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Pest categorisation of *Nilaparvata lugens*

EFSA Panel on Plant Health (PLH),
Claude Bragard, Paula Baptista, Elisavet Chatzivassiliou, Francesco Di Serio, Paolo Gonthier, Josep Anton Jaques Miret, Annemarie Fejer Justesen, Christer Sven Magnusson, Panagiotis Milonas, Juan A Navas-Cortes, Stephen Parnell, Roel Potting, Philippe Lucien Reignault, Emilio Stefani, Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent Civera, Jonathan Yuen, Lucia Zappalà, Jean-Claude Grégoire, Chris Malumphy, Virag Kertesz, Andrea Maiorano and Alan MacLeod

Abstract

The EFSA Panel on Plant Health performed a pest categorisation of *Nilaparvata lugens* (Hemiptera: Delphacidae), the brown planthopper, for the European Union. *N. lugens* is widespread in Asia where it is native; it also occurs in Oceania where it is naturalised. *N. lugens* is not known to be present in the EU and is not listed in Annex II of Commission Implementing Regulation (EU) 2019/2072. It is a monophagous species and a major pest of rice *(Oryza sativa*). High populations of planthoppers cause leaves to initially turn orange yellow before becoming brown and dry and this is a condition called 'hopperburn' that kills the plant. *N. lugens* can also transmit plant viruses. It can complete 12 generations per year in tropical areas, where it resides year-round. *N. lugens* can undertake long-distance migration of up to 500 km from tropical areas to form transient populations in sub-tropical and temperate areas but due to low temperatures and absence of rice plants during the winter it does not establish in such areas. Entry to the EU via migration is unlikely given the distance from tropical rice growing areas. A possible but unlikely potential pathway is the import of infested rice seedlings, although we have no evidence that such trade exists. In the EU, rice is mainly planted from seed; when transplanted, it is sourced locally. *N. lugens* is very unlikely to survive year-round in the EU due to unsuitable climate and lack of hosts during the winter. Consequently, the pest is very unlikely to become established in the EU territory. Nevertheless, there are measures available to further reduce the likelihood of entry, establishment and spread of *N. lugens* within the EU. *N. lugens* does not satisfy the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest.

Keywords: brown planthopper, rice, pest risk, plant health, plant pest, quarantine

Requestor: European Commission

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Correspondence: plants@efsa.europa.eu

Panel members: Claude Bragard, Paula Baptista, Elisavet Chatzivassiliou, Francesco Di Serio, Paolo Gonthier, Josep Anton Jaques Miret, Annemarie Fejer Justesen, Alan MacLeod, Christer Sven Magnusson, Panagiotis Milonas, Juan A Navas-Cortes, Stephen Parnell, Roel Potting, Philippe L Reignault, Emilio Stefani, Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent Civera, Jonathan Yuen and Lucia Zappalà.

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1. Introduction

1.1. Background and Terms of Reference as provided by the requestor

1.1.1. Background

The new Plant Health Regulation (EU) 2016/2031, on the protective measures against pests of plants, is applying from 14 December 2019. Conditions are laid down in this legislation in order for pests to qualify for listing as Union quarantine pests, protected zone quarantine pests or Union regulated non-quarantine pests. The lists of the EU regulated pests together with the associated import or internal movement requirements of commodities are included in Commission Implementing Regulation (EU) 2019/2072. Additionally, as stipulated in the Commission Implementing Regulation 2018/2019, certain commodities are provisionally prohibited to enter in the EU (high risk plants, HRP). EFSA is performing the risk assessment of the dossiers submitted by exporting to the EU countries of the HRP commodities, as stipulated in Commission Implementing Regulation 2018/2018. Furthermore, EFSA has evaluated a number of requests from exporting to the EU countries for derogations from specific EU import requirements.

In line with the principles of the new plant health law, the European Commission with the Member States are discussing monthly the reports of the interceptions and the outbreaks of pests notified by the Member States. Notifications of an imminent danger from pests that may fulfil the conditions for inclusion in the list of the Union quarantine pest are included. Furthermore, EFSA has been performing horizon scanning of media and literature.

As a follow-up of the above-mentioned activities (reporting of interceptions and outbreaks, HRP, derogation requests and horizon scanning), a number of pests of concern have been identified. EFSA is requested to provide scientific opinions for these pests, in view of their potential inclusion by the risk manager in the lists of Commission Implementing Regulation (EU) 2019/2072 and the inclusion of specific import requirements for relevant host commodities, when deemed necessary by the risk manager.

1.1.2. Terms of Reference

EFSA is requested, pursuant to Article 29(1) of Regulation (EC) No 178/2002, to provide scientific opinions in the field of plant health.

EFSA is requested to deliver 53 pest categorisations for the pests listed in Annex 1A, 1B, 1D and 1E (for more details see mandate M-2021-00027 on the Open.EFSA portal). Additionally, EFSA is requested to perform pest categorisations for the pests so far not regulated in the EU, identified as pests potentially associated with a commodity in the commodity risk assessments of the HRP dossiers (Annex 1C; for more details see mandate M-2021-00027 on the Open.EFSA portal). Such pest categorisations are needed in the case where there are not available risk assessments for the EU.

When the pests of Annex 1A are qualifying as potential Union quarantine pests, EFSA should proceed to phase 2 risk assessment. The opinions should address entry pathways, spread, establishment, impact and include a risk reduction options analysis.

Additionally, EFSA is requested to develop further the quantitative methodology currently followed for risk assessment, in order to have the possibility to deliver an express risk assessment methodology. Such methodological development should take into account the EFSA Plant Health Panel Guidance on quantitative pest risk assessment and the experience obtained during its implementation for the Union candidate priority pests and for the likelihood of pest freedom at entry for the commodity risk assessment of High Risk Plants.

1.2. Interpretation of the Terms of Reference

Nilaparvata lugens is one of a number of pests listed in Annex 1D to the Terms of Reference (ToR) to be subject to pest categorisation to determine whether it fulfils the criteria of a potential Union quarantine pest (QP) for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores, and so inform EU decision making as to its appropriateness for potential inclusion in the lists of pests of Commission Implementing Regulation (EU) 2019/2072. If a pest fulfils the criteria to be potentially listed as a Union QP, risk reduction options will be identified.

1.3. Additional information

This pest categorisation was initiated as a result of media monitoring, PeMoScoring[1] (EFSA, 2022), and subsequent discussion at the Standing Committee on Plants, Animals, Food and Feed, resulting in it being included in the current mandate within the list of pests identified by horizon scanning and selected for pest categorisation.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on *N. lugens* was conducted at the beginning of the categorisation in the ISI Web of Science bibliographic database, using the scientific name of the pest as search term. Papers relevant for the pest categorisation were reviewed, and further references and information were obtained from experts, as well as from citations within the references and grey literature.

2.1.2. Database search

Pest information, on host(s) and distribution, was retrieved from the European and Mediterranean Plant Protection Organization (EPPO) Global Database (EPPO, online), the CABI databases and scientific literature databases as referred above in Section 2.1.1.

Data about the import of commodity types that could potentially provide a pathway for the pest to enter the EU and about the area of hosts grown in the EU were obtained from EUROSTAT (Statistical Office of the European Communities).

The Europhyt and TRACES databases were consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network run by the Directorate General for Health and Food Safety (DG SANTÉ) of the European Commission as a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. TRACES is the European Commission's multilingual online platform for sanitary and phytosanitary certification required for the importation of animals, animal products, food and feed of non-animal origin and plants into the European Union, and the intra-EU trade and EU exports of animals and certain animal products. Up until May 2020, the Europhyt database managed notifications of interceptions of plants or plant products that do not comply with EU legislation, as well as notifications of plant pests detected in the territory of the Member States and the phytosanitary measures taken to eradicate or avoid their spread. The recording of interceptions switched from Europhyt to TRACES in May 2020.

GenBank was searched to determine whether it contained any nucleotide sequences for *N. lugens* which could be used as reference material for molecular diagnosis. GenBank® (www.ncbi.nlm.nih.gov/genbank/) is a comprehensive publicly available database that as of August 2019 (release version 227) contained over 6.25 trillion base pairs from over 1.6 billion nucleotide sequences for 450,000 formally described species (Sayers et al., 2020).

2.2. Methodologies

The Panel performed the pest categorisation for *N. lugens*, following guiding principles and steps presented in the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018), the EFSA guidance on the use of the weight of evidence approach in scientific assessments (EFSA Scientific Committee, 2017) and the International Standards for Phytosanitary Measures No. 11 (FAO, 2013).

The criteria to be considered when categorising a pest as a potential Union quarantine pest (QP) is given in Regulation (EU) 2016/2031 Article 3 and Annex I, Section 1 of the Regulation. Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. In judging whether a criterion is met the Panel uses its best professional judgement (EFSA Scientific Committee, 2017) by integrating a range of evidence from a variety of sources (as presented above in Section 2.1) to reach an informed conclusion as to whether or not a criterion is satisfied.

[1] PeMoScoring is a ranking system that orders pests by risks posed to the EU and provide a tool to support risk managers in the decision of actions to take. It helps risk managers decide (i) whether further risk assessment, such as pest categorisation, is needed, (ii) whether EU surveillance and import control must be enforced for newly identified specific pests.

The Panel's conclusions are formulated respecting its remit and particularly with regard to the principle of separation between risk assessment and risk management (EFSA founding regulation (EU) No 178/2002); therefore, instead of determining whether the pest is likely to have an unacceptable impact, deemed to be a risk management decision, the Panel will present a summary of the observed impacts in the areas where the pest occurs, and make a judgement about potential likely impacts in the EU. While the Panel may quote impacts reported from areas where the pest occurs in monetary terms, the Panel will seek to express potential EU impacts in terms of yield and quality losses and not in monetary terms, in agreement with the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel et al., 2018). Article 3 (d) of Regulation (EU) 2016/2031 refers to unacceptable social impact as a criterion for QP status. Assessing social impact is outside the remit of the Panel.

Table 1: Pest categorisation criteria under evaluation, as derived from Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest (Article 3)
Identity of the pest (Section 3.1)	Is the identity of the pest clearly defined, or has it been shown to produce consistent symptoms and to be transmissible?
Absence/presence of the pest in the EU territory (Section 3.2)	Is the pest present in the EU territory? If present, is the pest in a limited part of the EU or is it scarce, irregular, isolated or present infrequently? If so, the pest is considered to be not widely distributed.
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	Is the pest able to enter into, become established in, and spread within, the EU territory? If yes, briefly list the pathways for entry and spread.
Potential for consequences in the EU territory (Section 3.5)	Would the pests' introduction have an economic or environmental impact on the EU territory?
Available measures (Section 3.6)	Are there measures available to prevent pest entry, establishment, spread or impacts?
Conclusion of pest categorisation (Section 4)	A statement as to whether (1) all criteria assessed by EFSA above for consideration as a potential quarantine pest were met and (2) if not, which one(s) were not met.

3. Pest categorisation

3.1. Identity and biology of the pest

3.1.1. Identity and taxonomy

Is the identity of the pest clearly defined, or has it been shown to produce consistent symptoms and/or to be transmissible?

Yes, the identity of the species is established and *Nilaparvata lugens* (Stål) is the accepted name.

N. lugens (Stål) is an insect within the Order Hemiptera and Family Delphacidae. It is commonly known as the brown planthopper. It was first described as *Delphax lugens* Stål in 1854 and synonyms include *Delphax sordescens* Motschulsky, *Liburnia oryzae* (Matsumura), *Nilaparvata oryzae* (Matsumura) (EPPO, online; Dmitriev, 2019).

There are two *N. lugens* forms feeding on cultivated and wild rice, which differ in mating signals and DNA sequences, and they may represent sibling species. *N. lugens* populations appear to contain abundant polygenic variation for host-associated traits. The physiological and behavioural strains are referred to as 'biotypes' (Sezer and Butlin, 1998). Reports of *N. lugens* feeding on *Leersia hexandra* are referable to a different species (Claridge et al., 1985; Ferrater, 2015 and references cited therein).

The EPPO code[2] (Griessinger and Roy, 2015; EPPO, 2019) for this species is: NILALU (EPPO, online).

3.1.2. Biology of the pest

N. lugens is a plant phloem sap feeder infesting rice (*Oryza sativa*). It can complete 12 generations in a single year in tropical areas, where it resides year-round, and fewer generations in temperate areas, where it is a migratory pest (Stout, 2014). It cannot overwinter in temperate and subtropical regions (such as mainland China, Japan and the Korean Peninsula) (Chen et al., 1979; Kisimoto and Sogawa, 1995) because winter climate is not suitable both for the insect and rice cultivation, thus *N. lugens* must engage in long-distance migratory flights to overwinter in warmer permanent breeding areas (Peng et al., 2012).

N. lugens acts as the vector of two important plant viruses: the rice grassy stunt virus (Tymoviridae*; Tymovirus*) and the rice ragged stunt virus (*Reoviridae; Oryzavirus*) (Mochida and Okada, 1979; Saxena and Khan, 1989).

The brown planthopper is dimorphic, with fully winged 'macropterous' and truncate-winged 'brachypterous' forms. The macropterous forms are potentially migrants and are responsible for colonising new fields. Long-distance return migrations occur in China in mid and late September, with *N. lugens* being carried on the prevailing wind towards overwintering areas; mass take-off occurs in the late afternoon or at dusk and then the migrants fly for several hours during the evening, at heights between about 400 and 1,000 m above ground with an air temperature limit of about 16°C. The distance covered can be up to 240 km. In the presence of strong winds (i.e. 12 m/s) migrants could conceivably travel as much as 500 km in one night's flight (Riley et al., 1991). After settling on rice plants, they produce the following generation, where most of the female insects develop as brachypterous and males as macropterous. Adults usually mate on the day of emergence, and the females start laying eggs from the day following mating. Oviposition usually occurs in the leaf sheath tissues near the rice plant base or in the ventral midribs of leaf blades. The eggs are laid in masses of 1–27 eggs each, arranged in 2 straight lines. The average number of eggs laid is 244.2 per female. At 29°C this average declined to 86.8 and at 33°C no oviposition occurred (Bae and Pathak, 1970). The most favourable temperatures for the survival and reproduction of *N. lugens* ranges from 25°C to 30°C (Bae and Pathak, 1970; Kumar et al., 2022). Both male and female planthoppers had the longest life spans at 25°C; at higher temperatures the longevity of females declined considerably. At 33°C the average longevity of male and female planthoppers was 3.9 and 4.1 days, respectively, as compared with 11.6 and 18.6 days at 25°C (Bae and Pathak, 1970). In the Northern Hemisphere, the brown planthopper could overwinter only in south of isotherm of 10°C in January (Hu et al., 2018; Guru-Pirasanna-Pandi et al., 2021). In terms of relative humidity, the highest survival rate of *N. lugens* nymphs was recorded at 70% RH and the pest infestation was significantly positively correlated with the RH values (Sharma et al., 2018). Fecundity of *N. lugens* was significantly higher with a higher leaf nitrogen content; besides, fecundity, hatching rate, adult longevity and development duration were seen to be significantly influenced by the rice variety (Kumar et al., 2022). The nymphs hatch in 7–9 days; the newly hatched nymphs are cottony-white, and turn purple-brown within an hour. They feed on plant sap and pass through five instars before becoming adults. The nymphal period varies between 12 and 15 days and the adults usually live for about 10–21 days (Kumar et al., 2022). In some cases, *N. lugens* lay eggs in the rice seed beds (rice nurseries) shortly before transplanting, so they enter the field in this manner (Preap et al., 2002).

N. lugens is known to be able to develop resistance both to insecticides which have been widely used for controlling the pest (Zhang et al., 2016; Fang et al., 2018; Wu et al., 2018) and to *N. lugens*-resistant rice varieties (Sezer and Butlin, 1998). Indeed, outbreaks of brown planthopper became more frequent and more intense after the introduction of improved rice varieties and input-intensive farming practices during the green revolution of the 1960s (Kumar et al., 2022). The increased importance of the brown planthopper as a pest prompted efforts to identify sources of planthopper resistance (Stout, 2014).

Several natural enemies are known to feed on this species. Predators include the spiders *Pardosa* (=Lycosa) *pseudoannulata* (Bösenberg and Strand) and *Araneus inustus* (Koch) (Preap et al., 2001) and the bugs *Cyrtorhinus lividipennis* Reuter (Hemiptera: Miridae) (Sigsgaard, 2007; Manorod and

[2] An EPPO code, formerly known as a Bayer code, is a unique identifier linked to the name of a plant or plant pest important in agriculture and plant protection. Codes are based on genus and species names. However, if a scientific name is changed the EPPO code remains the same. This provides a harmonised system to facilitate the management of plant and pest names in computerised databases, as well as data exchange between IT systems (Griessinger and Roy, 2015; EPPO, 2019).

Rattanakul, 2019) and *Amphiareus constrictus* (Stål) (Hemiptera: Anthocoridae) (Ballal et al., 2019). The fish *Anabas testudineus* caused a significant reduction of *N. lugens* population by 51%, 85 days after sowing (Fahad et al., 2021).

Numerous parasitoids belonging to the orders Strepsiptera, Diptera and, especially, Hymenoptera have been found developing on *N. lugens* in Asia with highly variable levels of field parasitism between parasitoid species and locations (Gurr et al., 2011). For example, studies in Peninsular Malaysia found total egg mortality to be as high as 92% for *N. lugens* with parasitoids being responsible for 68% of this mortality (Watanabe et al., 1992) (Table 2).

Table 2: Important features of the life history strategy of *Nilaparvata lugens*

Life stage	Phenology and relation to host	Other relevant information
Egg	Eggs are laid in masses of 1 to 27 eggs each, all year round in tropical areas, in the leaf sheath tissues near the plant base or in the ventral midribs of leaf blades. The average number of eggs laid is 244.2 per female. They can also be laid in rice seed beds before transplanting.	The nymphs hatch in 7–9 days
Nymph	Newly hatched nymphs are cottony-white and turn purple-brown within an hour.	They feed on plant sap and pass through five instars before becoming adults. The mean Critical Thermal maximum of nymphs was 34.9°C; the Heat Coma Temperature was 37.7°C. The Upper Lethal Temperature was 41.8°C (Piyaphongkul et al., 2012a, b).
Adult	Adults are fully winged (macropterous) or truncate-winged (brachypterous).	The macropterous forms are potentially migrants and are responsible for colonising new fields. After settling on rice plants, they produce the following generation, where most of the female insects develop as brachypterous and males as macropterous. Adults usually mate on the day of emergence, and the females start laying eggs from the day following mating. The mean critical thermal maximum of adult females and males were 37.0°C and 37.4°C, respectively; the heat coma temperatures were 43.5°C and 42.0°C. The upper lethal temperature value for adults was 42.5°C (Piyaphongkul et al., 2012a, b).

3.1.3. Host range/species affected

N. lugens feeds and reproduces on rice. It can use many rice varieties as a host plant and can adapt rapidly to resistant varieties (Den Hollander and Pathak, 1981). Some wild *Oryza* species in Asia were reported as field hosts for *N. lugens*, but there are no published studies on this topic (CABI, online). *N. lugens* has been reported also on *Leersia hexandra*, a genus occurring in the EU. However, bioassays and molecular studies have indicated that populations feeding on rice and feeding on the weed *L. hexandra* represent distinct species (sibling species or cryptic species) (Claridge et al., 1985, Ferrater, 2015 and references cited therein). Kumar et al. (2020) citing Jones et al. (1996) report that *N. lugens* is believed to have undergone a host shift from *Leersia* plants to rice about 0.25 million years ago. Subsequently, N. *lugens* evolved as a monophagous insect, which selectively feeds on rice plants (Jing et al., 2017; Zhao et al., 2016).

3.1.4. Intraspecific diversity

The two *N. lugens* forms feeding on cultivated and wild rice, differ in mating signals and DNA sequences and may represent sibling species. *N. lugens* populations appear to contain abundant polygenic variation for host-associated traits. The physiological and behavioural strains are referred to as 'biotypes' (Sezer and Butlin, 1998).

3.1.5. Detection and identification of the pest

Are detection and identification methods available for the pest?
Yes, visual detection is possible, and morphological and molecular identification methods are available.

Detection

N. lugens adults and nymphs suck the plant phloem of the leaf blades and leaf sheaths causing yellowing of the plants. At early infestation, circular yellow patches appear which soon turn brownish due to the drying up of the plants. *N. lugens* is usually more abundant and therefore more easily detected in the dry season than in the wet season. It is commonly found in rain-fed and irrigated fields during the reproductive stage of the rice plant. Hopperburn caused by the plant hoppers is distinguished from other hopperburn symptom by the presence of visible sooty moulds at the base of the rice plant (TNAU, 2023). The grain setting is also affected to a great extent. Plant-shaking and light traps can be used to detect this planthopper (Hu et al., 2014). Hyperspectral remote sensing was also used to detect plants damaged by this pest (Prasannakumar et al., 2013).

Symptoms

The main symptoms of *N. lugens* infestation are:

- yellowing of the plants,
- leaves initially turn orange-yellow before becoming brown and dry; this condition is called hopperburn and kills the plant,
- during sustained feeding, it excretes a large amount of honeydew.

These symptoms are similar to those caused by other plant-sap feeding insects and should not be considered as diagnostic.

Identification

The identification of *N. lugens* requires microscopic examination of slide mounted adult male specimens. Morphological keys are available for specific identification (Wilson and Claridge, 1991). However, no taxonomic keys for the nymphal stage are available (Caro et al., 2015).

Molecular techniques based on multiplex PCR and loop-mediated isothermal amplification (LAMP) have been developed for species identification (Rahman et al., 2023). The complete assembled (chromosome level) genome (including mtDNA) of *N. lugens* is available (King et al., 2023).

Description

Eggs are white, transparent, slender cylindrical with broad flat egg caps and are laid in straight-line in two rows in leaf sheath near the plant base or in the ventral midribs of leaf blades. They are covered with a dome-shaped egg plug secreted by the female. Only the tips protrude from the plant surface.

Nymph – Freshly hatched nymph is cottony white, 0.6 mm long and it then turns purple-brown in later stages. In the fifth instar, it is 3.0 mm long.

Adult – Adult hopper is 4.5–5.0 mm long and has a yellowish brown to dark brown body. It has two characteristic wing morphs: macropterous (long winged) and brachypterous (short winged). The wings are subhyaline with a dull yellowish tint.

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

N. lugens is native to Asia, where it is widely distributed, and naturalised in Oceania (EPPO, online; CABI, online) (Figure 1). For a detailed list of countries where *N. lugens* is present, see Appendix B.

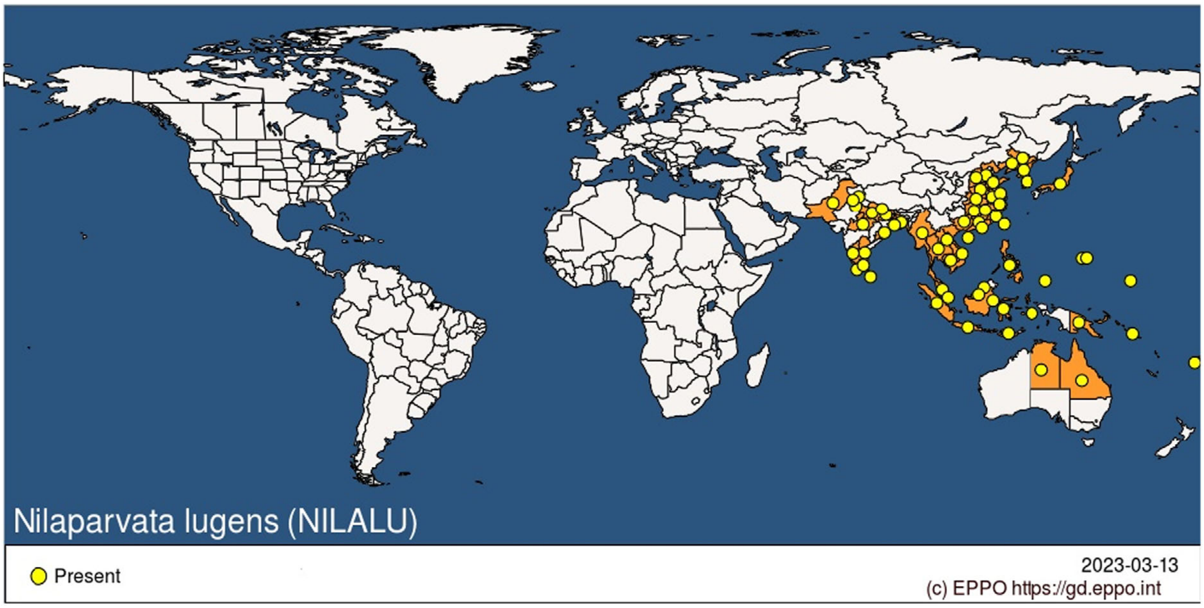

Figure 1: : Global distribution of *Nilaparvata lugens* (Copyright: EPPO Global Database accessed on 13 March 2023)

3.2.2. Pest distribution in the EU

Is the pest present in the EU territory? If present, is the pest in a limited part of the EU or is it scarce, irregular, isolated or present infrequently? If so, the pest is considered to be not widely distributed.

No, *N. lugens* is not known to be present in the EU.

3.3. Regulatory status

3.3.1. Commission Implementing Regulation 2019/2072

N. lugens is not listed in Annex II of Commission Implementing Regulation (EU) 2019/2072, an implementing act of Regulation (EU) 2016/2031, or in any emergency plant health legislation.

3.3.2. Hosts or species affected that are prohibited from entering the union from third countries (Table 3)

Table 3: List of plants, plant products and other objects that are *N. lugens* hosts whose introduction into the Union from certain third countries is prohibited (Source: Commission Implementing Regulation (EU) 2019/2072, Annex VI)

List of plants, plant products and other objects whose introduction into the Union from certain third countries is prohibited			
	Description	**CN code**	**Third country, group of third countries or specific area of third country**
14.	Plants for planting of the family Poaceae, other than plants of ornamental perennial grasses of the subfamilies Bambusoideae and Panicoideae and of the genera *Buchloe*, *Bouteloua* Lag., *Calamagrostis*, *Cortaderia* Stapf., *Glyceria* R. Br., *Hakonechloa* Mak. ex Honda, *Hystrix*, Molinia, *Phalaris* L., *Shibataea*,	ex 0602 90 50 ex 0602 90 91 ex 0602 90 99	Third countries other than Albania, Algeria, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Egypt, Faeroe Islands, Georgia, Iceland, Israel, Jordan, Lebanon, Libya, Liechtenstein, Moldova, Monaco, Montenegro, Morocco, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny

List of plants, plant products and other objects whose introduction into the Union from certain third countries is prohibited			
	Description	**CN code**	**Third country, group of third countries or specific area of third country**
	Spartina Schreb., *Stipa* L. and *Uniola* L., other than seeds		federalny okrug), Northwestern Federal District (Severo- Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Syria, Tunisia, Türkiye, Ukraine and the United Kingdom

3.3.3. Legislation addressing the organisms vectored by *N. lugens* (Commission Implementing Regulation 2019/2072)

The viruses vectored by *N. lugens* (rice grassy stunt virus and rice ragged stunt virus) are not regulated in the EU, while they are both quarantine in the USA (EPPO, online).

3.4. Entry, establishment and spread in the EU

3.4.1. Entry

Is the pest able to enter into the EU territory? If yes, identify and list the pathways.

Yes, possible but very unlikely. If host plants were imported as fresh cut or plants for planting, they could provide an entry pathway for this species. However, there is no evidence that such trade exists.

Comment on plants for planting as a pathway.

Plants for planting include seeds. On a commercial scale *N. lugens* host plants are planted mainly as seeds. However, seeds do not provide a pathway for this pest.

The EU does import rice from regions where *N. lugens* is known to occur, however this is rice as grains (wholly milled or semi-milled, broken, in the husk and husked) and not rice plants for planting or cut rice plants. In the EU, rice is mainly drilled as seed into production sites (Kraehmer et al., 2017); when transplanted as seedlings, the seedlings are sourced locally. Table 4 shows two hypothetical pathways. However, there is no evidence that hosts are traded as growing or cut plants. Immature and adult planthoppers are highly mobile, departing plants when disturbed and are likely to hop off plants at origin and so not be transported on traded plants. Planthoppers in general are infrequently intercepted relative to other families in Hemiptera (Turner et al., 2021).

Table 4: Potential pathways for *N. lugens* into the EU

Pathways (e.g. host/ intended use/source)	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI), special requirements (Annex VII) or phytosanitary certificates (Annex XI) within Implementing Regulation 2019/2072]
Freshly cut host plants	Eggs, nymphs, adults	No prohibitions nor special requirements are in place
Hitchhiking	Nymphs, adults	No prohibitions nor special requirements are in place

Entry to the EU via migration is unlikely given the distance from tropical rice growing areas.

Notifications of interceptions of harmful organisms began to be compiled in Europhyt in May 1994 and in TRACES in May 2020. As at 8.3.2023, there were no records of interception of *N. lugens* in the Europhyt and TRACES databases. Note that because *N. lugens* is not a quarantine pest, member states are not obliged to notify findings to plant health authorities.

3.4.2. Establishment

Is the pest able to become established in the EU territory?

No. *N. lugens* cannot overwinter in temperate or subtropical climates and the lack of rice growing in the EU from autumn until spring further reduces the likelihood of establishment. For these reasons, it is very unlikely to become established in the EU territory.

Climatic mapping is the principal method for identifying areas that could provide suitable conditions for the establishment of a pest taking key abiotic factors into account (Baker, 2002). Availability of hosts is considered in Section 3.4.2.1. Climatic factors are considered in Section 3.4.2.2.

3.4.2.1. EU distribution of main host plants

The host of *N. lugens* is rice, a crop cultivated in the EU (Table 5).

Table 5: Harvested area of rice (Code: C2000 × 1,000 ha) in the EU, 2016–2020. (Source: Eurostat, accessed on 17 February 2023)

MS/Year	2016	2017	2018	2019	2020
EU	448.74	440.68	417.37	419.09	427.55
Bulgaria	11.99	10.43	11.00	11.82	12.35
Greece	35.14	30.95	30.35	29.86	36.09
Spain	109.27	107.60	105.01	103.37	102.06
France	16.71	16.72	13.28	15.10	14.81
Italy	234.13	234.13	217.19	220.03	227.32
Hungary	2.91	2.77	2.93	2.65	2.99
Portugal	29.15	28.94	29.35	28.83	25.94
Romania	9.44	9.13	8.25	7.43	6.00

Even in the warmest areas of the EU where rice is grown, rice planting starts around May and is harvested around October. The host is therefore not available for about 7 months, from October until May the following year, inhibiting the likelihood of establishment.

3.4.2.2. Climatic conditions affecting establishment

Although rice is grown in the EU, it is not present year-round and EU climates further limit the establishment of this tropical species. Figure 2 shows the distribution of selected EU Köppen–Geiger climate types (Kottek et al., 2006) that occur in the EU and in regions where *N. lugens* has been reported (shown by red dots). Recall that *N. lugens* migrates from tropical areas to sub-tropical and temperate regions and so records shown in Figure 2 outside of the tropics do not necessarily indicate locations where *N. lugens* is established.

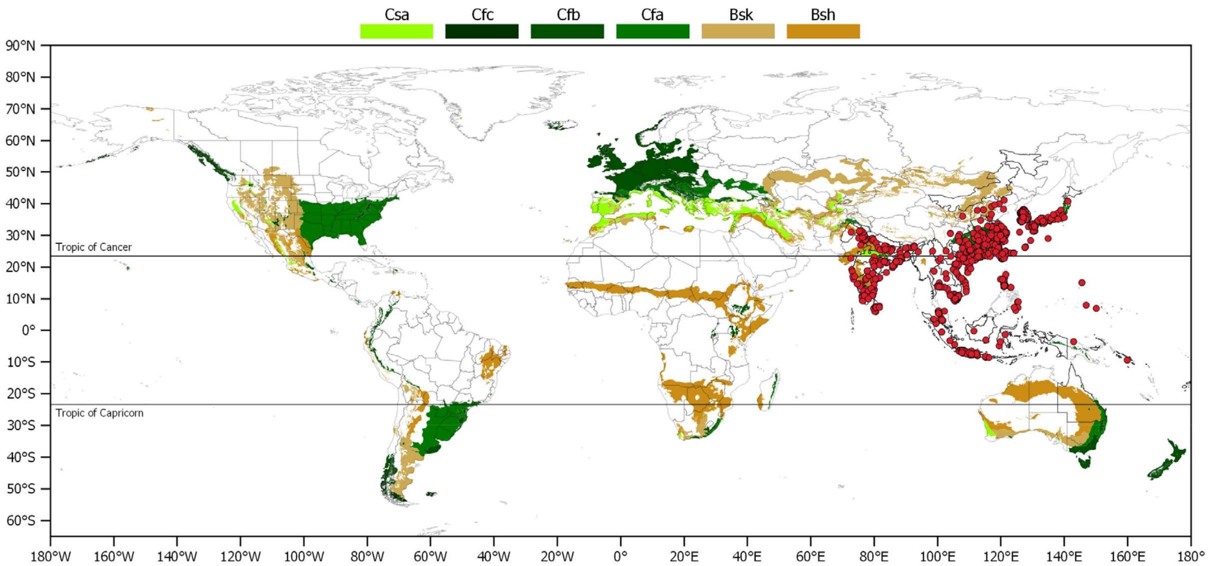

Figure 2: Distribution of Köppen–Geiger climate types Bsh, BSk, Cfa, Cfb, Cfc and Csa that occur in the EU and in third countries where *Nilaparvata lugens* has been reported. The legend shows the list of Köppen–Geiger climates. Red dots indicate point locations where *N. lugens* was reported. This includes subtropical and temperate areas where transient populations exist

3.4.3. Spread

Describe how the pest would be able to spread within the EU territory following establishment?

The brown planthopper is a long-distance migratory insect known to migrate passively with prevailing winds (Hu et al., 2018). The pest could also spread by movement of plants for planting and freshly cut host plants.

Comment on plants for planting as a mechanism of spread.

Rice seedlings (plants for planting) could provide a pathway for spread although such transplants if used they are not moved great distances within the EU and are assumed to be transplanted locally, close to where the seed was originally planted. Most rice is, however, directly drilled and seed does not provide a mechanism for spread for this insect.

3.5. Impacts

Would the pests' introduction have an economic or environmental impact on the EU territory?

Yes, if *N. lugens* established in the EU, it could have an economic impact on rice production. However, establishment is not considered possible.

The brown planthopper is one of the most important insect pests of rice in Asia. Its feeding induces plant wilting and causes hopperburn, which does not usually appear until the crop reaches the milk or dough stages; in its vegetative stage, rice can tolerate a population of 100–200 nymphs/hill (hill being the term used in rice cultivation to identify a rice plant with multiple stems) without showing any outward symptom of injury on the plants. Under heavy infestations, it can cause the wilting and complete drying of plants (Bottrell and Schoenly, 2012). Lower infestations reduce the number of tillers, number of panicles, and total grain weight of the plants (Bae and Pathak, 1970).

The pest is also able to transmit grassy stunt and ragged stunt virus diseases (CABI, online). The species was a minor rice pest until the mid-1960s in much of tropical Asia (Pathak and Dhaliwal, 1981). However, it assumed the status of the most destructive pest in the 1970s causing billions dollar of economic loss (Heinrichs and Mochida, 1984). In India, it is considered one of the pests responsible for large-scale devastation to the rice crop, causing yield losses amounting to as high as 60% and up to 80% in case of outbreaks (Srivastava et al., 2009; Kumar et al., 2012; Narayana et al., 2022). The loss of rice yield in China caused by *N. lugens* was approximately 1,880,000 tn in 2005 (Hu et al., 2011).

Although establishment is not considered possible, if *N. lugens* did establish, yield losses in rice would be expected.

3.6. Available measures and their limitations

Are there measures available to prevent pest entry, establishment, spread or impacts such that the risk becomes mitigated?

Yes. Although the existing phytosanitary measures identified in Section 3.3.2 do not specifically target *N. lugens*, they mitigate the likelihood of its entry into, establishment and spread within the EU (see also Section 3.6.1).

3.6.1. Identification of potential additional measures

Phytosanitary measures (prohibitions) are currently applied to some host plants for planting (see Section 3.3.2).

Additional potential risk reduction options and supporting measures are shown in Sections 3.6.1.1 and 3.6.1.2.

3.6.1.1. Additional potential risk reduction options

Potential additional control measures are listed in Table 6.

Table 6: Selected control measures (a full list is available in EFSA PLH Panel, 2018) for pest entry/establishment/spread/impact in relation to currently unregulated hosts and pathways. Control measures are measures that have a direct effect on pest abundance

Control measure/Risk reduction option (Blue underline = Zenodo doc, Blue = WIP)	RRO summary	Risk element targeted (entry/establishment/spread/impact)
Require pest freedom	The presence of the pest is rather limited to southeast Asia and Oceania, therefore the origin of plants or plant products from pest free areas could be effective in preventing pest entry. Although we do not think that host plants present a pathway, if in the future rice seedlings are imported, they could be sourced from pest free areas.	Entry
Managed growing conditions	Draining rice fields can be effective for reducing *N. lugens* infestation levels; growing no more than two crops per year and using early-maturing varieties is recommended. Judicious use of fertiliser by splitting nitrogen applications can also reduce planthopper outbreaks. The field should be drained for 3 or 4 days when heavy infestations occur. Increasing nitrogen levels, and higher relative humidity are known to increase *N. lugens* populations (CABI, online).	Impact/Spread
Crop rotation, associations and density, weed/volunteer control	Rice should not be planted at high density (CABI, online). In the tropics, growing no more than two crops per year, using early-maturing varieties is recommended (Reissig et al., 1986). In the EU, it is currently not possible to grow more than one crop in a year.	Establishment/Spread/Impact

Control measure/ Risk reduction option (Blue underline = Zenodo doc, Blue = WIP)	**RRO summary**	**Risk element targeted (entry/establishment/ spread/impact)**
Use of resistant and tolerant plant species/ varieties	Approximately 10 major genes for resistance to *N. lugens* have been identified from rice germplasm, and many cultivars also show minor gene resistance. Three resistance genes have been used extensively in modern, semi-dwarf cultivars. However, some brown planthopper populations adapted to the new varieties in as little as 3 years. Host-plant resistance breaks down due to the high variation in field populations of *N. lugens* and it may happen more quickly with intense pesticide applications which lead to a more rapid population growth of surviving *N. lugens*. Wide hybridisation of *Oryza sativa* with wild rice species, and the use of genetic engineering, are providing new sources of resistance against *N. lugens*. Resistant varieties can also help to reduce pesticide use and thus assist in the build-up of natural enemies in areas where pesticides have been heavily used in previous seasons (CABI, online).	Entry/Establishment/Spread/ Impact
Timing of planting and harvesting	Synchronous planting, including planting neighbouring fields within 3 weeks of each other and maintaining a rice-free period, may be effective (Reissig et al., 1986). However, asychronous rice cultivation within areas provides better continuity of natural enemy populations (Way and Heong, 1994).	Spread/Impact
Biological control and behavioural manipulation	a) Biological control Existing species and levels of natural enemies in Asian rice areas are currently regarded as the key to the brown plant hopper management. *N. lugens* is normally controlled at low levels by the numerous predators, egg and nymphal parasites, pathogens and nematodes found in ricefield environments (CABI, online; Gurr et al., 2011). The fish *Anabas testudineus* caused a significant reduction of *N. lugens* population by 51% 85 days after sowing (Fahad et al., 2021). b) Mass trapping Light and yellow pan traps can be used.	Spread/Impact
Chemical treatments on crops including reproductive material	Several Economic Injury and Threshold Levels (ETL) were calculated at different growing stages in different countries (CABI, online). Five to ten *N. lugens* nymphs/plant at the seedling stage and 15 to 20 nymphs/plant represent the ETL causing yellowing in the lower leaves, and then wilting and death in the paddy crop (Kushwaha et al., 2016). In the 1980s, it was recognised that the over-use of insecticides was the root cause of outbreaks. Biological control, complemented by host-plant resistance, is now seen as the basis of management of *N. lugens* (Way and Heong, 1994). IPM programs emphasise that the routine use of insecticides should be avoided (Gallagher et al., 1994; Matteson et al., 1994). In temperate areas, where *N. lugens* does not overwinter, waves of migration in each cropping season can lead to a sudden build-up of the	Entry/Establishment/Impact

Control measure/ Risk reduction option (Blue underline = Zenodo doc, Blue = WIP)	RRO summary	Risk element targeted (entry/establishment/ spread/impact)
	population. Consequently, insecticide use is more often needed in these areas than in the tropics, but should still be kept to a minimum. Kumar and Singh (2020) list active ingredients used in Asia for the management of *N. lugens*.	
Chemical treatments on consignments or during processing	Use of chemical compounds that may be applied to plants or to plant products after harvest, during process or packaging operations and storage.	Entry/Spread
	The treatments addressed in this information sheet are: a) fumigation; b) spraying/dipping pesticides; c) surface disinfectants; d) process additives; e) protective compounds	
Conditions of transport	Specific requirements for mode and timing of transport of commodities to prevent escape of the pest and/or contamination. a) physical protection of consignment b) timing of transport/trade	Entry/Spread
Controlled atmosphere	Treatment of plants by storage in a modified atmosphere (including modified humidity, O_2, CO_2, temperature, pressure).	Entry/Spread (via commodity)

3.6.1.2. Additional supporting measures

Potential additional supporting measures are listed in Table 7.

Table 7: Selected supporting measures (a full list is available in EFSA PLH Panel, 2018) in relation to currently unregulated hosts and pathways. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk reduction options that do not directly affect pest abundance

Supporting measure (Blue underline = Zenodo doc, Blue = WIP)	Summary	Risk element targeted (entry/establishment/ spread/impact)
Inspection and trapping	Inspection is defined as the official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations (ISPM 5). The effectiveness of sampling and subsequent inspection to detect pests may be enhanced by including trapping and luring techniques. Timely detection of brown planthopper incidence in the crop, through regular monitoring, is the key to effective pest management. Plant-shaking and light traps can be used to detect this planthopper (Hu et al., 2014. Hyperspectral remote sensing was also used to detect damaged plants by this pest (Prasannakumar et al., 2013).	Entry/Establishment/Spread

Supporting measure (Blue underline = Zenodo doc, Blue = WIP)	Summary	Risk element targeted (entry/establishment/ spread/impact)
Laboratory testing	Examination, other than visual, to determine if pests are present using official diagnostic protocols. Diagnostic protocols describe the minimum requirements for reliable diagnosis of regulated pests.	Entry/Spread
Sampling	According to ISPM 31, it is usually not feasible to inspect entire consignments, so phytosanitary inspection is performed mainly on samples obtained from a consignment. It is noted that the sampling concepts presented in this standard may also apply to other phytosanitary procedures, notably selection of units for testing. For inspection, testing and/or surveillance purposes the sample may be taken according to a statistically based or a non-statistical sampling methodology.	Entry
Phytosanitary certificate and plant passport	An official paper document or its official electronic equivalent, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (ISPM 5) a) export certificate (import) b) plant passport (EU internal trade)	Entry/Spread
Surveillance	Surveillance to guarantee that plants and produce originate from a Pest Free Area could be an option.	Spread

3.6.1.3. Biological or technical factors limiting the effectiveness of measures

In case the European Commission wishes to introduce measures, the following could be limiting factors:

- Eggs may not be easily detectable as they are laid into in the leaf sheath tissues;
- long-distance migration;
- resistance to insecticides;
- overcoming resistance.

3.7. Uncertainty

No key uncertainties have been identified.

4. Conclusions

There is no data about rice being imported as freshly cut plants and/or growing plants for planting (excluding seed). Environmental conditions are not suitable for establishment, and consequently impacts are not expected. *N. lugens* does not satisfy the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest (Table 8).

Table 8: The Panel's conclusions on the pest categorisation criteria defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Key uncertainties
Identity of the pest (Section 3.1)	The identity of the species is established and *Nilaparvata lugens* (Stål) is the accepted name. Morphological and molecular identification methods are available.	None

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Key uncertainties
Absence/presence of the pest in the EU (Section 3.2)	*N. lugens* is not known to occur in the EU territory.	None
Pest potential for entry, establishment and spread in the EU (Section 3.4)	*N. lugens* is unlikely to enter, become established or spread within the EU territory. A possible but unlikely potential pathway is import of infested freshly cut plants or plants for planting, for which we have no evidence of trade. Rice is mainly planted from seed; when transplanted, it is sourced locally. *N. lugens* cannot survive year-round in the EU due to unsuitable climate and lack of hosts during winter.	None
Potential for consequences in the EU (Section 3.5)	If *N. lugens* established in the EU, it could have an economic impact. However, establishment is not considered possible.	None
Available measures (Section 3.6)	In a scenario where rice seedlings are imported, there are measures available to prevent entry, establishment and spread of *N. lugens* within the EU. Risk reduction options include inspections, chemical treatments, biological control on the crop and use of resistant varieties (although the pest has been developing resistance to insecticides and to resistant varieties), and the production of plants for import in the EU in pest free area.	None
Conclusion (Section 4)	*N. lugens* does not satisfy the criteria, that are within the remit of EFSA to assess, for it to be regarded as a potential Union quarantine pest.	None
Aspects of assessment to focus on/ scenarios to address in future if appropriate:	It would be worthwhile noting whether *N. lugens* establishes within 500 km of EU rice growing areas. This could result in transient populations in the EU due to the pest's ability to migrate up to 500 km.	

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Abbreviations

EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
MS	Member State
PAFF	The Standing Committee on Plants, Animals, Food and Feed (PAFF Committee)
PLH	EFSA Panel on Plant Health
PZ	Protected Zone
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference

Glossary

Containment (of a pest)	Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO, 2021)
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 2021)
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2021)
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2021)
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2021)
Greenhouse	A walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material and energy with the surroundings and prevents release of plant protection products (PPPs) into the environment.
Hitchhiker	An organism sheltering or transported accidentally via inanimate pathways including with machinery, shipping containers and vehicles; such organisms are also known as contaminating pests or stowaways (Toy and Newfield, 2010).

Impact (of a pest)	The impact of the pest on the crop output and quality and on the environment in the occupied spatial units
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO, 2021)
Pathway	Any means that allows the entry or spread of a pest (FAO, 2021)
Phytosanitary measures	Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2021)
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2021)
Risk reduction option (RRO)	A measure acting on pest introduction and/or pest spread and/or the magnitude of the biological impact of the pest should the pest be present. A RRO may become a phytosanitary measure, action or procedure according to the decision of the risk manager
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO, 2021)

Appendix A – *Nilaparvata lugens* host plants/species affected

Source: EPPO Global Database (EPPO, online)

Host status	Host name	Plant family	Common name	
Cultivated hosts	*Oryza*	Poaceae		EPPO (online)
	Oryza sativa	Poaceae	Rice	EPPO (online)
	*Zizania palustris**	Poaceae	Lake rice	EPPO (online)
Wild weed hosts	*Leersia oryzoides**	Poaceae	Cutgrass	EPPO (online)

*: No reference provided to support this species as a host.

Appendix B – Distribution of *Nilaparvata lugens*

Distribution records based on EPPO Global Database (EPPO, online) and CABI CPC (CABI, online).

Region	Country	Sub-national (e.g. State)	Status	References
Asia	Bangladesh		Present, widespread	EPPO (online)
	Brunei Darussalam		Present, no details	EPPO (online)
	Cambodia		Present, no details	EPPO (online)
	China		Present, widespread	EPPO (online)
	China	Anhui	Present, no details	EPPO (online)
	China	Chongqing	Present, no details	CABI (online)
	China	Fujian	Present, no details	EPPO (online)
	China	Guangdong	Present, no details	EPPO (online)
	China	Guangxi	Present, no details	EPPO (online)
	China	Guizhou	Present, widespread	CABI (online)
	China	Hainan	Present, no details	EPPO (online)
	China	Hebei	Present, no details	EPPO (online)
	China	Henan	Present, no details	EPPO (online)
	China	Hubei	Present, no details	EPPO (online)
	China	Hunan	Present, no details	EPPO (online)
	China	Jiangsu	Present, no details	EPPO (online)
	China	Jiangxi	Present, no details	EPPO (online)
	China	Jilin	Present, no details	EPPO (online)
	China	Liaoning	Present, no details	EPPO (online)
	China	Shandong	Present, no details	EPPO (online)
	China	Shanxi	Present, no details	EPPO (online)
	China	Sichuan	Present, no details	CABI (online)
	China	Xianggang (Hong Kong)	Present, no details	EPPO (online)
	China	Yunnan	Present, widespread	EPPO (online)
	China	Zhejiang	Present, no details	EPPO (online)
	India		Present, no details	EPPO (online)
	India	Andhra Pradesh	Present, no details	EPPO (online)
	India	Arunachal Pradesh	Present, widespread	CABI (online)
	India	Assam	Present, widespread	CABI (online)
	India	Bihar	Present, no details	EPPO (online)
	India	Delhi	Present, no details	CABI (online)
	India	Gujarat	Present, no details	CABI (online)
	India	Haryana	Present, no details	EPPO (online)
	India	Himachal Pradesh	Present, no details	EPPO (online)
	India	Karnataka	Present, no details	EPPO (online)
	India	Kerala	Present, no details	EPPO (online)
	India	Madhya Pradesh	Present, no details	EPPO (online)
	India	Maharashtra	Present, widespread	CABI (online)
	India	Meghalaya	Present, widespread	CABI (online)
	India	Odisha	Present, no details	EPPO (online)
	India	Punjab	Present, no details	EPPO (online)
	India	Tamil Nadu	Present, no details	EPPO (online)
	India	Uttar Pradesh	Present, no details	EPPO (online)
	India	West Bengal	Present, no details	EPPO (online)
	Indonesia		Present, no details	EPPO (online)
	Indonesia	Java	Present, no details	EPPO (online)

Region	Country	Sub-national (e.g. State)	Status	References
	Indonesia	Kalimantan	Present, no details	EPPO (online)
	Indonesia	Lesser Sunda Islands	Present, no details	CABI (online)
	Indonesia	Maluku	Present, no details	EPPO (online)
	Indonesia	Nusa Tenggara	Present, no details	EPPO (online)
	Indonesia	Sulawesi	Present, no details	EPPO (online)
	Indonesia	Sumatra	Present, no details	EPPO (online)
	Japan		Present, widespread	EPPO (online)
	Japan	Hokkaido	Present, widespread	CABI (online)
	Japan	Honshu	Present, no details	EPPO (online)
	Japan	Shikoku	Present, widespread	CABI (online)
	Korea Dem. People's Republic		Present, no details	EPPO (online)
	Korea, Republic		Present, no details	EPPO (online)
	Laos		Present, widespread	EPPO (online)
	Malaysia		Present, no details	EPPO (online)
	Malaysia	Sabah	Present, no details	EPPO (online)
	Malaysia	Sarawak	Present, no details	CABI (online)
	Malaysia	West	Present, no details	EPPO (online)
	Myanmar		Present, no details	EPPO (online)
	Nepal		Present, no details	EPPO (online)
	Pakistan		Present, no details	EPPO (online)
	Philippines		Present, no details	EPPO (online)
	Singapore		Present, no details	EPPO (online)
	Sri Lanka		Present, no details	EPPO (online)
	Taiwan		Present, no details	EPPO (online)
	Thailand		Present, no details	EPPO (online)
	Vietnam		Present, no details	EPPO (online)
Oceania	Australia		Present, no details	EPPO (online)
	Australia	Northern Territory	Present, no details	EPPO (online)
	Australia	Queensland	Present, no details	EPPO (online)
	Fiji		Present, no details	EPPO (online)
	Guam		Present, no details	EPPO (online)
	Micronesia		Present, no details	EPPO (online)
	New Caledonia		Present, widespread	CABI (online)
	Northern Mariana Islands		Present, no details	EPPO (online)
	Palau		Present, no details	EPPO (online)
	Papua New Guinea		Present, no details	EPPO (online)
	Solomon Islands		Present, no details	EPPO (online)