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

Quick scan for eggplant mottled crinkle virus (EMCV)

National Plant Protection Organization, the Netherlands

Quick scan number: 2021VIR002

Quick scan date: 15 November 2021

No.	Question	Quick scan answer for eggplant mottled crinkle 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*.	Eggplant mottled crinkle virus (EMCV), genus *Tombusvirus*, family *Tombusviridae* Note: lisianthus necrosis virus (LNV) and pear latent virus (PeLV) can be considered strains of EMCV (Dombrovsky et al 2009) and as such are part of this analysis.
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.*	EMCV is (currently) not regulated in the EU. EMCV has been detected in pear trees in Italy (Russo et al 2002) and in eggplants in Greece (Beris et al 2021).
3.	What is the current area of distribution?	The virus was first described in Lebanon (Makkouk et al 1981) and subsequently reported from Japan (Iwaki et al 1987), India (Raj et al 1988, 1989), Italy (Russo et al 2002), Peru (Melgarejo et al 2003), Taiwan (Chen et al 2007), Iran (Rasoulpour and Izadpanah 2008, 2011), Israel (Dombrovsky et al 2009) and Greece (Beris et al 2021). In the Netherlands, a possible finding of lisianthus necrosis virus in *Eustoma* was reported in the Annual Report of 1999 (Anonymous, 2000). The preliminary identification was based on the symptoms on the original host and on mechanically inoculated test plants, as well as on the morphology of the virus particles. However, since no serological or molecular test was available at the time, it had not been possible to confirm the identity of the virus isolate.

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		No distribution map was available in the EPPO Global Database (EPPO, 2013).
4.	What are the hostplants?	Natural host plants: Field or greenhouse infections have been reported in *Eustoma russellianum* (Iwaki et al 1987), *Pelargonium hortorum* (Rasoulpour and Izadpanah 2008), *Pyrus communis* (Russo et al 2002), *Solanum capsicastrum* (Raj et al 1988), *Solanum melongena* (Makkouk et al 1981, Raj et al 1989, Dombrovsky et al 2009), *Solanum sessiliflorum* (Melgarejo et al 2003) and *Zantedeschia* spp. (Chen et al 2007). Experimental host plants: A large experimental host range of more than 70 species from 13 families has been reported (Chen et al 2007; Dombrovsky et al 2009; Iwaki et al 1987; Makkouk et al 1981; Melgarejo et al 2003; Raj et al 1988, 1989; Rasoulpour and Izadpanah 2008), including species widely cultivated in the Netherlands such as *Capsicum annuum, Cucumis sativus, Petunia x hybrida* and *Spinacia oleracea.*
5.	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? *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.).*	Yes, the following symptoms have been described in natural hosts of EMCV: - *Eustoma russellianum*: necrotic spots and rings on leaves and stems, stunting, tip necrosis, purple-colored flowers sometimes showed white color breaking (Iwaki et al 1987), bright yellow chlorosis followed by necrosis (Chen et al 2007). - *Pelargonium hortorum*: ring spots and chlorotic spots on leaves (Rasoulpour and Izadpanah 2008). - *Solanum capsicastrum*: leaf crinkle, stem necrosis, stunting (Raj et al 1988). - *Solanum melongena*: stunting, apical necrosis, leaf mottling, leaf yellowing, leaf narrowing, fruit malformation and necrotic lesions on the calyx, peduncle and the endocarp, ringspot, line pattern and mosaic on leaves (Raj et al 1989, Dombrovsky et al 2009, Beris et al 2021) - *Solanum sessiliflorum*: severe mosaic, chlorotic rings and necrotic spots on leaves (Melgarejo et al 2003). - *Zantedeschia* spp.: systemic necrosis (Chen et al 2007) Note: EMCV has been isolated from symptomatic pear trees in Italy. Symptoms observed were reduced growth, small and distorted fruits, reddish discolorations and, premature shedding of leaves but these symptoms were not attributed to EMCV because inoculated pear seedlings were still symptomless after five months (Russo et al 2002).
6.	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)	a. The natural hosts *Eustoma russellianum, Pelargonium hortorum, Solanum melongena, Solanum capsicastrum* and *Zantedeschia* spp. are grown in greenhouses in the Netherlands and EMCV may potentially establish in these greenhouses. However, no natural vectors are currently known and growers may be able to eradicate the virus from the greenhouse by hygiene measures. These crops, other than *Eustoma russelianum*, are grown on artificial substrates and the drain water is often disinfected before reuse.

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		b. *Pyrus communis* is grown outdoors in the Netherlands. EMCV could potentially spread through infested soil and possibly surface water. As disinfestation of soil and surface water is difficult outdoors, EMCV could potentially become established once introduced. c. Not relevant.
7.	Assess the probability of establishment in the EU (i.e. the suitability of the environment for establishment).	The virus may already be established in the EU. It has been reported in pear from Italy in 2002. Symptomatic pear trees have repeatedly been observed in several areas of Apulia from the early 1990s onwards (Russo et al 2002). An outbreak in eggplants growing under protected conditions in Heraklion, Crete, Greece was observed during winter 2020-2021 (Beris et al 2021). In many EU countries, the probability of establishment is higher than in the Netherlands because several natural hosts are grown in the field. EMCV could potentially spread through infested soil, water and mechanical contact (see also question 8) and the potential area of establishment of EMCV is probably mainly determined by the distribution of its host plants and management practices.
8.	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)?	EMCV can spread through soil (Chen et al 2007, Iwaki et al 1987, Melgarejo et al 2003). Surface water is a potential pathway, since various tombusviruses have been isolated from rivers and streams (Koenig et al 2004). Tombusvirus species in general are readily transmitted mechanically in the field. Most species are soil-borne and can spread without the aid of a biological vector. Cucumber necrosis virus has been reported to be transmitted by a chytrid fungus in the genus *Olpidium* (Dias 1970). Some tombusvirus species may be seed transmitted at a very low level (King et al 2012). For EMCV however, neither vector nor seed transmission has been reported (Iwaki et al 1987, Melgarejo et al 2003). Based on the general characteristics of tombusviruses it is expected that after introduction, EMCV might spread through plants for planting (EFSA PLH 2019), soil, water, and mechanical contact.
9.	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?	Direct damage could be yield loss and lower quality of products. Yield losses may be very high. In Greece, 100% of plants of *Solanum melongena* were found infected in three greenhouses and the crop was abandoned (Beris et al 2021). It was, however, the first known outbreak of EMCV in Greece and growers may not have been aware of the virus before. The amount of damage is expected to depend very much on management practices and preventive measures growers will take against the virus. Indirect losses might apply when importing countries impose export restrictions.
10.	Has the organism been intercepted or found by the NPPO of the Netherlands on/in a product other than plants for planting (e.g. cut flowers, fruit, vegetables)? *If "no", go to question 12*	No.
11.	If the organism has been found on/in a product other than plants for planting (e.g. cut flowers, fruit, vegetables),	

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	what is the probability of introduction (entry + establishment)? *Only to be answered in case of an interception or a find.*	
12.	Additional remarks	The virus is relatively stable since infectivity persisted when stored as plant sap outside of the host at 20°C for more than 9 weeks (Iwaki et al 1987). EFSA-panel-on-plant-health (2019) concluded that EMCV meets all the criteria to be considered as a Union quarantine pest, with the possible exception of being absent from the EU territory or having a restricted distribution and being under official control (EFSA PLH, 2019). The virus may currently be considered a Union quarantine pest because "*Non-European viruses, viroids and phytoplasmas of Cydonia Mill., Fragaria L., Malus Mill., Prunus L., Pyrus L., Ribes L., Rubus L. and Vitis L."* are listed in Annex IIA of Implementing Regulation (EU) 2019/2072. However, the virus is not listed in a recent proposal of the European Commission[1] to amend several Annexes in the Regulating including deletion of "Non-European viruses …" and including a list of specifically mentioned "*Viruses, viroids and phytoplasmas of Cydonia Mill., Fragaria L., Malus Mill., Prunus L., Pyrus L., Ribes L., Rubus L. and Vitis L*" that does not include EMCV. Italy and Greece have not reported any official measures against EMCV.
13.	References	**Chen, Y. K., Jan, F. J., Chen, C. C., & Hsu, H. T. (2007).** A new natural host of Lisianthus necrosis virus in Taiwan. *Plant disease*, *90*(8), 1112-1112. **Dias, H.F. (1970).** Transmission of cucumber necrosis virus by Olpidium cucurbitacearum. *Virology,* 828-839. **Dombrovsky, A., Pearlsman, M., Lachman, O., & Antignus, Y. (2009).** Characterization of a new strain of Eggplant mottled crinkle virus (EMCV) infecting eggplants in Israel. *Phytoparasitica*, *37*(5), 477. **EFSA Panel on Plant Health (PLH) (2019).** Pest categorisation of non-EU viruses and viroids of *Cydonia* Mill*., Malus* Mill*.,* and *Pyrus* L. *EFSA Journal, 17*(9):5590. **EPPO (2013).** Eggplant mottled crinkle virus. EPPO Global Database. Available at: https://gd.eppo.int/taxon/EMCV00 (last visited: 17.08.2021). **Anonymous (2000)** Lisianthus necrosis virus in Eustoma russellianum. In *Annual report 1999*, Hamers M.E.C., Baayen R.P., Jenniskens M.J.P.J. (Eds.). Diagnostic Centre Plant Protection Service, Wageningen, the Netherlands, pp. 98-99 **Beris, D., Malandraki, I., Kektsidou, O., & Varveri, C. (2021).** First report of eggplant mottled crinkle virus infecting eggplant in Greece. *Plant Disease*, 2021 (https://doi.org/10.1094/PDIS-03-21-0611-PDN).

[1] Draft Commission Implementing Regulation amending Implementing Regulation (EU) 2019/2072 as regards the listing of pests, prohibitions and requirements for the introduction into, and movement within, the Union of plants, plant products and other objects, and repealing Decisions 98/109/EC and 2002/757/EC and Implementing Regulations (EU) 2020/885 and (EU) 2020/1292 (https://members.wto.org/crnattachments/2021/SPS/EEC/21_4995_01_e.pdf).

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		Bragard C., Dehnen-Schmutz, K., Gonthier, P., Jacques, M. A., Miret, J. A. J., Justesen, A. F., ... & Rubino, L. (2019). Pest categorisation of non-EU viruses and viroids of *Cydonia* Mill*., Malus* Mill*.,* and *Pyrus* L. *EFSA Journal, 17*(9):5590. **Chen, Y. K., Jan, F. J., Chen, C. C., & Hsu, H. T. (2007).** A new natural host of Lisianthus necrosis virus in Taiwan. *Plant disease*, *90*(8), 1112-1112. **Dias, H.F. (1970).** Transmission of cucumber necrosis virus by Olpidium cucurbitacearum. *Virology,* 828-839. **Dombrovsky, A., Pearlsman, M., Lachman, O., & Antignus, Y. (2009).** Characterization of a new strain of Eggplant mottled crinkle virus (EMCV) infecting eggplants in Israel. *Phytoparasitica*, *37*(5), 477. **EPPO (2013).** Eggplant mottled crinkle virus. EPPO Global Database. Available at: https://gd.eppo.int/taxon/EMCV00 (last visited: 18.10.2021). **Iwaki, M., Hanada, K., Maria, E. R. A., & Onogi, S. (1987).** Lisianthus necrosis virus, a new necrovirus from Eustoma russellianum. *Phytopathology*, *77*(6), 867-870. **King, A. M. Q., Adams, M. J., Carstens, E. B. & , Lefkowitz, E.J (2012).** Genus – Tombusvirus. In *Virus taxonomy*, King *et al*. (Eds.), Elsevier, ISBN 9780123846846, pp. 1114-1118. https://doi.org/10.1016/B978-0-12-384684-6.00096-3. **Koenig, R., Pfeilstetter, E., Kegler, H., & Lesemann, D. E. (2004).** Isolation of two strains of a new Tombusvirus (Havel river virus, HaRV) from surface waters in Germany. *European journal of plant pathology*, 110(4), 429-433. **Makkouk, K. M., Koenig, R., & Lesemann, D. E. (1981).** Characterization of a tombusvirus isolated from eggplant. *Phytopathology*, *71*(572.577). **Melgarejo, T. A., Fribourg, C. E., & Russo, M. (2003).** Properties of a tombusvirus that infects cocona (Solanum sessiliflorum) in the Peruvian jungle. *Journal of Plant Pathology*, 105-110. **Raj, S. K., Srivastava, K. M., Aslam, M., & Singh, B. P. (1988).** Occurrence of a strain of eggplant mottled crinkle virus in Solanum capsicastrum in India. *Plant pathology*, *37*(4), 599-603. **Raj, S. K., Aslam, M., Srivastava, K. M., & Singh, B. P. (1989).** Occurrence and identification of Eggplant mottled crinkle virus in India. *Journal of Phytopathology*, *125*(3), 283-288. **Rasoulpour, R., & Izadpanah, K. (2008).** First report of Eggplant mottled crinkle virus in geranium in Iran. Plant Pathology, 57(2), 397-397. **Rasoulpour, R., & Izadpanah, K. (2011).** Isolation and partial characterization of Pelargonium leaf curl virus, Moroccan pepper virus and Eggplant mottled crinkle virus from plant and soil in Iran. Journal of Phytopathology, 159(11-12), 802-804. **Russo, M., Vovlas, C., Rubino, L., Grieco, F., & Martelli, G. P. (2002**). Molecular characterization of a tombusvirus isolated from diseased pear trees in southern Italy. *Journal of Plant Pathology*, 161-166.

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14.	**Conclusions**	This Quick scan was prompted by a paper reporting severe damage in eggplant caused by eggplant mottled crinkle virus (EMCV) in Greece in 2021. Damage has also been reported in some ornamental plant species outside the EU. The virus may be spread through plants for planting, soil, water and contact. There is no evidence for vector transmission. The origin of the virus is unknown and EMCV appears to have a limited distribution in the EU; its impact is expected to increase if it were to be spread further.
15.	**Follow-up measures**	EMCV is included in the survey program of the NPPO