The Food & Environment Research Agency

Rapid Pest Risk Analysis for

Xiphinema americanum s.l. (European populations)

This document provides a rapid assessment of the risks posed by the pest to the UK in order to assist Risk Managers decide on a response to a new or revised pest threat. It does not constitute a detailed Pest Risk Analysis (PRA) but includes advice on whether it would be helpful to develop such a PRA and, if so, whether the PRA area should be the UK or the EU and whether to use the UK or the EPPO PRA scheme.

STAGE 1: INITIATION

1.What is the name of the pest?

Xiphinema americanum sensu lato

Synonyms: None

Taxonomic position: Nematoda: Dorylaimida: Longidoridae

Common names: American dagger nematode, dagger nematodes

Xiphinema americanum sensu lato, is considered to comprise at least 51 morphologically closely related species (Lamberti *et al*., 2000), although a recent proposal has been made to increase this number to 56 (Prior, pers. comm. 2014).

2. What is the pest's status in the EC Plant Health Directive (Council Directive 2000/29/EC[1]) and in the lists of EPPO[2]?

EU Annex designation: IAI for non-European populations of *Xiphinema americanum sensu lato.* One member of this group, *X. californicum,* is listed separately.

EPPO designation: EPPO A1 for *Xiphinema americanum s. l.* no. 150, *Xiphinema bricolense* no. 260, *Xiphinema californicum* no. 261 and EPPO A2 for *Xiphinema rivesi* no. 262.

3. What is the reason for the rapid assessment?

As recommended by the UK Plant Health Risk Register, to evaluate the threat posed by the European species of the *Xiphinema americanum s.l*. group to the UK and assess whether statutory action is appropriate on detection. Non-European species of the group are already controlled by EU legislation.

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[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0029:20100113:EN:PDF
[2] http://archives.eppo.int/EPPOStandards/PM1_GENERAL/pm1-02(21)_A1A2_2012.pdf

It was noted that an updated risk assessment is needed for this group due to significant uncertainties and gaps in the regulation of the main pathway. This PRA takes account of the findings of the detailed PRA produced by the Netherlands (van der Gaag et al., 2010).

Because of the lower intensity of border inspections applied to plants and plant products moving between EU MS, and the lack of restrictions on bulk soil moving between EU MS, it is likely that European species within the *X. americanum* group could enter the UK undetected and become established.

The phytosanitary risk of X*. americanum s.l*. is primarily the ability of some of these populations (or vector species within the *X. americanum* group) to transmit the following EU IAI listed nepoviruses:

- *Tomato ringspot nepovirus* (ToRSV)*
- *Tobacco ringspot nepovirus* (TRSV)*
- *Cherry rasp leaf nepovirus* (CRLV)
- *Peach rosette mosaic nepovirus* (PRMV)

Two of these nepoviruses, ToRSV and TRSV, are known to have limited distribution in some European countries (possibly including the UK) and one nematode virus vector species, *X. rivesi*, within the *X. americanum* group, also has limited distribution within some European countries but not the UK (ref. Section 4b).

X. rivesi, the only known virus vector species within the European population of *X. americanum s.l*., is known to be capable of transmitting ToRSV and TRSV and possibly CRLV. *X. rivesi* is absent from the UK and thus this nematode presents a quarantine risk to the UK. It is possible that were it to become established it would be capable of facilitating the spread of both ToRSV and TRSV. In the absence of the vector both ToRSV and TRSV could spread in the UK by vegetative propagation or seed (EPPO 1997a,b). However, it should be noted that research on the ability of many *X. americanum s.l.* species to transmit viruses has not been carried out, and thus the vector potential of the other European species has not been assessed. No other nepoviruses which occur in the UK are known to be transmitted by X*. americanum s.l*.

STAGE 2: RISK ASSESSMENT

4. What is the pest's present geographical distribution?

Seventeen of the 56 species of the *Xiphinema americanum s. l*. complex, including one known virus vector, *X. rivesi,* are already established in several EU member states.

The risk to the UK posed by X*. americanum s.l*. is the risk of *X. rivesi* being transported in association with one or both of the two viruses (ToRSV and TRSV) known to be present in Europe.

For this reason, the European distribution of X*. americanum s.l*. and the vector species *X. rivesi*, as well as the viruses ToRSV and TRSV, is detailed below.

4a. European Distribution of *Xiphinema americanum s.l.* and *X. rivesi*

Species in the *Xiphinema americanum s.l.* group occur on all continents except Antarctica; these include known virus vector species. They have not to date been recorded in the most northerly regions of Europe (Sweden and Finland) (van der Gaag *et al*, 2010). The distribution of many or all species in the group is probably under-reported, as they require specialist identification.

The following species in the *Xiphinema americanum s.l.* group are already established in some EU countries (see below) (van der Gaag *et al*., 2010) but not in the UK:

Widespread	**Locally distributed**	
X. pachtaicum	*X. brevicolle*	*X. opisthohysterum*
	X. brevisicum	*X. pachydermum*
	X. diffusum	*X. parabrevicolle*
	X. duriense	*X. parapachydermum*
	X. fortuitum	*X. parasimile*
	X. incertum	*X. paratenuicutis*
	X. longistillum	*X. rivesi*
	X. madeirense	*X. santos*
	X. mesostillum	*X. simile*
	X. microstillum	*X. taylori*

With the exception of *X. rivesi* these are not known to be virus vector species (Lamberti *et al*., 2000), though the vector potential of many species has not been studied and thus additional species may, in fact, be capable of vectoring viruses.

X. rivesi is present in several EU countries (Lamberti & Ciancio, 1993; Lamberti et al., 2000; EPPO, 2014; CABI, 2007; Sirca *et al*., 2007) although it has not, so far, been implicated in the transmission of the viruses in Europe (van der Gaag *et al*, 2010).

Occurrence of *X. americanum s.l.*	**Occurrence of *X. rivesi***	**Reference**
Bulgaria	Y	Lamberti et al 2000
France	Y	Lamberti et al 2000
Germany	Y	Lamberti et al 2000
Italy	Y	CABI 2007,
Portugal	Y	CABI 2007, Lamberti et al 2000
Slovenia	Y	Urek et al 2003, 2005
Spain	Y	Bello et al 2005, CABI 2007, Lamberti et al 2000

4b. European Distribution of ToRSV and TRSV

The current European distribution of ToRSV and TRSV is shown below (EPPO, 2014).

Virus	Occurrence in Europe
ToRSV	Belarus, Croatia, France, Germany*, Italy, Lithuania, Russia, Serbia, Slovakia, Slovenia, Turkey
TRSV	Czech Republic*, Georgia, Hungary, Italy, Lithuania, Poland, Russia, Serbia, Turkey, Ukraine

* Occasionally reported

ToRSV and TRSV are occasionally reported from plant nurseries in the UK. There were frequent findings of ToRSV on pelargonium plants imported from America between 1996 and 2004 but the virus did not become established and is now considered to be absent from the UK. TRSV was last reported in the UK on *Lactuca sativa* seed on a plant nursery in Cambridgeshire in 2011 (but not on growing plants) and, like ToRSV, may not be established in the country.

5. Is the pest established or transient, or suspected to be established/transient in the UK?

The *Xiphinema americanum* group is not known to be established in the UK although it is possible that populations exist in imported containers of large ornamentals that were not checked or missed during sampling at border inspection posts or could have been introduced in soil on planting material from other parts of the EU.

Whilst the pest is unlikely to be established outdoors in the UK (Prior, Pers. Comm.), the difficulty of detecting species of *Xiphinema* at low population densities as well as the lack of recent surveys (most recent survey 1986) for the pest in the UK suggests that the uncertainty in this area is relatively high. However, according to van der Gaag et al (2010), adults of species within the *Xiphinema americanum* group are relatively easy to distinguish from other *Xiphinema* spp. as well as species of other related genera within the Longidoridae. However, distinguishing *X. rivesi* from other members of *X. americanum s.l.* is much more difficult, and may require examination by a specialist in the group, or molecular identification. Juveniles cannot be identified beyond the genus (T. Prior, pers. comm.).

Since 1995 PHSI has made interceptions of this pest from the following EU MS and third countries:

Year	Pest	Host	Country of origin
1995	*Xiphinema americanum s.l.*	*Acer palmatum, Bambusa vulgaris, Ficus* sp.*, Ligustrum* sp.*, Serissa foetida, Zelkova serrata* – all bonsai plants for planting	China
1996	*Xiphinema* sp.	Unknown bonsai species	China
1998	*Xiphinema* sp.	*Ulmus sp.*- bonsai	Netherlands
2004	*Xiphinema americanum s.l.*	*Dicksonia* sp.	New Zealand
2006	*Xiphinema americanum s.l.*	*Ilex crenata*	Japan
2008	*Xiphinema rivesi*	*Trachycarpus fortunei*	Spain
2012	*Xiphinema americanum s.l.*	*Medicago sativum* seed	Australia
2012	*Xiphinema americanum s.l.*	*Podocarpus macrophyllus* cuttings	China
2012	*Xiphinema* sp.	*Pachira aquatic* *Araucaria* sp. *Ficus* sp.	China
2012	*Xiphinema* sp.	*Taxus cuspidate* (planted)	Japan
2012	*Xiphinema americanum s.l.*	*Camellia* sp *Cornus* sp. *Loropetalum chinense*	Japan
2013	*Xiphinema* sp.	bonsai	Japan

A total of 172 interceptions of *Xiphinema americanum* and *Xiphinema* sp. from a total of 23 countries have been notified to EUROPHYT by EU MS (including Switzerland) since 1995. Countries of origin included Japan (95 cases), China (26 cases), Italy (11 cases), Egypt (5 cases), USA (3 cases). All interceptions have been on plants for planting with most interceptions associated with bonsai from Japan and China.

A number of the interceptions categorised as *Xiphinema* sp. are likely to be species of the *Xiphinema americanum* group but the number of species within the *Xiphinema americanum* group relative to other *Xiphinema* spp. cannot be estimated from interception data.

Furthermore, juveniles can only be identified to the genus *Xiphinema*, and in a limited amount of material, adult nematodes may not be present.

6. What are the pest's natural and experimental host plants; of these, which are of economic and/or environmental importance in the UK?

The pest is polyphagous. Economic effects are largely limited to transmission of four nepoviruses (above), two of which have limited distribution in Europe, including the UK. The hosts of the two European viruses according to EPPO (2014) are shown in the table below:

ToRSV	TRSV
Major hosts	
Pelargonium hortorum *Prunus persica* *Rubus idaeus*	*Glycine max* *Nicotinia tabacum*
Minor hosts	
Fragaria x ananassa Gladiolus *Hydrangea macrophylla* *Pelargonium* *Prunus* spp. *Prunus avium* *Prunus domestica* *Prunus dulcis* *Ribes* nigrum *Ribes uva-crispa* *Rubus* spp. *Rubus fruticosus* *Vaccinium corymbosum* *Vitis vinifera* Woody plants	*Cucurbita pepo* Cucurbitaceae *Vaccinium* *Vaccinium corymbosum* Woody plants
Incidental	
Fraxinus americana *Malus* sp. *Rubus laciniatus* *Solanum lycopersicum*	Anemone *Capsicum* sp. Carica papaya *Cornus* sp. *Fraxinus* sp. Gladiolus Iris *Lupinus* sp. *Malus domestica* *Mentha* sp. *Narcissus pseudonarcissus* *Pelargonium* *Petunia* *Phlox subulata* *Prunus avium* *Rubus fruticosus* *Sambucus* sp. *Solanum melongena* *Sophora microphylla* *Vitis vinifera*
Wild/weed	
Stellaria media	
Taraxacum officinale	

X. *americanum s.l.* species, in the absence of virus, are not known to cause significant losses in the areas of continental Europe where they occur.

Van der Gaag *et al* (2010) have reported additional hosts of the two viruses. It is likely, however, that there are more hosts yet to be identified, some of which could be of economic importance.

7. If the pest needs a vector, is it present in the UK?

N/A

8. What are the pathways on which the pest is likely to move and how likely is the pest to enter the UK? (*By pathway*):

- Soil associated with plants for planting
- Plant products with attached soil
- Bulk soil
- Contamination of other goods (farm machinery, footwear etc.) with soil

X. americanum s.l. is entirely soil living, feeding on roots of plants. Bare rooted plants free from soil do not, therefore, present a pathway for entry of the pest. The pest is transported solely in soil associated with plants for planting, plant products (such as ware potatoes contaminated with soil), bulk soil and any other goods contaminated with soil.

There is a lack of definitive information on the pest's ability to survive for extended periods in dry soil although some studies suggested survival is limited in such conditions (Griffin and Barker, 1966; Sutherland and Slugget, 1974; Harris, 1979; Sultan and Ferris, 1991). However the vector species may lose the ability to transmit viruses after air drying at 22-30°C for 1-3 weeks (Iwaki and Komuro, 1974).

The nematode is thought to be unable to establish in soil-free growing media in the absence of clay or sand.

The widespread trade of plants for planting between EU MS would suggest that this pathway presents the greatest risk of entry of the pest into the UK.
For example, in 2008, the UK imported around €193 million of nursery stock (with soil) from the Netherlands (68%), Italy (9%) and Germany, France and Spain (around 8%) (Van der Gaag *et al.*, 2010). No information is readily available on whether any of these imported plants originated in *X. americanum s.l.* or *X. rivesi* contaminated areas.

	Very unlikely	Unlikely	Moderately likely	Likely	Very Likely
Plants for planting with soil				✓	
Soil with potato or other commodity		✓			
Soil with other imported goods		✓			

	Very unlikely	Unlikely	Moderately likely	Likely	Very Likely
Bulk soil	Very unlikely		Unlikely		Moderately likely	✓	Likely		Very Likely	

Both ToRSV and TRSV could enter the UK along with the vector by any of the above pathways. In the absence of the nematode vector both ToRSV and TRSV could enter the UK on plants for planting having been infected in a supplier nursery or through seed (EPPO, 1997 a,b). Diseased plants may escape detection as symptoms are not always evident. Vegetative propagation and distribution from British nurseries could then lead to spread of one or both viruses in the UK.

9. How likely is the pest to establish outdoors or under protection in the UK?

Species of the *Xiphinema americanum s. l.* complex have been recorded on all continents. Nepovirus vector species have been recorded on all continents except Antarctica in a wide range of environments (van der Gaag *et al*, 2010). In Europe the pest has not been recorded in the northern regions including Sweden and Finland (van der Gaag *et al*, 2010). It is likely, therefore, that the pest would be capable of establishing in soils outdoors and under protected cultivation throughout the UK with the possible exception of northern Scotland. Because the nematode is normally present in the soil in low numbers (~200/gm), and does not always cause obvious aerial or root symptoms in the absence of virus, it is likely that the pest would establish and spread widely in the field before being detected. Detection is more likely in protected cultivation.

	Very unlikely		Unlikely		Moderately likely		Likely		Very likely	
Outdoors:										✓
Under protection:										✓

10. How quickly could the pest spread in the UK?

The pest is likely to be carried over short distances in contaminated soil on boots and farm machinery. Spread within fields would also be facilitated in areas where flooding occurs. Under these circumstances spread over long distances would be expected to be slow. Spread would likely be rapid and over long distances with the trade in pot plants and, potentially, soil attached to root produce.

	Very slowly		Slowly		Moderate pace		Quickly		Very quickly	
Natural spread:		✓								
In trade:						✓				

11. What is the area endangered by the pest?

Because of the widespread geographical distribution of the pest, and its polyphagous nature, it is likely that the pest would be capable of spreading and establishing throughout most of the UK although natural spread is likely to be extremely slow. In the absence of associated viruses it is unlikely that the pest would be of major concern due to the fact that when present, it is usually found in low numbers.

12. What is the pest's economic, environmental or social impact within its existing distribution?

12 a. Direct effects of *Xiphinema americanum s. l.* in the current distribution

When present in large numbers the pest can cause direct adverse effects by damaging plant roots and indirect effects by its ability to transmit nepoviruses.

In America, *X. americanum* in association with other plant parasitic nematodes has been associated with yield losses in peach orchards (Walters *et al*, 2008) although the pest is generally considered not to cause major negative impacts in areas where it is present on crops (EPPO 1997c, Pinkerton *et al*, 2008). The related species *X. diversicaudatum* is widely distributed throughout Europe and has similar feeding patterns to *Xiphinema americanum s. l.* but has not been recorded as a major pest in its area of distribution (van der Gaag *et al*, 2010), although it is able to transmit nepoviruses in fruit plants.

Very small		Small	✓	Medium		Large		Very large	

12b. Indirect effects of associated viruses in the current distribution

Both ToRSV and TRSV have wide host ranges. Van der Gaag *et al* (2010) reviewed the reported effects of the viruses on economically important crops. Adverse economic effects caused by ToRSV are principally related to fruit crops, particularly grapes and raspberries. In grapes, yield reductions of between 37 and 63% were reported in vineyards in New York, USA. Fifty percent yield reductions were reported in some raspberry cultivars whilst other cultivars were unaffected. ToRSV was also implicated in apple union necrosis and decline in American apple orchards. Severe losses have also been reported on blueberry in New York and peach in Pennsylvania. The virus is known to infect species of *Prunus*, *Ribes* and *Rubus* but no reduction in yield has been reported in these crops. Among the horticultural crops ToRSV has been reported to produce symptoms on leaves of pelargonium making plants unmarketable. In Turkey, symptoms of infection were reported on wild blackberry plants, but not in neighbouring peach orchards (Sertkaya, 21010). In Lithuania, ToRSV was detected in 4.6% of one raspberry cultivar (Stankienė *et al.,* 2012), but impacts due to the virus infection are unknown.

TRSV causes yield losses in soybean and blueberries in the USA. Serious losses were also reported in grapes in vineyards affected by a dual infection of TRSV and ToRSV. The virus also affects cucurbits but causes only minor damage to this crop. Elsewhere, 60-80% yield losses were reported in aubergine in India and minor losses were reported in capsicum in Mexico.

Very small		Small		Medium	✓	Large		Very large	

13. What is the pest's potential to cause economic, environmental or social impacts in the UK?

13a. Direct effects of *Xiphinema americanum s. l.* in the UK

Limited, because evidence suggests that it causes little direct mechanical feeding damage to plants in Europe. It is possible that it could cause localised losses to apple and other fruit crop production if it became established in orchards over a number of years. However, there is no evidence for this in continental Europe and it is thought unlikely given the absence of economic effects caused by the closely related nematode species *X. diversicaudatum* (Section 12) in Europe and the UK. Losses to tomato production would likely be limited because most UK crops are produced in soil free media with the possible exception of organic crops.

Very small		Small	✓	Medium		Large		Very large	

13b. Indirect effects of associated viruses in the UK

Both viruses have wide host ranges, though most impacts are seen on fruit crops. Due to the impacts on raspberries and apples in North America, the impact to UK crops is assessed as medium.

Very small		Small		Medium	✓	Large		Very large	

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

Xiphinema americanum s. l is currently considered to include at least 56 species, the following seven of which have been shown to transmit one or more of the EU IAI viruses listed with them:

X. americanum s.s. CLRV, TRSV, ToRSV, PRMV(?)
X. bricolensis ToRSV
X. californicum CLRV, TRSV, ToRSV
X. intermedium TRSV, ToRSV
X. rivesi CLRV, TRSV, ToRSV
X. tarjanense TRSV, ToRSV
X. inaequale ToRSV (Verma *et al.*, 2003)

Only *X. rivesi* is known to occur in the EU countries listed in section 4. Two of the above viruses (ToRSV and TRSV) have a limited distribution in some EU countries (despite their EU 1A1 status) and it has been demonstrated experimentally that *X. rivesi* is capable of transmitting them. However, field transmission of ToRSV and TRSV by *X. rivesi* has not thus far been demonstrated in any EU country. It is suspected that the viruses spread in these countries without the vector nematode mainly by plant propagation, mechanical transmission or infected seeds.

STAGE 3: PEST RISK MANAGEMENT

15. What are the risk management options for the UK?

Exclusion

The non-European populations of *X. americanum s.l.* are prohibited from entry into the EU because of the risk that they may be carrying four viruses – ToRSV, TRSV, CRLV and PRMV listed in IIAII of Directive 2000/29/EC. This means that if any species of *X. americanum s.l.* is found in imports from non-European countries they will be deemed to be 'non-European' and prohibited from entry.

'European populations' of the nematode are not presently regulated because the four viruses are listed as generally not known to occur in the EU (even though two are present in a limited number of European countries), are prohibited during intra-EU trade and will have eradicatory action taken against them. In addition, the viruses have not been reported as found in the *X. americanum s.l.* nematode vectors in the environment.

The possibility of exclusion of the 'European populations' of the pest is considered to be low in view of the high level of trade in potted plants and planting material such as fruit plants or seed potatoes (with soil) within the EU, where the pest is established in several countries (France, Germany, Italy, Portugal, Spain, Slovenia), together with the lower level of inspection for intra-EU trade and the difficulty of detection: the nematode will not be found unless targeted surveys are carried out. As the pest is present within the EU it would not be appropriate to list it in Directive 2000/29/EC ('Plant Health Directive') with requirements for all the MS.

Van der Gaag et al (2010) carried out an analysis of management options for *X. americanum s.l.* and concluded that the most effective way to prevent introduction of vector species of *X. americanum s.l.* would be to establish measures at the places of production to ensure that:

- "plants should originate from a pest free production area (for both *X. americanum s.l.* and its associated viruses ToRSV and TRSV), place of production or production site"
- "plants should be grown in a soilless medium"

Both these management options would be effective for both plants for planting and plant products (e.g. potato tubers or other root crops with soil attached). Implementation of either might adversely affect trade and the measures may not be cost effective in view of the fact that direct damage from the pest is generally considered to be low.

A Protected Zone approach could be considered for the UK. To obtain a protected zone a national survey of UK soils would be needed to provide evidence of freedom of the pest (i.e. all its different species). It is possible that the pest is already present in the UK due to the movement of soil into the UK from infested area. It is very possible that the nematodes could remain undetected for some time due to the limited damage they cause in the absence of the viruses they vector. However if the UK could be shown to be free from the pests requirements could be introduced via listing of the pest (either as *X. americanum s.l.* or *X. rivesi*), in either Annex IB or IIB of Directive 2000/29/EC, but as the pest can be found in soil which is not associated with host plants, requirements would need to be particularly onerous and include restrictions on the movement on all plants for planting with soil from area where the pest is known to occur. Specific measures could include requirements that plants have originated in a place of production which has been shown to be free from both the vector and the viruses or plants have been produced in a soil free media. This would be very difficult to justify due to the high costs involved compared to the small direct and indirect economic, environmental or social impacts envisaged for the UK.

Eradication

The possibility of eradication of *X. americanum s.l.* once established on agricultural land is considered to be extremely low in view of its ability to survive in the field in the absence of host plants. Additionally, low populations would normally be present in regularly cultivated agricultural soil. Gross symptomology of plants cannot be used to identify nematode damage from, e.g., deficiency symptoms; soil analysis would be required to confirm the presence of *Xiphinema* spp; and specialist identification to distinguish indigenous *Xiphinema* species from *X. americanum s.l*. It is therefore, likely that the pest would be widely distributed before detection.

The possibility of eradication from protected cultivation is more feasible with the potential for containment and treatment of soil and equipment. However, without the presence of the viruses it is unlikely that the presence of the nematodes will be detected.

Containment

The possibility of containment of the pest in open cultivation is considered extremely unlikely for the same reasons summarised in “Eradication” above.
The possibility of containment in protected cultivation is likely to be moderately high given the greater possibilities for control under these circumstances.

If outbreaks occurred of one or more of the EU IAI listed viruses in association with a European species of *X. americanum s.l.* then eradication or containment action could take place under EU and UK legislation. However, the nematode is not the only means by which the viruses could enter the UK, it is also possible that the viruses could (and have in the past) enter the UK in infected planting material from outside the EU.

Non-statutory controls

These could be similar to those already used for indigenous *Xiphinema* species and could consist of use of soil-free media, soil treatments by nematicides or very long crop rotation periods without susceptible hosts. In addition, voluntary pre-planting soil sampling and examination and identification of any nematodes found as used currently for other indigenous *Xiphinema* species which vector viruses which are damaging to certain fruit crops, could be carried out if damage to the proposed crop was thought to be likely. However, the success of detecting infestations of nematodes depends on the amount and intensity of sampling that can be conducted as well as the soil and climatic conditions. In general, control measures against nematodes, such as crop rotation, green-manure cover crops and nematicides may reduce population levels but are not likely to prevent establishment.

Sourcing of planting material is important and if of concern, the growers should contact their suppliers to obtain assurance on the quality or sources of material they purchase.

16. Summary and conclusion of rapid assessment.

This rapid assessment shows:

Risk of entry

Risk of entry of *X. americanum s.l.* from continental Europe is high because of the high levels of trade in potted plants with Europe together with the lower levels of inspection of these plants compared to imports from third countries and the difficulties of detection. The risk of entry of *X. americanum s.l.* carrying the viruses ToRSV or TRSV will be lower, as there is no evidence that European populations of *X. rivesi* (the only known vector species in the *X. americanum s.l.* group present in Europe) are implicated in virus transmission in the field, though they have been shown to be capable vectors experimentally.

The lack of information on the precise origin of imported plants (with soil) from EU MS means that it is not currently known whether any of the imported material is grown in areas where *X. americanum s.l.* is present. In addition, accurate and detailed information on the distribution of *X. americanum s.l.*in Europe is lacking and it is likely that it may be more widespread than the seven EU countries in which it is currently known to occur. The pest may have already entered and become established in the UK, either from third countries or EU MS without being detected, so, whilst the risk of entry is considered to be high, there is also a high level of uncertainty in this assessment.

Risk of establishment

The risk of establishment is considered to be high both outdoors and in protected cultivation, once pest contaminated plant material has entered the UK. This material is likely to be distributed and planted widely throughout the UK. The frequent absence of root and aerial symptoms, and its ability to survive in the soil in the absence of host plants, means that the pest is likely to remain undetected for a considerable period in open cultivation. Under protected cultivation the pest may be detected earlier, but, again, it is possible that the pest would be widely distributed before detection. The risk of establishment is, therefore, considered to be high in both open cultivation and protected cultivation, with the level of uncertainty relatively low in both open and protected cultivation.

Economic impact

The economic impact is likely to be dependent on whether vector species with their associated viruses enter and establish in the UK. Non-vector species of *X. americanum s.l.* are likely to have no or minor economic impacts since they usually have low population densities in regularly cultivated soils. Localised severe economic effects may sometimes be caused in orchard crops or other hosts grown in a manner where the soil is relatively undisturbed, where nematode populations may build up over a number of years in association with the host. Under protected cultivation it is possible that yield reductions may be caused by populations of *X. americanum s.l.* before detection, and if the pest became established under such circumstances the cost of eradication may be high.

Only one vector species, *X, rivesi* within the *X. americanum s.l.* group is known to be established in Europe and this species has not been recorded as being associated with ToRSV or TRSV in Europe.

Based on the reported impacts of ToRSV in the USA, establishment of the virus with its vector *X. rivesi* in the UK would potentially have an adverse impact on raspberry, apple and grape production among the fruit crops and on pelargonium production in the horticultural sector. Other, as yet unidentified, hosts may also exist, particularly in the horticultural sector. Serious losses attributed to TRSV are mainly confined to blueberry and possibly grapes in the USA. The virus has also been reported to cause up to 80% losses in aubergine in India and minor losses in cucurbits in the USA. It may, therefore, have a negative impact on yields of these crops in the UK.

The economic impact is therefore considered to be low with a moderate level of uncertainty.

Endangered area

The endangered area is likely to be the whole of the UK in both open and protected cultivation because X*. americanum s.l.* is known to have established over a wide geographical range world-wide and there is no reason to consider that any area of the UK would be unsuitable to its establishment with the possible exception of northern Scotland.

Risk management

The exclusion of the ‘European populations’ of the pest from the UK is considered to be low in view of the high level of trade in potted plants and planting material such as fruit plants or seed potatoes (with soil) within the EU, where the pest is established, together with the lower level of inspection for intra-EU trade and the difficulty of detection.

Measures taken at the places of production either to ensure pest freedom of the production area, place of production or production site (for both *X. americanum s.l.* and its associated viruses ToRSV and TRSV), or to require that plants are grown in a soilless medium would be effective for both plants for planting and plant products (e.g. potato tubers or other root crops with soil attached). However, implementation of either might adversely affect trade and the measures may not be cost effective in view of the fact that direct damage from the pest is generally considered to be low. It would also be exceptionally difficult for the UK to justify and implement a Protected Zone for *X. americanum s.l.* because of the difficulty of proving pest absence and the need for onerous restrictions on the movement on all plants for planting with soil from areas where the pest is known to occur.

Unless there are controls on the movement of bulk soil and planting material that may have attached soil between EU MS, there is no possibility of containment of *X*. *americanum s.l.* in its current area of distribution. This species group seems to be comparable to *Bemisia tabaci*, i.e., a pest that is not in the UK but already in continental Europe. Without taking action against EU movements, action against ‘non-European’ finds is of limited value. Non-European populations may also be moved to the UK via other Member States, and in that case, it is not possible to distinguish between non-European and European populations and plants.

If recognised as established, pre-planting soil sampling and testing could be carried out if economic damage to the proposed crop was thought to be likely. If found, then alternative fields or soil treatments could then be selected. In general, control measures against nematodes, such as crop rotation, green-manure cover crops and nematicides may reduce population levels but are not likely to eradicate the pest.

17. Is there a need for a detailed PRA? If yes, select the PRA area (UK or EU) and the PRA scheme (UK or EPPO) to be used.

No	✓

Yes		PRA area: UK or EU		PRA scheme: UK or EPPO	

18. IMAGES OF PEST

Photo 1 (pest)	*Photo 2 (e.g. symptoms?)*
Source/ copyright owner	*Source/ copyright owner*

19. Given the information assembled within the time scale required, is statutory action considered appropriate / justified?

Statutory action will continue to be taken against all non-European populations of *X. americanum s.l.*
For European populations of *X. americanum s.l.,* statutory action is not considered appropriate but, where relevant, plants for certification must meet the requirements of the PHPS in relation to the presence of nematodes and associated viruses.

Yes Statutory action	✓	No Statutory action	✓

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Date of production: June 2014

Version no.: 2

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