



Department  
for Environment  
Food & Rural Affairs

# Regulation proposal for potato spindle tuber viroid (PSTVd) on sticky nightshade (*Solanum sisymbriifolium*)

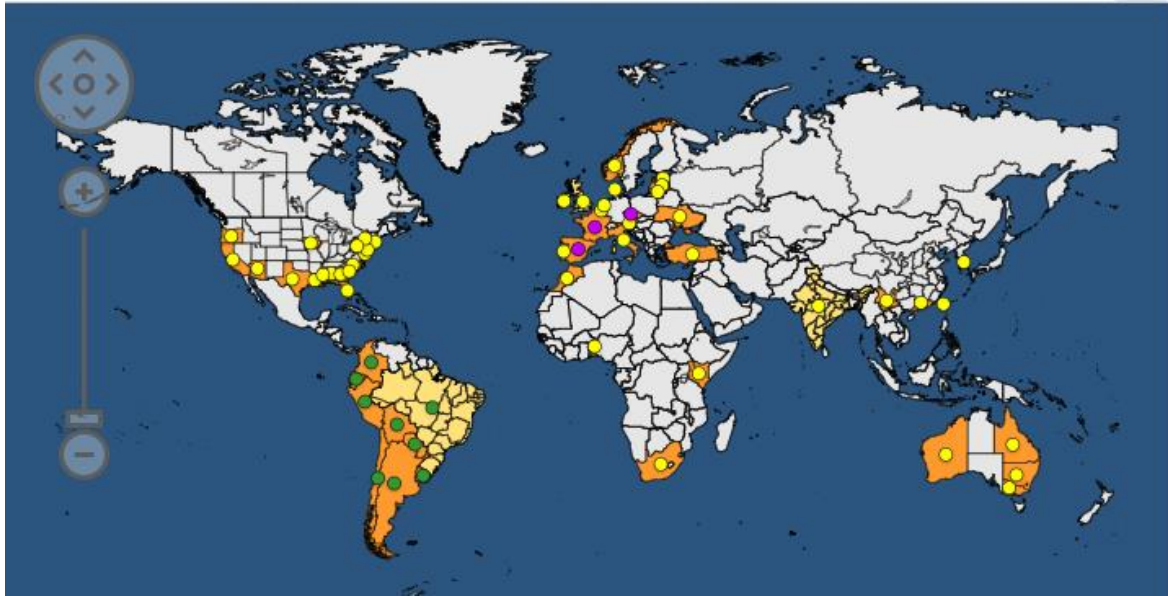
## Objective

To prepare a proposal for the introduction of requirements for PSTVd on sticky nightshade.

## Background

### Sticky nightshade

Sticky nightshade is a solanaceous plant native to South America (Fowkes *et al.*, 2021). It was introduced into Europe as an ornamental plant, but it has recently been added to the EPPO Alert List due to its impact as a weed in Sicily and coastal regions of the Mediterranean (EPPO, 2022; Fowkes *et al.*, 2021). The full distribution of the plant is shown below.



**Figure 1.** Global distribution of sticky nightshade. Green dots represent its native range, yellow dots represent where it is present, and purple dots represent where it is considered to be transient (EPPO, 2022).

Sticky nightshade is used as a trap crop for potato cyst nematodes (PCN), such as *Globodera rostochiensis* and *G. pallida*, because it stimulates the hatching of juvenile PCN from their cysts by root diffusates but it is resistant to infestation by the juveniles once they hatch, preventing reproduction of the nematodes (EPPO, 2022). It can give up to 75% control of PCN.

Sticky nightshade has been used as a trap crop for at least a couple of decades, first being used in the Netherlands, before being introduced as a trap crop in the UK.

The extent of use in the UK has been estimated at between 100-300 ha but could be more. It is expected that the market for sticky nightshade will grow. There are currently only two nematicides on the market: Nemathorin 10G (fosthiazate) and NEMguard PCN granules (garlic extract). There is the possibility that Nemathorin 10G will be withdrawn once it comes up for renewal, reducing the control options available against PCN. The interest in sticky nightshade may also increase if it is recognised as a cover crop in stewardship schemes.

Sticky nightshade is used during a potato rotation. The timing of when it is used varies, but it could be used in the year prior to planting potato or the year after. Generally, it is only used once, as it is an expensive process (£350-400 per hectare). In the year that it is used, seeds are sown between late May and early July and sticky nightshade is grown until the end of September/early October. At that point, the sticky nightshade is cut, macerated and/or ploughed in prior to the fruiting of the plant in mid-October. This reduces the risk of volunteers being produced the following year. It should be noted experience in the UK and the Netherlands is that it can be difficult to establish in cooler conditions.

## Virus and viroid association

As part of a project looking at novel risk pathways, Fera Science Ltd identified alfalfa mosaic virus, endornovirus, potato virus Y and tobacco necrosis virus A and D in sticky nightshade from plant samples taken in the UK. Further action was not taken for this host as a result of these particular findings, because the viruses were not considered to be harmful or were considered to be present in the UK.

In 2018, Fera Science Ltd also carried out testing of sticky nightshade seed as part of commercial “due diligence” testing prior to importing seed into the UK for efficacy trials (Fowkes *et al.*, 2021). As part of this, 5 of the 19 samples tested positive for potato spindle tuber viroid (PSTVd). This viroid has also been intercepted in the Netherlands, suggesting that sticky nightshade is a natural host of PSTVd. There is now evidence that sticky nightshade harbours a regulated pest.

Given that this host can harbour PSTVd and is being used as a trap crop in potato rotations, there is a significant risk of transfer of PSTVd to potatoes. Guatemala, which is mentioned as a source of sticky nightshade seed, also borders Mexico where PSTVd is present and is a source of pospiviroid diversity. Regulation may therefore be justified to reduce this risk.

Other viruses that have been recorded in sticky nightshade include Andean Potato mottle virus (APMoV), tomato chlorosis virus and tomato matilda virus. These appear to be less of a risk than PSTVd.

APMoV is a GB quarantine pest and was recorded naturally infecting sticky nightshade in Brazil (Souza-Diaz *et al.*, No date). However, it may not be APMoV since it was unable to infect potato. Other viruses previously described as APMoV (based on serology) have subsequently, following sequence analysis, been found to be closely related viruses. APMoV has not been reported to be seed transmitted, though other members of the genus Comovirus, of which APMoV is a member, have. Overall, the risk of transmission in seed of sticky nightshade, whether it be APMoV or a closely related Comovirus, is low.

Tomato chlorosis virus is a provisional quarantine pest found naturally infecting sticky nightshade (Arruabarrena *et al.*, 2015), but it is not considered to be seed transmitted, in common with other criniviruses. Also, it is mainly an issue for protected crops, so spread from sticky nightshade in a potato field may be unlikely if present. The virus is vectored by whiteflies, including *Bemisia tabaci* and *Trialeurodes vaporariorum*.

Tomato matilda virus is not a GB quarantine pest. It was first reported in symptomless tomato plants in Australia in 2015 (Saqib *et al.*, 2015). Further study showed it was symptomless in tomato and aubergine and induced mild symptoms in

chili plants. It was recently found infecting wild *Solanum chenopodioides* and *S. sisymbriifolium* in South Africa in 2022 (Mahlanza *et al.*, 2022).

## Other trap crops

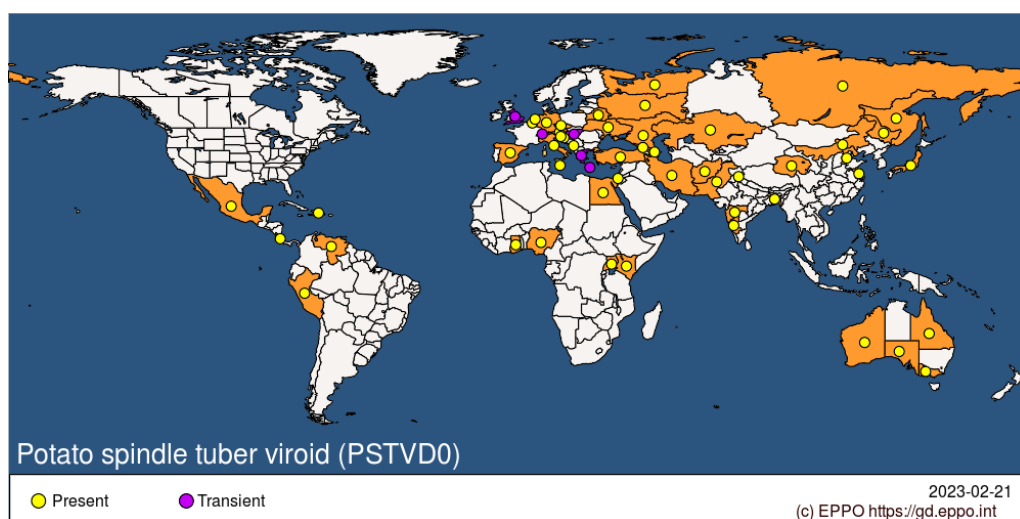
It should be noted that other *Solanum* species may be used as a trap crop in potato plantations and may therefore be a risk (Adrian Fox personal communication, 2022). *Solanum scabrum* (garden huckleberry) and *Solanum chenopodioides* (velvety nightshade) could potentially be used as trap crops. However, harmful viruses have not been recorded in these species yet. Other *Solanum* species that have been imported over the last five years include *Solanum crispum*, *S. jasminoides*, *S. lycopersicum*, *S. melongena*, *S. pseudocapsicum*, *S. stramonifolium*, and *S. tuberosum*.

Trials work is being carried out by Harper Adams in collaboration with other partners on sticky nightshade and *Solanum scabrum*. They are investigating different drilling techniques, nutrient use and other areas.

## Distribution of PSTVd

PSTVd was first described in the United States of America (EPPO, 2023). Since then, the viroid has been reported from the Americas, Asia, Africa, Europe and Oceania (EPPO, 2023). Because PSTVd remains symptomless in many plants, including ornamentals, its distribution may be under recorded (EPPO, 2023).

PSTVd is considered to be present in the UK, but only in ornamentals.



**Figure 2.** Global distribution of potato spindle tuber viroid (EPPO, 2023).

## Host plants of PSTVd

Potato (*Solanum tuberosum*) and tomato (*Solanum lycopersicum*) suffer from disease and are economically important hosts. *Capsicum annum* (bell peppers) can also suffer symptoms, though it is more usual for no symptoms to be seen. Ornamentals such as *S. jasminoides* are asymptomatic.

Hosts listed on the EPPO Global Database include *Atriplex semilunaris*, *Brugmansia hybrids*, *Brugmansia sanguinea*, *Brugmansia suaveolens*, *Calibrachoa sp.*, *Capsicum annum*, *Cestrum aurantiacum*, *Cestrum elegans*, *Cestrum endlicheri*, *Cestrum nocturnum*, *Chenopodium eremaeum*, *Dahlia sp.*, *Datura leichhardtii*, *Datura sp.*, *Erigeron bonariensis*, *Hevea brasiliensis*, *Ipomoea batatas*, *Lycianthes rantonnetii*, *Nicandra physalodes*, *Persea americana*, *Petunia sp.*, *Physalis angulata*, *Physalis peruviana*, *Solanum anguivi*, *Solanum coagulans*, *Solanum dasyphyllum*, *Solanum laxum*, *Solanum lycopersicum*, *Solanum muricatum*, *Solanum nigrum*, *Solanum pseudocapsicum*, *Solanum sisymbriifolium*, *Solanum tuberosum*, *Streptoglossa sp.*, and *Streptosolen jamesonii*.

## Pathways for introduction of PSTVd on sticky nightshade into potato crops

Pathways for introduction of PSTVd into the country include:

- Plants for planting (except seeds, bulbs and tubers)
- Seeds
- Fruits or vegetables

However, it is seed that is sown into potato fields and seed which is imported from other countries for the purpose of being used for a trap crop. Seed is therefore the main pathway of introduction into the UK.

### Seed

Sticky nightshade seed is known to harbour PSTVd. The role of seed transmission, however, is more uncertain. According to EPPO (2023), PSTVd has been reported in many seed lots of tomato and pepper, but only limited numbers of outbreaks have been reported. Grow-outs of commercially produced seed lots of tomato and pepper, testing positive for PSTVd or other pospiviroids, did not result in any infection in over 100,000 seedlings in one study, while only one out of 370 seedlings from an infested tomato seed lot were found to be infected in another study.

## Current legislation

Prohibition on plants for planting of Solanaceae other than seeds and the plants specified in entries 15, 16 and 17 (Annex 6 of phytosanitary conditions regulations) from any third country other than: Albania, Algeria, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Egypt, EU Member States, Faroe Islands, Georgia, Iceland, Israel, Jordan, Lebanon, Libya, Liechtenstein, Moldova, Monaco, Montenegro, Morocco, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny 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, Turkey and Ukraine.

There are gaps in the legislation for sticky nightshade seed and plants for planting from a number of countries.

## Justification for regulation

PSTVd meets the criteria of a regulated non-quarantine pest on sticky nightshade for intended use as a trap crop in potato rotations:

1. The taxonomic identity of the pest is clearly defined.
2. The pest is considered to be present in the GB territory in ornamental plants.
3. The pest is not a quarantine pest or a pest that meets the criteria of a quarantine pest if not yet listed.
4. The transmission of the pest is mainly via specific plants for planting, rather than via natural spread or via movement of plant products or other objects.
5. Infestations of the plants for planting with the pest will have an unacceptable economic impact on the intended use of those plants, because of the potential impact on potato plants.
6. Feasible and effective measures are available to prevent its presence on the plants for planting concerned.

# Proposal for regulation

The Phytosanitary Conditions Regulation (retained regulation (EU) 2019/2072<sup>1</sup>)

## Annex 4

List of GB regulated non-quarantine pests and their respective plants for planting

### New Part L

RNQPs concerning seed of *Solanum sisymbriifolium*

Viruses, viroids, virus-like diseases and phytoplasmas		
(1)	(2)	(3)
RNQP	Plants for planting	Threshold for seed
Potato spindle tuber viroid (PSTVD0)	<i>Solanum sisymbriifolium</i> Lam.	0%

## Annex 5

Measures to prevent the presence of RNQPs on specific plants for planting

### New Part K

Measures to prevent the presence of RNQPs on seed of *Solanum sisymbriifolium*

The competent authority, or the professional operator under the official supervision of the competent authority, must carry out checks and take any other action which is necessary or appropriate to ensure that the requirements specified in the following table in relation to the respective RNQPs and plants for planting are satisfied:

(1)	(2)	(3)
Requirements		

<sup>1</sup> [Commission Implementing Regulation \(EU\) 2019/2072 of 28 November 2019 establishing uniform conditions for the implementation of Regulation \(EU\) 2016/2031 of the European Parliament and the Council, as regards protective measures against pests of plants, and repealing Commission Regulation \(EC\) No 690/2008 and amending Commission Implementing Regulation \(EU\) 2018/2019 \(legislation.gov.uk\)](#)



<i>RNQPs or symptoms caused by RNQPs</i>	<i>Plants for planting (genus or species)</i>	
Potato spindle tuber viroid (PSTVD0)	Seed of <i>Solanum sisymbriifolium</i> Lam.	The seeds have been subjected to official testing for Potato spindle tuber viroid, on a representative sample using appropriate methods and have been found in those tests to be free from that pest.

## Justification

There are currently no measures for sticky nightshade seed in GB legislation.

The option for seed testing seems appropriate to the risk. While there is the possibility of low levels of infection being missed by seed testing, because seed transmission is likely to be low, the likelihood of any seedlings (from seeds that have tested negative) becoming infected and transferring PSTVd to a potato crop is negligible.

It should be noted that the measure chosen differs to the measures for PSTVd on vegetable seed. On vegetable seed, two additional measures are given:

- a) the seeds originate in areas where Potato spindle tuber viroid is not known to occur
- (b) no symptoms of diseases caused by Potato spindle tuber viroid have been observed on the plants at the place of production during their complete cycle of vegetation

The pest free area option may not be appropriate for sticky nightshade, as the distribution of PSTVd on sticky nightshade is uncertain and PSTVd can be asymptomatic on various plant species. If we did want to have the pest free area option, the wording would need to be significantly strengthened.

The option around observing symptoms may also not be appropriate, as there is little information on the infection of PSTVd on sticky nightshade and whether symptoms are always present.

## Annex 11

List of plants, plant products and other objects and the respective third countries of origin or dispatch in respect of which phytosanitary certificates are required



## PART A

List of plants, plant products and other objects and the respective third countries of origin or dispatch, which may not be introduced into Great Britain unless they are accompanied by a phytosanitary certificate, as referred to in Article 72(1) of Regulation (EU) 2016/2031

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(1)	(2)	(3)
<i>Description of plants, plant products or other objects</i>	<i>CN code and its respective description under Council Regulation (EEC) No.2658/87</i>	<i>Country of origin or dispatch</i>
<b>Seeds of:</b>		
<i>Solanum</i> spp.	Other seeds, for sowing: ex 1209 99 99	Any third country

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## Justification

Other *Solanum* species may be used as a trap crop in potato plantations and may therefore be a risk. *Solanum scabrum* (garden huckleberry) and *Solanum chenopodioides* (velvety nightshade) are also being investigated as a trap crop. In general, it would be useful to monitor the import of seeds of *Solanum* species and assess their risk.

## References

**Arruabarrena, A., Rubio, L., González-Arcos, M., Maeso, D., Sánchez-Campos, S., Fonseca, M. E. N. and Boiteux, L. S.** (2015) First report of *Solanum sysymbriifolium* and *S. Americanum* as natural weed hosts of tomato chlorosis virus (genus *crinivirus*) in South America. *Plant Disease*. 99, 895.

**Souza-Diaz et al., No date.**

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**Mahlanza, T., Makwarela, L., Roberts, R. and van der Merwe, M.** (2022) Occurrence of the Iflavirus-like tomato matilda virus in *Solanum* species in South Africa. *Plant Disease*. 106.

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