin to feed and mate almost immediately. The

eggs are pale yellow and deposited in polygonal clusters; these take from five days to three weeks to hatch. As with most other Pentatomidae, *N. viridula* develops through five nymphal instars. The complete life-cycle from egg to adult is temperature-dependent and can range from 24 to 60 days (Knight & Gurr, 2007) and up to six generations are thought to be possible in a season (Panizzi *et al.*, 2000).

Reports of *N. viridula* nymphs have been made each year since 2003, many via the Royal Horticultural Society (RHS) members' advisory service and the Natural History Museum (NHM) Insect Information Service, indicating that *N. viridula* is established as a breeding insect in south-east England. These reports are discussed with reference to the shield bug's establishment and its potential to become a plant pest in the UK.

#### ESTABLISHMENT AND DISTRIBUTION IN THE UK

*Nezara viridula* is an occasional accidental import into the UK. Between 1930 and 2007 there were 23 recorded interceptions of *N. viridula* by the Plant Health and Seeds Inspectorate (Fig. 1) (Reid, 2006). Twenty-two of the interceptions were of adults, but details of the life stage(s) from the other interception were not recorded; 17 were associated with imported plant material, with Italy the most recurrent country of origin (Reid, 2006). This is likely to under-represent the number of occasions *N. viridula* has been accidentally imported, as this insect is known to be a stow-away with imports of fruit and vegetables (Southwood & Leston, 1959). Additional records of *N. viridula* associated with imported material known to the authors are an adult in 1997 with watercress from a London supermarket (RHS data) and in 2004 a nymph found in a pallet of Spanish raspberries in Camborne, Cornwall (B. Nau, *pers. comm.*).

It was thought unlikely that *N. viridula* would become established in the UK (Southwood & Leston, 1959). However, in August and September 2003, nymphs of *N. viridula* were recorded from several locations in London (Barclay, 2004; Brooke, 2004; Shardlow & Taylor, 2004). These were the first reports of nymphs on plants that had not been recently imported, indicating probable breeding of *N. viridula* in the UK. Since 2003 there have been four additional published reports of *N. viridula* nymphs: Isleworth, Middlesex (Ismay & Schulten, 2006); Stanford, Essex (Harvey, 2008) and Staines, Middlesex (Diver, 2008). Andrew Halstead also observed nymphs in Brookwood and Knaphill, Surrey, in 2005 and 2006. The Food and Environment Research Agency (FERA) received nymphs from Chertsey and Egham (Surrey) in 2006. Nymphs were also reported from Cambridge in 2007 (B. Nau, *pers. comm.*).

The first outdoor report of *N. viridula* to the Royal Horticultural Society was received in August 2004 from Chiswick, London. Records of *N. viridula* received by the RHS are only considered valid when accompanied with samples or photographs, or when an accurate written or verbal description of the distinctive nymphs is provided. Verbal/written descriptions of the adult are discounted due to possible confusion with *P. prasina*. Thirty-six verifiable records of *N. viridula* were received between 2004 and 2008, all from London and adjacent areas of Surrey, Essex and Kent. All 36 records of *N. viridula* included the presence of nymphs.

Between 2004 and 2009 staff at the Natural History Museum received 19 verifiable outdoor records of *N. viridula*. Most records were from London, including one site where *N. viridula* was found to be present each year from 2005 to 2009 (near Colindale Tube Station, TQ28, Dr. J. Starr). One record of nymphs (M. Shardlow, *pers. comm.*) was received outside the London area from near Southampton, Hampshire (SU4401) in May 2005.

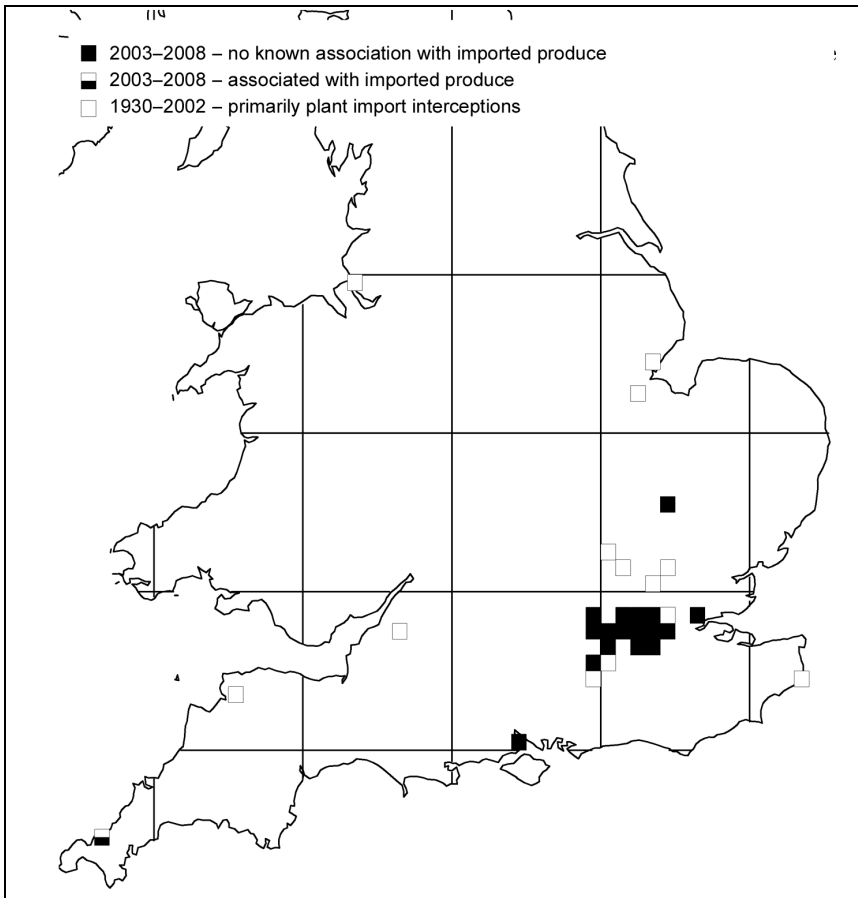


Fig. 1. Map of southern green shield bug *Nezara viridula* distribution in England, 10 km squares. RHS/FERA/NHM and published data (at March 2009). Produced using Dmap.

In total the authors are aware of 77 outdoor records of *N. viridula* between 2003 and 2008, 65 with nymphs present. These records indicate that the bug is established in London and some surrounding areas. The status of this insect in Cambridge (recorded 2007) and near Southampton (recorded 2005) is unknown as no records of *N. viridula* have been received from these areas since the original reports.

#### TEMPORAL DISTRIBUTION OF UK RECORDS

*Nezara viridula* may have up to six generations a year in favourable conditions (Panizzi *et al.*, 2000). However 66 (86%) of the 77 UK sightings were made between July and November, and over 60% of records were reported in September or October (Fig. 2). The bug has only been recorded outdoors on one occasion in May, three occasions in June and two occasions in July; five of these records are

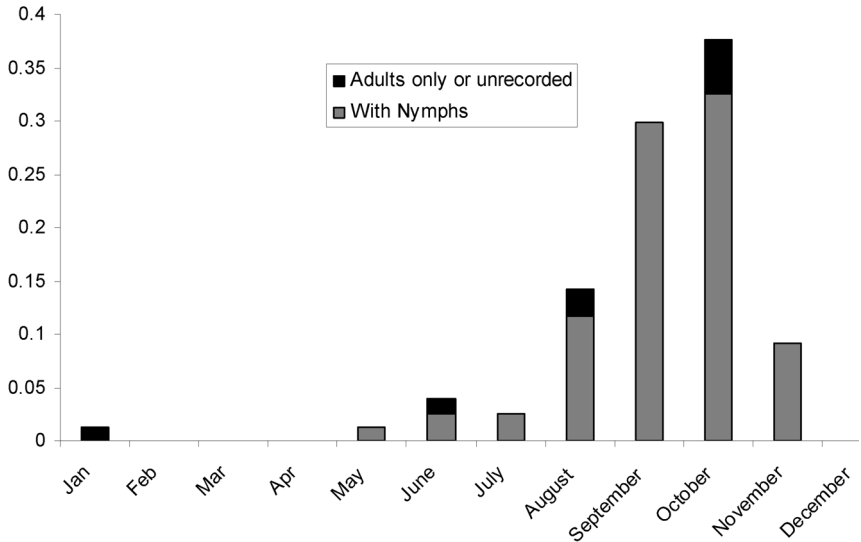


Fig. 2. Proportion of post-2002 *Nezara viridula* nymph records by month. RHS, FERA, NHM data and published data at March 2009 ( $n=77$ ).

associated with nymphs. To date there is only one record of the overwintering brown form of *N. viridula*, which was collected in January 2008 inside the Entomology Department of the NHM, by Gavin Broad. With nymphs in most cases appearing in late summer and autumn, it is probable that there may be only one or two generations a year in the UK, although there are insufficient data to conclude that this is the case.

#### HOST RANGE AND POTENTIAL PLANT DAMAGE IN THE UK

*Nezara viridula* is a pest of a wide range of plant species (Todd, 1989). The bug feeds by sucking sap from the foliage and developing fruits, pods and seed heads. This can result in fruits and pods failing to develop or doing so in a distorted fashion. Shield bugs can also taint edible crops by releasing a foul-tasting substance onto the crop when they are disturbed. In the UK, 50 of the 77 post-2002 records of *N. viridula* have information on the plants on which they were found (Table 1). Runner bean and other food crops account for more than 50% of the records and garden ornamental plants most of the rest. However, most of these records were made in late summer and autumn (Fig. 2) when harvesting of susceptible fruits and vegetables was nearing completion. Plant damage at this late stage is unlikely to affect the quantity or quality of the crop. Because of this, *N. viridula* is not a major pest in the UK at the present time but could become more significant if heavier infestations develop earlier in the growing season.

#### DISCUSSION

The southern green shield bug, *N. viridula*, has become established in London and some surrounding areas. Its distribution may be restricted by cold winters but it is

Table 1. Observations of *Nezara viridula* on plants in the UK, post-2002. RHS/FERA/NHM and published data.

Host	Number of reports
<i>Abelia</i> sp.	1
<i>Abutilon</i> sp.	1
<i>Agapanthus</i> sp.	1
<i>Alcea</i> sp. (Hollyhock)	2
<i>Alyssum</i> sp.	1
Bamboo	1
<i>Caryopteris</i> sp.	1
<i>Eruca sativa</i> (Rocket)	1
<i>Eupatorium cannabinum</i> (Hemp agrimony)	1
<i>Euphorbia</i> sp. (Spurge)	1
<i>Fuchsia</i> sp.	1
<i>Hibiscus</i> sp.	1
<i>Ipomea</i> sp. (Morning glory)	1
<i>Knautia</i> sp. (Scabious)	1
<i>Lavandula</i> sp. (Lavender)	1
<i>Lycopersicon esculentum</i> (Tomato)	2 (seen feeding in one case)
<i>Phaseolus coccineus</i> (Runner bean)	24
<i>Pyrus</i> sp. (Pear)	1
<i>Rorippa nasturtium-aquaticum</i> (Watercress)	1
<i>Rosa</i> sp. (Rose)	1
<i>Rubus</i> sp. (Raspberry/Blackberry)	3
<i>Salix</i> sp. (Willow/sallow)	2
<i>Sollya</i> sp.	1
<i>Stipa</i> sp.	1
<i>Viburnum</i> sp.	1
<i>Solidago</i> sp. (Goldenrod)	1

likely to survive in sheltered places, such as London gardens, where winter frosts have become uncommon in recent years. However, its life-cycle, host range and pest status in the UK require further investigation. The small number of pre-July reports indicates that *N. viridula* is present at low densities in the early part of the summer, only becoming noticeable in late summer, presumably as numbers increase. If this remains the case in the UK, damage to edible crops and garden ornamental plants may remain slight, as by late summer/early autumn damage to annual crops is likely to be unimportant.

When a species such as *N. viridula* becomes established further north than previously, climate change is often implicated. There is some evidence that this is the case with *N. viridula*. Its spread northwards in Japan has been correlated with increased winter temperatures (Musolin & Numata, 2003; Musolin, 2007). However, movement north is not without some cost, because in temperate climates *N. viridula* has an adult diapause. At the new northern edge of its range in Japan, adult diapause in *N. viridula* was induced after mid-September. This late diapause resulted in female oviposition in late summer/early-autumn when the progeny had no chance of attaining adulthood and were therefore unlikely to survive the winter (Musolin & Numata, 2003). It is possible that similar late-season ineffective reproduction is occurring in the UK, as the majority of reports of *N. viridula* have been made in the autumn and most are of nymphs.

*Nezara viridula* is established in the UK and its distribution may continue to expand. Its lifecycle in the UK needs investigation, and its future pest status is unclear. However, *N. viridula* is a pest through much of its range and it should be assumed that it will cause problems in the UK in future if it occurs in greater numbers earlier in the summer.

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