Netherlands Food and Consumer
Product Safety Authority
Ministry of Agriculture,
Nature and Food Quality

Quick scan for pepper ringspot virus

National Plant Protection Organization, the Netherlands

Quick scan number: QS2024VIR001

Quick scan date: 23 October 2024

No.	Question	Quick scan answer for pepper ringspot virus
1.	What is the scientific name (if possible up to species level + author, also include (sub)family and order) and English/common name of the organism? *Add picture of organism/damage if available and publication allowed*.	*Tobravirus capsici* (PepRSV, pepper ringspot virus), genus *Tobravirus*, family *Virgaviridae*
2.	What prompted this quick scan? *Organism detected in produce for import, export, in cultivation, nature, mentioned in publications, e.g. EPPO alert list, etc.*	Recently, South Africa reported PepRSV in potato (*Solanum tuberosum*) in multiple municipalities in the country. Detection was performed with real-time RT-PCR, endpoint RT-PCR and Next generation sequencing (IPPC, 2023)(pers. comm. Lindy Esterhuizen). Pepper ringspot virus has not been widely studied. Since its discovery in the 1960s, it has not been described outside Brazil until the recent report from South-Africa. Most studies on PepRV have been done in the second half of the 20th century and have been published in Portuguese in journals that have not been digitalized. These journals could, therefore, not be consulted. For this Quick scan, information has been used that was available on the internet and was found through searches on the web (Google Scholar) and in databases (CAB abstracts and Biological Abstracts).
3.	Wat is the risk assessment area?	The risk assessment area is the territory of the European Union (EU 27)

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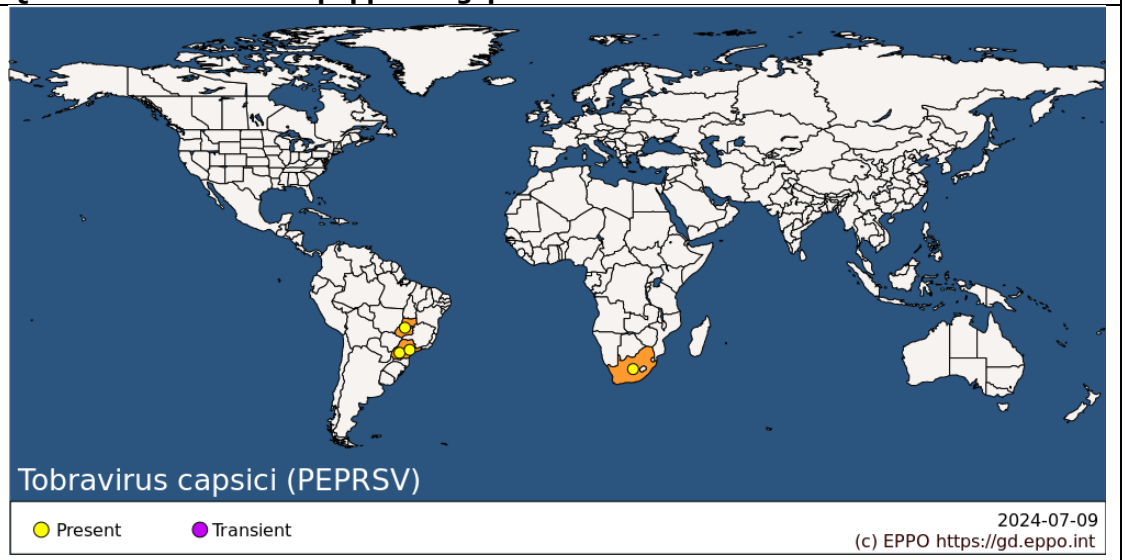
4.	What is the current area of distribution?	 Africa: South Africa (IPPC, 2023) America: Brazil (Batista et al., 2014) Given the recent report outside of America, it may have a wider distribution than currently known.
5.	What are the host plants?	- *Capsicum annuum, Cynara scolymus, Eustoma russellianum, Solanum lycopersicum, Solanum tuberosum* are currently listed in the EPPO Global Database (EPPO, 2024). - *Bidens* sp. (Harrison & Woods, 1966) - *Gloxina sylvatica* (Kitajima et al., 1998) - *Helianthus annuus* (Read, 2023) - In Tavares, 2017 and Kitajima, 2020 the following hosts are reported, but the original papers were not available online: *Columnea*, *Gerbera jamesonii, Pogostemun patchouli* and *Solanum violifolium.* Additionally, they mention an earlier report of PepRSV in potato. - Given that the reported host range of PepRSV covers multiple plant families as well as the broad host range of other tobraviruses, the true host range is likely to be wider than currently reported.
6.	Does the organism cause any kind of plant damage in the current area of distribution and/or does the consignment demonstrate damage suspected to have been caused by this organism?	Symptoms have been noted in various hosts: - *Capsicum*: chlorotic lines and rings, ringspot (Kitajima, 2020) - *Columnea*: yellow band and chlorotic and necrotic rings (Tavares, 2017) - *Cynara scolymus*: Yellow band (Kitajima, 2020)

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	Yes/no + plant species on which damage has been reported + short description of symptoms. *Please indicate also when the organism is otherwise harmful (e.g. predator, human/veterinary pathogen vector, etc.).*	- *Eustoma russellianum*: mosaic, necrotic line pattern, colour breaking of flowers (Kitajima, 2020; Rivas et al., 2000) - *Gerbera jamesonii*: chlorotic rings and bands on leaves (Kitajima, 2020) - *Gloxinia sylvatica*: vein banding (Kitajima et al., 1998) - *Helianthus annuus*: chlorotic ringspot (Uys & Esterhuizen, 2024) - *Pogostemun patchouli*: chlorotic rings and yellow lines (Kitajima, 2020) - *Solanum lycopersicum*: chlorotic inteveinal lines (Kitajima, 2020) - *Solanum tuberosum*: yellow spots and concentric rings on leaves (Kitajima, 2020), yellowing on leaves (Uys & Esterhuijzen, 2024), superficial necrotic rings and internal brown spots and rings on tubers (Uys & Esterhuijzen, 2024) - *Solanum violifolium*: chlorotic spots (Kitajima, 2020)
7.	Assess the probability of establishment in the Netherlands (NL) (i.e. the suitability of the environment for establishment). a. In greenhouses b. Outdoors c. Otherwise (e.g. storage facilities, human environment)	For the establishment of PepRV, host plants need to be present and the virus must be transmitted between host plants (otherwise the virus will remain limited to the plants with which it was introduced and disappears when these plants are removed or die). Not much is known about transmission of PepRV. Transmission by the nematode *Paratrichodorus minor* has been reported for artichoke (Salomao, 1973 cited by Brown et al., 1989) and seed transmission has been reported for tomato (Costa & Kitajima, 1968 cited by Kitajima & Costa, 1969. However, the original conference proceedings about nematode and seed transmission are not available online and both transmission by *P. minor* and tomato seeds requires further confirmation. The other two tobraviruses, tobacco rattle virus (TRV, *Tobravirus tabaci*) and pea early browning virus (PEBV, *Tobravirus pisi*) are also nematode transmissible, have a large vector and host range that mostly overlaps and are seed transmitted in some crops (CABI, 2019;2022). It is likely that PepRSV can also be transmitted by multiple nematode species, possibly by the same species as the other tobraviruses, and can be seed transmitted (in some hosts). Thus: a) PepRSV may be able to establish in greenhouses where host plants are grown in soil (e.g. in tomato and pepper crops). In soil, the virus can spread and survive between two crops by vector populations (if present). However, most tomato and pepper crops are grown on soilless substrates in NL in which establishment is unlikely (substrates are renewed or steamed regularly between crop cycles and drainwater is usually disinfested). b) PepRSV may establish outdoors with high uncertainty. The related TRV and PEBV are both established in the Netherlands. If the vector species of PepRSV overlap with TRV and PeBV, vectors are present in the Netherlands c) Not relevant

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8.	Assess the probability of establishment in the EU (i.e. the suitability of the environment for establishment).	The related virus TRV is a widespread pest in the EU and PepRSV can likely establish in most of the EU with high uncertainty (the high uncertainty concerns the presence of vector species, see Question 7).
9.	What are the possible pathways that can contribute to spread of the organism after introduction? How rapid is the organism expected to spread (by natural dispersal and human activity)?	Natural spread may occur by nematodes (see the answers to Questions 7 and 8). Spread by nematodes is in general slow and localized. After establishment, PepRSV may be spread via trade of infected plants for planting including seeds and tubers and also by soil (attached to plants, machinery etc.) containing viruliferous nematodes.
10.	Provide an assessment of the type and amount of direct and indirect damage (e.g. lower quality, lower production, export restrictions, threat to biodiversity, etc.) likely to occur if the organism would become established in NL and the EU, respectively?	Assessment made for the entire EU (not separately for the Netherlands): - Economic damage is expected if PepRSV can be transmitted by nematode species that are present and widespread in the EU (e.g. the same nematode species that transmit TRV in the EU). - Whether introduction of PepRSV will increase the damage caused by tobraviruses (especially the widespread TRV) is uncertain. Potato cultivars can differ in resistance or tolerance for infection by TRV (Molendijk et al., 2006) and cultivars that are resistant to or tolerant for TRV might be susceptible to or sensitive for PepRSV. Additional impact may also occur if PepRSV has other hosts than TRV that are grown in soil. *Helianthus annuus* has for example not been reported as host of TRV.
11.	Has the organism been detected on/in a product other than plants for planting (e.g. cut flowers, fruit, vegetables)? *If "no", go to question 12*	No
12.	If the organism has been found on/in a product other than plants for planting (e.g. cut flowers, fruit, vegetables), what is the probability of introduction (entry + establishment)? *Only to be answered in case of an interception or a finding.*	Not relevant
13.	Additional remarks	
14.	Summary and conclusions	• This Quickscan was prompted by the report of a finding of *Tobravirus capsici* (Pepper ringspot virus, PepRSV) in *Solanum tuberosum* (potato) in South Africa. • PepRSV is not known to be present in the EU. It can infect and cause symptoms in a wide range of plant species belonging to different plant families. • PepRSV could potentially enter the EU by import of infected plants for planting. • PepRSV can likely establish in the EU but there is uncertainty about the nematode species that can transmit the virus. • There is uncertainty whether introduction of PepRSV will increase the impact of tobraviruses in the EU because TRV is widely present in for example potato. Potato cultivars can differ in resistance to or tolerance for infection by TRV and cultivars that are resistant to or tolerant for TRV might be susceptible to or sensitive for PepRSV. Additional impact may also occur if PepRSV has other hosts than TRV that are grown in soil. *Helianthus annuus* has for example not been reported as host of TRV.
15.	References	Batista, A. R., Nicolini, C., Rodrigues, K. B., Melo, F. L., Vasques, R. M., de Macedo, M. A., Inoue-Nagata, A. K., & Nagata, T. (2014). Unique RNA 2 sequences of two

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		Brazilian isolates of Pepper ringspot virus, a tobravirus. *Virus Genes*, *49*(1), 169-173. https://doi.org/10.1007/s11262-014-1066-8 Brown, D. J., Ploeg, A. T., & Robinson, D. J. (1989). A review of reported associations between Trichodorus and Paratrichodorus species (Nematoda: Trichodoridae) and tobraviruses with a description of laboratory methods for examining virus transmission by trichodorids. *Revue de nématologie*, *12*(3), 235-241. CABI (Centre for Agriculture and Bioscience International). (2019). Crop Protection Compendium. Pea early browning virus. Pea early-browning virus | CABI Compendium (cabidigitallibrary.org) [Accessed 19-08-2024] CABI (Centre for Agriculture and Bioscience International). (2022). Crop Protection Compendium. Tobacco rattle virus (sprain of potato) Tobacco rattle virus (spraing of potato) | CABI Compendium (cabidigitallibrary.org)| [Accessed 19-08-2024] EPPO (European and Mediterranean Plant Protection Organization). (2024). *Tobravirus capsici* (PEPRSV). EPPO Global Database. <Tobravirus capsici (PEPRSV)[Overview]| EPPO Global Database> [Accessed 19-08-2024] IPPC (International Plant Protection Convention). (2023). Notification on the detection of Pepper ringspot virus (PepRSV) in the Republic of South Africa. <Latest Pest Reports - International Plant Protection Convention (ippc.int)> Harrison, B. D., & Woods, R. D. (1966). Serotypes and particle dimensions of tobacco rattle viruses from Europe and America. *Virology*, *28*(4), 610-620. Kitajima, E. W. (2020). An annotated list of plant viruses and viroids described in Brazil (1926-2018). *Biota Neotropica*, *20*, e20190932. Kitajima, E. W., & Costa, A. S. (1969). Association of pepper ringspot virus (Brazilian tobacco rattle virus) and host cell mitochondria. *Journal of General Virology*, *4*(2), 177-181. Kitajima, E. W., Ferreira, A. P. M., Oliveira, L., Bertuol, L., & Oliveira, L. H. R. (1998). Natural infection of Gloxinia sylvatica by pepper ringspot tobravirus and its in situ immunolocalization. *Fitopatologia Brasileira, 23*(4), 489-491 Molendijk L, Hartsema O, Zoon F, van Gastel A & Hoek J, 2006. Tabaksratelvirus in aardappel: Tabaksratelvirus als oorzaak van kringerigheid en opbrengstreductie in aardappelrassen. Praktijkonderzoek Plant & Omgeving. Read, D. (2023, August 20-25). Novel viral diversity associated with helianthus annuus l. in South Africa [Poster abstract]. 12th International Congres of Plant Pathology 2023, France. Rivas, E. B., Galleti, S. R., Duarte, L. M. L., Seabra, P. V., & Alexandre, M. A. V. (2000). Virus and phytoplasma diseases of lisianthus. *Summa Phytopathologica, 26*(2), 257-262 Tavares, M. L. (2017). Interação do vírus do anel do pimentão (Pepper ringspot virus-PepRSV) com plantas hospedeiras. <2017_MoanaLimaTavares.pdf (archive.org)> Uys, D. and Esterhuizen, L. (2024). Pepper ringspot virus in the spotlight. *Chips, 38*(1), 26-27.

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16.	Follow-up measures	Further developments regarding PepRSV (e.g. distribution and impact) will be monitored.