

# EPPO Datasheet: *Nepovirus solani*

Last updated: 2023-02-08

## IDENTITY

**Preferred name:** *Nepovirus solani*

**Taxonomic position:** Viruses and viroids: Riboviria: Orthornavirae: Pisuviricota: Pisoniviricetes: Picornavirales: Secoviridae

**Other scientific names:** *PBRSV*, *Potato Andean calico virus*, *Potato black ringspot nepovirus*, *Potato black ringspot virus*, *Tobacco ringspot nepovirus Andean calico strain*, *Tobacco ringspot virus Andean calico strain*

**Common names:** Andean calico of potato

[view more common names online...](#)

**EPPO Categorization:** A1 list

[view more categorizations online...](#)

**EU Categorization:** A1 Quarantine pest (Annex II A)

**EPPO Code:** PBRSV0



[more photos...](#)

## Notes on taxonomy and nomenclature

A previously undescribed virus was isolated from the potato cultivar Antarku ( *Solanum tuberosum* x *S. tuberosum* subsp. *andigenum*) showing necrotic spotting on the tip leaves (Salazar, 1972) and was subsequently named *Potato black ringspot virus* (PBRSV) (Salazar & Harrison, 1977). At around the same time another previously undescribed virus was isolated from the potato cultivar Tichuasi ( *Solanum tuberosum* x *S. tuberosum* subsp. *andigenum*) showing calico leaf symptoms (Fribourg & Salazar, 1972) and was named as the calico strain of *Tobacco ringspot virus* (TRSV-Ca) (Fribourg, 1977). Subsequently it was proposed that TRSV-Ca was a strain of PBRSV since they were similar, but not identical, both antigenically and in their host plant reactions (Salazar & Harrison, 1978b). Analysis of the complete genome sequences of two isolates of PBRSV from potato have confirmed that PBRSV is a distinct virus species but closely related to TRSV (Souza Richards *et al.*, 2014). The genomes of PBRSV and of the TRSV-Ca strain have 90% amino acid (aa) identity in the Pro-Pol region (RNA1) (Pacheco, 2021) but it does not appear that the region encoding the coat protein (RNA2) of the TRSV-Ca strain has been sequenced. Furthermore, PBRSV isolates from *Arracacia xanthorrhiza* (arracacha) and *Solanum tuberosum* hybrids (potato) formed two distinct groups, with identities of approximately 94% for the Pro-Pol (proteinase and RNA polymerase protein domains) region of RNA1 and 81% for the CP (coat protein) gene of RNA2 (Souza Richards *et al.*, 2014). This is above the sequence demarcation limit for a new species of less than 80% amino acid (aa) identity in the Pro-Pol region and 75% aa identity in the CP region of RNA2 (ICTV, 2022a). A new PBRSV variant, possibly representing a new strain, was detected in Peru using high throughput sequencing (Fuentes *et al.*, 2019; Krueze *et al.*, 2019).

Nepoviruses are divided into three subgroups A, B and C based on sequence and genome organisation. PBRSV is in subgroup A. This subgroup has an RNA-2 of 3700–4000 nucleotides (nts) in length, present in both B and M components, which represent the bottom (B) and middle (M) components obtained after buoyant density centrifugation, during virus purification. Subgroup B has an RNA-2 of 4400–4700 nts in length, present only in the M component. Subgroup C has an RNA-2 of 6400–7300 nts in length, present in the M component, particles that are sometimes barely separable from those of B component. The three subgroups also differ in the cleavage sites recognized by their proteinase (ICTV, 2022b).

## HOSTS

The principal natural host of PBRSV is potato (*Solanum tuberosum*), although there are only reports of natural infection of *S. tuberosum* subsp. *andigenum* (Fribourg, 1977) and *S. tuberosum* x *S. tuberosum* subsp. *andigenum* (Fribourg, 1977; Salazar & Harrison, 1978a). Other natural hosts in the Andean region are *Arracacia xanthorrhiza* (family Apiaceae) (Lizarraga *et al.*, 1994), and *Oxalis tuberosa* (oca, family Oxalidaceae) (Lizarraga *et al.*, 1997; Jeffries, 1998; Kreuze *et al.*, 2020), which may be grown in the same field, in rotation with or intercropped with

potato (Bianco & Sachs, 1998; Lizarraga *et al.*, 1997; NRC, 1989).

Experimentally, plant species of at least 9 families have been infected, including plants in the Amaranthaceae, Aizoaceae, Cucurbitaceae, Fabaceae, Oxalidaceae and Solanaceae (Fribourg, 1977; Salazar & Harrison, 1978a).

**Host list:** *Arracacia xanthorrhiza*, *Solanum tuberosum* subsp. *andigenum*, *Solanum tuberosum*

## GEOGRAPHICAL DISTRIBUTION

Despite Fribourg (1983) suggesting that PBRSV (reported as TRSV-calico strain in his publication) may have a wider distribution it has currently only been reported from Peru; primarily from the Andean region but also other areas in Peru which have received seed tubers from this region. Interestingly, in Costa Rica, TRSV was found to be infecting 42% of potato leaf samples tested using ELISA (Vásquez *et al.*, 2006). However, confirmation of TRSV is required, since the supplier of the TRSV polyclonal antibody used in this study has reported cross reaction with PBRSV (Agdia, 2021). TRSV antibodies from other sources have also been reported to cross react with PBRSV (EPPO, 2017a).



**South America:** Peru

## BIOLOGY

Many species of nepovirus are transmitted non-persistently by nematodes (ICTV, 2022b) and *Xiphinema* spp. are assumed to transmit PBRSV (Salazar, 1996). Some *Xiphinema* spp. are present in the EPPO region, but it is not known whether these are able to transmit PBRSV (EFSA, 2020). It is easily transmitted by contact between plants, mechanically and vegetatively through tubers. Transmission through true potato seed of 2 – 9% (for the TRSV-Ca strain) has been demonstrated, but although the virus is detected in pollen no evidence of pollen transmission has been found (Jones, 1982). As far as it is known there are no reports of seed transmission of PBRSV in arracacha and oca.

## DETECTION AND IDENTIFICATION

### Symptoms

Symptoms of PBRSV in potato (*Solanum tuberosum* hybrids) are cultivar and environment dependent, and may also be virus strain dependent. Under cool Andean highland conditions these range from no symptoms to systemic necrotic leaf spotting (Salazar & Harrison, 1977) and calico-like symptoms (Fribourg, 1977). These bright yellow calico-like symptoms are particularly noticeable in some cultivars notably Tichuasi (Salazar & Harrison, 1977). Under warmer conditions the calico symptoms are less pronounced (Fribourg, 1977). Calico symptoms only appear to have been reported for the TRSV-Ca strain.

## Morphology

Virus particles are isometric, non-enveloped of two types but similar in size, 25–30 nm in diameter, and exhibit icosahedral symmetry (T = 1, pseudo T = 3) (ICTV (2022a)). The genome is a bipartite, linear positive-sense, single-stranded RNA. Complete sequences are available for a number of PBRSV isolates. RNA1 ranges from 7,579–7,598 bases between the different isolates and contains one single open reading frame (ORF), which is translated into a large polyprotein with 2 325 amino acids and a molecular weight of 257 kDa. RNA2 ranges from 3857 to 3918 bases for the different isolates, and it encodes a polyprotein of 1079–1082 amino acids with a molecular weight of 120 kDa (Souza Richards *et al.*, 2014). The complete coding sequence of PBRSV isolates are available at <https://www.ncbi.nlm.nih.gov/nuccore/?term=potato+black+ringspot+virus>.

## Detection and inspection methods

Field inspection of potato plants and other host plants may enable detection of the virus (see section on Symptoms); EPPO Standard PM 3/71 General crop inspection procedure for potatoes (EPPO, 2007). PBRSV is reliably detected in *in vitro* plants (4–6 weeks old and with stems of at least 5 cm) and plants grown from infected tubers, using indicator plants and serological and molecular methods. The reliability of testing tubers has not been reported.

### Indicator plants

Indicator plants for use in quarantine testing are listed in PM 3/21 *Post-entry quarantine for potato* (EPPO, 2019a) and symptoms are described by Verhoeven & Roenhorst (2000). Recommended indicator plants are: *Chenopodium giganteum* (synonym *C. amaranticolor*) and *C. quinoa* (necrotic local lesions followed by systemic apical necrosis); *Nicotiana benthamiana* (local chlorotic and necrotic lesions and rings, systemic chlorosis, chlorotic and necrotic rings); *N. occidentalis* P1 (local necrotic lesions and rings, systemic dwarfing and veinal necrosis) and *N. tabacum* (local and systemic chlorotic and necrotic ringspots and line patterns).

### Serological detection methods

High-titre antisera can be prepared against PBRSV. ELISA has been successfully used for virus detection (Schroeder & Weidemann, 1990) and both polyclonal and monoclonal antibodies are available commercially.

### Molecular methods

Two step (Wei & Clover, 2008) or one-step RT-PCR (EPPO, 2017) using forward and reverse primers A NepoA-F and NepoA-R for detection of nepoviruses in subgroup A may be used followed by sequencing the PCR amplicon (2340 bp) for confirmation of virus identity. Validation data is available for this test (Anses, 2015). Other primers for detection of nepoviruses and PBRSV are listed by Pacheco (2021) but these do not appear to have been validated.

## PATHWAYS FOR MOVEMENT

Local spread of PBRSV is by contact between plants and probably nematode vectors. Plants for planting (including tubers) of arracacha, oca and potato moved locally or internationally for commercial planting or as germplasm constitute major pathways for movement. Potentially other Andean root crops may present a risk since these are often grown in association with, or in the same area as potato. Additionally, for potato the virus may be spread by true potato seed (TPS) through its movement as potato germplasm, although the significance of this in practice is less clear since it has only been rarely reported infecting gene bank accessions. However, the increasing interest in use of TPS for commercial potato production means that care should be taken to ensure that parent plants used to produce

the TPS are free from PBRSV. Additionally, infected pollen moved for potato breeding may possibly present a risk, of introducing the virus into breeding programmes, although there is currently no evidence of pollen transmission. Whether PBRSV may be spread by seed and pollen of other hosts has not been reported. Infective *Xiphinema* spp. in soil and growing media attached to plants (host or non-host plants) from areas where the nematode occurs may be a major entry pathway (EFSA, 2020). Although soil and growing media attached to (agricultural) machinery, tools, and packaging materials was identified as an entry pathway, it was not considered as an important pathway (EFSA, 2020).

## PEST SIGNIFICANCE

### Economic impact

PBRSV causes damaging symptoms in some potato cultivars under certain conditions. Although Fribourg (1977) describes it as widespread in Peru, it has not been recorded as causing any particular losses in potato production, and it appears to be no more important than the nepoviruses *Beet ringspot virus* and *Tomato black ring virus* are on potato in Europe. Moreover, PBRSV was only recorded once in a recent survey in Peru using high throughput sequencing (Fuentes *et al.*, 2019; Krueze *et al.*, 2019).

### Control

Control depends on the production of high-quality planting material from virus-free nuclear stock or true potato seed that is produced from PBRSV-free parents in a pest free area or facility. Planting should be in fields free from potential vectors and volunteer plants. Measures to minimize mechanical transmission may be used.

### Phytosanitary risk

Climatic conditions will not impair the ability of PBRSV to establish in the EPPO region. Potato is widely grown and is the main crop at risk. Although EFSA (2020) concluded that PBRSV met the criteria to qualify as an EU quarantine pest, the magnitude of potential impact in the EU was unclear.

## PHYTOSANITARY MEASURES

EPPO recommends its member to prohibit the import of all breeding material of potato, of whatever origin, except under a special permit, subject to post-entry quarantine (EPPO, 2017b; EPPO, 2019a). Once tested and found to be free from pests it may be released from quarantine and moved within the EPPO region.

Certified seed potatoes (micropropagative material and minitubers) may be traded if they meet the requirements of EPPO Standards PM 3/62 *Production of pathogen-free microplants of potato* (EPPO, 2019c) and PM 3/63 *Production of pathogen-free minitubers of potato* (EPPO, 2019d) respectively. For import of seed potatoes and ware potatoes EPPO recommends that trade should be subject to transitional arrangements described in PM 8/1 *Commodity-specific phytosanitary measures for potato* (EPPO, 2017a), which requires for countries where PBRSV occurs, import from a pest-free area and from a pest-free potato production and distribution system, according to EPPO Standard PM 3/61 *Pest-free areas and pest-free production and distribution systems for quarantine pests of potato* (EPPO, 2019b). Additionally for ware potatoes, for countries in Central and South America where PBRSV does not occur, recommendations are confirmation by detection survey that PBRSV does not occur and inspection or testing of tubers on import.

Import of potato is regulated/prohibited in many EPPO countries. In the EU, the import of seed potatoes and plants (including true potato seed for planting of stolon- or tuber-forming species of *Solanum* or their hybrids) is prohibited from third countries, other than Switzerland, by Annex VI of Commission Implementing Regulation (EU) 2019/2072 (EU, 2022). Furthermore, such material stored in gene banks or genetic stock collection are subject to quarantine restrictions. Entry of ware potatoes is also regulated, and import is only permitted from specified countries, which currently does not include countries in Central and South America. However, as long as ware potatoes are not planted and only used for consumption or processing, the ability of PBRSV to establish is likely very low (EFSA,

2020).

Currently, EPPO countries do not prohibit the import of the other potential hosts of PBRSV, the Andean root crops arracacha and oxalis from South America for planting although prohibitions for example in the EU, have been introduced for plants for planting (other than seeds and *in vitro* material) of another Andean root crop, *Ullucus tuberosus* by Commission Implementing Regulation (EU) 2018/2019 (EU, 2018).

The pathway of viruliferous vectors of PBRSV is possibly open, because the existence of the pathway cannot be excluded based on comparisons with the biology of closely related viruses (in the same genus or family) (EFSA, 2020).

## REFERENCES

Agdia (2021) Validation Report: ELISA PSA/SRA 64001. Tobacco ringspot virus (TRSV). Available at <https://d163axztg8am2h.cloudfront.net/static/doc/f5/05/e77d30230e5b60ff7b9f2041e76c.pdf> [accessed on 21/01/2023]

Anses (2015) Summary sheet of validation data for a diagnostic test: Nepovirus. Available at [https://dc.eppo.int/validation\\_data/dwvalidation?id=124](https://dc.eppo.int/validation_data/dwvalidation?id=124) [accessed on 5 December 2022]

Bianco M & Sachs C (1998) Growing oca, ulluco, and mashua in the Andes: Socioeconomic differences in cropping practices. *Agriculture and Human Values* **15**, 267–280.

EFSA PLH Panel (EFSA Panel on Plant Health), Bragard C, Dehnen-Schmutz K, Gonthier P, Jacques M<sup>2</sup>A, Jaques Miret JA, Justesen AF, MacLeod A, Magnusson CS, Milonas P, Navas-Cortes JA, Parnell S, Potting R, Reignault PL, Thulke H<sup>2</sup>H, van der Werf W, Vicent Civera A, Yuen J, Zappalà L, Candresse T, Lacomme C, Bottex B, Oplaat C, Roenhorst A, Schenk M & Di Serio F (2020) Scientific opinion on the pest categorisation of non-EU viruses and viroids of potato. *EFSA Journal* **18**, 5853, 134pp. Available at <https://doi.org/10.2903/j.efsa.2020.5853> [accessed on 5 December 2022]

EPPO (2007) EPPO Standard PM 3/71(1) General crop inspection procedure for potatoes. Phytosanitary procedures. *EPPO Bulletin* **37**, 592-597. Available at <https://gd.eppo.int/download/standard/76/pm3-071-1-en.pdf> [accessed on 12 December 2022]

EPPO (2017a) EPPO Standard PM 7/2 (2) Tobacco ringspot virus. *EPPO Bulletin* **47**, 135–145. Available at <https://gd.eppo.int/download/standard/126/pm7-002-2-en.pdf> [accessed on 5 December 2022]

EPPO (2017b) EPPO Standard PM 8/1(2) Potato. Commodity-specific phytosanitary measures. *EPPO Bulletin* **47**, 487-503. Available at <https://gd.eppo.int/download/standard/243/pm8-001-2-en.pdf> [accessed on 5 December 2022]

EPPO (2019a) EPPO Standard PM 3/21(3) Post entry quarantine for potato. *EPPO Bulletin* **49**, 452–479. Available at <https://gd.eppo.int/download/standard/26/pm3-021-3-en.pdf> [accessed on 5 December 2022]

EPPO (2019b) EPPO Standards PM 3/61(2) Pest-free areas and pest-free production and distribution systems for quarantine pests of potato. *EPPO Bulletin* **49**, 480–481. Available at <https://gd.eppo.int/download/standard/66/pm3-061-2-en.pdf> [accessed on 5 December 2022]

EPPO (2019c) EPPO Standard PM 3/62 (3) Production of pathogen-free microplants of potato. *EPPO Bulletin* **49**, 482–483. Available at <https://gd.eppo.int/download/standard/67/pm3-062-3-en.pdf> [accessed on 5 December 2022]

EPPO (2019d) EPPO Standard PM 3/63 (3) Production of pathogen-free minitubers of potato. *EPPO Bulletin* **49**, 484–485. Available at <https://gd.eppo.int/download/standard/68/pm3-063-3-en.pdf> [accessed on 5 December 2022]

EPPO (2022) EPPO A1 List of pests recommended for regulation as quarantine pests version 2020-09. [https://www.eppo.int/ACTIVITIES/plant\\_quarantine/A1\\_list](https://www.eppo.int/ACTIVITIES/plant_quarantine/A1_list) [accessed on 5 December 2022]

EU (2022) Consolidated text: 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. Lastly revised in 2022. Available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R2072-202207141> [accessed on 5 December 2022]

EU (2018) Commission Implementing Regulation (EU) 2018/2019 of 18 December 2018 establishing a provisional list of high risk plants, plant products or other objects, within the meaning of Article 42 of Regulation (EU) 2016/2031 and a list of plants for which phytosanitary certificates are not required for introduction into the Union, within the meaning of Article 73 of that Regulation. Available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018R2019> [accessed on 24 December 2022]

EU (2022) Consolidated text: 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. Lastly revised in 2022. Available at [https://eur-lex.europa.eu/eli/reg\\_impl/2019/2072#:~:text=Consolidated%20text%3A%20Commission%20Implementing%20Regulation%20](https://eur-lex.europa.eu/eli/reg_impl/2019/2072#:~:text=Consolidated%20text%3A%20Commission%20Implementing%20Regulation%20) [accessed on 6 November 2022]

Fribourg CE (1977) Andean potato calico strain of tobacco ringspot virus. *Phytopathology* **67**, 174-178.

Fribourg CE (1983) Tobacco ringspot virus. In *Compendium of potato diseases* (ed. Hooker WJ), pp. 84-85. American Phytopathological Society, St. Paul, Minnesota, USA.

Fribourg CE & Salazar LF (1972) Newly detected potato viruses in Peru. In *Prospects for the potato in the developing world* (ed. French ER), pp 230-233. International Potato Center, Peru

Fuentes S, Perez A & Kreuze J (2019) Dataset for: The Peruvian potato virome, V1. International Potato Center. Available at <http://popathodiv.org> or <https://doi.org/10.21223/P3/YFHLQU> [accessed on 5 December 2022]

Hermann M (1997) Arracacha (*Arracacia xanthorrhiza* Bancroft). In: Herman M & Heller J (eds) *Andean roots and tubers. Ahipa, arracacha, maca and yacon. Promoting the Conservation and Use of Underutilized and Neglected Crops* **21**, pp 75-172. Institute of Plant Genetics and Crop Plant Research, Gatersleben, Germany and International Plant Genetic Resources Institute, Rome, Italy. <https://cgspace.cgiar.org/handle/10568/104208> [accessed on 27 December 2022]

ICTV (2022a) The ICTV Report on Virus Classification and Taxon Nomenclature: *Secoviridae*. Available at <https://ictv.global/report/chapter/secoviridae/secoviridae> [accessed on 9 December 2022]

ICTV (2022b) The ICTV Report on Virus Classification and Taxon Nomenclature: *Nepovirus*. Available at <https://ictv.global/report/chapter/secoviridae/secoviridae/nepovirus> [accessed on 5 December 2022]

Kreuze J, Fuentes S, Pérez A, Gutierrez D & Cadenas C (2019) Viroma de la papa en el Perú y fortalecimiento de capacidades INIA y UNALM en el diagnóstico de patógenos con técnicas de última generación para enfrentar al riesgo de enfermedades emergentes por el calentamiento global” Programa Nacional de Innovación Agraria : 029-2015-INIA-PNIA/UPMSI/IE [Potato viruses in Peru and strengthening of INIA and UNALM capacities in the diagnosis of pathogens with state-of-the-art techniques to face the risk of emerging diseases due to global warming” National Program for Agrarian Innovation: 029-2015-INIA-PNIA/ UPMSI/IE]. Available at <http://popathodiv.org> or [http://potpathodiv.org/static/papers/2\\_Resultados\\_Viroma%20de%20la%20Papa\\_Marzo%202019\\_\(SFD\).pdf](http://potpathodiv.org/static/papers/2_Resultados_Viroma%20de%20la%20Papa_Marzo%202019_(SFD).pdf) [accessed on 5 December 2022]

Kreuze JF, Souza-Dias JAC, Jeevalatha A, Figueira AR, Valkonen JPT & Jones RAC (2020) Viral diseases in potato. In *The Potato Crop. Its Agricultural, Nutritional and Social Contribution to Humankind* (eds) Campos H & Ortiz O), pp. 389-430. Springer, Cham (CH). Available at [https://link.springer.com/content/pdf/10.1007%2F978-3-030-28683-5\\_11.pdf](https://link.springer.com/content/pdf/10.1007%2F978-3-030-28683-5_11.pdf) [accessed on 5 December 2022]

- Lizarraga C, Chuquillanqui C & Jayasinghe U (1994) Una variante del virus del anillo necrótico de la papa (Potato black ringspot virus - PBRV) aislado de arracacha (*Arracacia xanthorrhiza*). [A strain of PBRV (potato black ringspot virus) isolated from arracacha (*Arracacia xanthorrhiza*)]. *Fitopatología* **29**, 144-149.
- Lizarraga C, Santa Cruz M, & Salazar LF (1997) Progress in identifying viruses infecting Andean root and tuber crops. In: *CIP Program Report 1995-1996*, pp 156-158. International Potato Centre, Lima, Peru.  
<https://cgspace.cgiar.org/handle/10568/109459>
- NRC (1989) Lost crops of the Incas: Little-Known Plants of the Andes with Promise for Worldwide Cultivation. The National Academies Press, Washington, DC, USA. <https://nap.nationalacademies.org/download/1398>
- Jones RAC (1982) Tests for transmission of four potato viruses through potato true seed. *Annals of Applied Biology* **100**, 315-320.
- Jones RAC, Fribourg CE & Slack SA (1982) Set 2: Potato virus and virus-like diseases. College of Agricultural Sciences, Clemson University, USA.
- Pacheco JAS (2021) Caracterización molecular de secuencias asociadas a virus provenientes de arracacha (*Arracacia xanthorrhiza* Bancroft) y su detección en papa [Molecular characterization of sequences associated with viruses from arracacha (*Arracacia xanthorrhiza* Bancroft) and their detection in potato]. Msc thesis, National Agrarian University, Lima, Peru. Available at <https://core.ac.uk/download/pdf/482041718.pdf> [accessed on 5 December 2022]
- Salazar L (1972) Detección de virus en índices de tubérculos y índices de plantas de papa [Virus detection in tuber indices and potato plant indices]. *Investig Agropecuarias Peru* **3**, 3-9.
- Salazar LF & Harrison BD (1977) Two previously undescribed potato viruses from South America. *Nature* **265**, 337-338.
- Salazar F & Harrison BD (1978a) Host range and properties of potato black ringspot virus. *Annals of Applied Biology* **90**, 375-386.
- Salazar LF & Harrison BD (1978b) The relationship of potato black ringspot virus to tobacco ringspot and allied viruses. *Annals of Applied Biology* **90**, 387-394.
- Salazar LF (1996) Potato Viruses and their Control. International Potato Centre, Lima, Peru.
- Sastry KS, Mandal B, Hammond J, Briddon RW & Scott SW (2019) *Encyclopedia of Plant Viruses and Viroids*. New Delhi, Springer.
- Schroeder M, Weidemann HL (1990) Detection of quarantine viruses of potato by ELISA. *EPPO Bulletin* **20**, 581-590.
- Souza Richards R, Adams IP, Kreuze JF, De Souza J, Cuellar W, Dullemans AM, Van Der Vlugt RAA, Glover R, Hany U, Dickinson M & Boonham N (2014) The complete genome sequences of two isolates of potato black ringspot virus and their relationship to other isolates and nepoviruses. *Archives of Virology* **159**, 811-815.
- Vasquez V, Montero-Astúa M & Rivera C (2006) Incidencia y distribución altitudinal de 13 virus en cultivos de *Solanum tuberosum* (Solanaceae) en Costa Rica. [Incidence and altitudinal distribution of 13 viruses in *Solanum tuberosum* (Solanaceae) crops in Costa Rica (Abstract in English)]. *Revista de Biología Tropical* **54**, 1135-1141.  
<https://revistas.ucr.ac.cr/index.php/rbt/article/view/3090/2998> [accessed on 2 May 2021]
- Verhoeven JThJ & Roenhorst JW (2000) Herbaceous test plants for the detection of quarantine viruses of potato. *EPPO Bulletin* **30**, 463-467
- Wei T & Clover G (2008) Use of primers with 50 non-complementary sequences in RT-PCR for the detection of nepovirus subgroups A and B. *Journal of Virological Methods* **153**, 16-21.

## AAB, CABI and other resources used when preparing this datasheet

CABI Datasheet on Andean potato mottle virus. <https://www.cabi.org/isc/datasheet/42520> [accessed on 5 December 2022]

Jeffries C (1998) FAO/IPGRI Technical Guidelines for the Safe Movement of Germplasm. No.19. Potato. [https://www.bioversityinternational.org/fileadmin/user\\_upload/Potato\\_booklet\\_reduced.pdf](https://www.bioversityinternational.org/fileadmin/user_upload/Potato_booklet_reduced.pdf) [accessed on 5 December 2022]

Salazar LF & Harrison BD (1979) AAB description of plant viruses. Available at <https://www.dpvweb.net/dpv/showdpv/?dpvno=206> [accessed on 5 December 2022]

## ACKNOWLEDGEMENTS

This datasheet was extensively revised in 2023 by C Jeffries (SASA, UK) with help from L Salazar (formerly CIP, Peru). Their valuable contribution is gratefully acknowledged.

## How to cite this datasheet?

EPPO (2024) *Nepovirus solani*. EPPO datasheets on pests recommended for regulation. Available online. <https://gd.eppo.int>

## Datasheet history

This datasheet was first published in the EPPO Bulletin in 1984 and revised in the two editions of 'Quarantine Pests for Europe' in 1992 and 1997, as well as in 2023. It is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', 'Hosts', and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

CABI/EPPO (1992/1997) *Quarantine Pests for Europe* (1<sup>st</sup> and 2<sup>nd</sup> edition). CABI, Wallingford (GB).

EPPO (1984) EPPO Data Sheet on Quarantine Organisms no 128: potato viruses (non-European). *EPPO Bulletin* **14** (1), 11-22. <https://doi.org/10.1111/j.1365-2338.1984.tb01975.x>



Co-funded by the  
European Union