Express – PRA[1)] for Tomato brown rugose fruit virus – Occurrence –

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Updates in italics and highlighted in red.

Initiation: Outbreak in a tomato cultivation company in North Rhine-Westphalia

Initiation for the revision: *relevant new information*

Express-PRA	**Tomato brown rugose fruit virus**		
Phytosanitary risk for Germany	**high** ☒	**medium** ☐	**low** ☐
Phytosanitary risk for EU-Member States	**high** ☒	**medium** ☐	**low** ☐
Certainty of assessment	**high** ☐	**medium** ☒	**low** ☐
Conclusion	In 2015, the tobamovirus „tomato brown rugose fruit virus“ (ToBRFV) was found in Jordan but it was already present in Israel in 2014. *In 2018, the virus occurred in Mexico, in California (USA) and Palestine. In 2018, the virus was found in Sicily.* So far, ToBRFV is not present in Germany and the EU. It is listed neither in the Directive 2000/29/EC nor by EPPO. *Since January 2019, it is included in the EPPO Alert List.* ToBRFV infests tomato plants and causes mosaic discolouring and deformation of the fruits. The virus can infect up to 100 % of a crop. The available resistance-genes in conventional tomato varieties against other tobamoviruses are not effective against ToBRFV. *In Mexico, also damage on peppers was detected.* Currently, only little information on the virus is available and thus, further possible damage on other plants cannot be excluded. The virus is able to establish in greenhouse crops of tomatoes *and pepper* in Germany and other EU-Member States. Potential host plants are also present outdoors that could at least serve as a reservoir for new infections. Due to its high damage potential for the tomato production, ToBRFV poses a considerable phytosanitary risk for Germany and other EU-Member States. Based on this risk analysis, it is assumed that the pest is able to establish in Germany and in other Member States and to cause considerable damage. ToBRFV is classified as a potential quarantine pest. Thus, the infestation has to be eradicated according to § 4a of the Plant Inspection Order. *Infested plant material must be disposed of by incineration for the secure inactivation of the virus.* Strict sanitization measures have to be applied to prevent the		

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	movement to other production sites or further companies. An infestation caused by this pest has to be notified officially.
Taxonomy[2)]	Kingdom: viruses and viroids; classification: viruses; family: Virgaviridae; genus: Tobamovirus; species: Tomato brown rugose fruit virus (ToBRFV)
Trivial name	Tomato brown rugose fruit virus *Jordan-Virus*
Synonyms	--------
Does a relevant earlier PRA exist?	No
Biology	Tobamoviruses (known representatives are the Tobacco-Mosaic-Virus and the Tomato-Mosaic-Virus) consist of a single stranded RNA-molecule that is located in a crinkled cylindrical capsid. It is transmitted via infested seeds of host plants or mechanically. The virus enters the plant via tiny injuries. The host plant reproduces big quantities of new viruses. Tobamoviruses are very stable and can survive without any host on surfaces, in clothes, plant remnants, nutrient film solutions, soil or a transport material for a long time without losing the virulence.
Is the pest a vector?[3)]	No
Is a vector needed?[4)]	No Transmission via seeds or mechanically. *Transmission is also possible via infested bumble-bee colonies for pollination (Bombus terrestris) (LEVITZKI et al., 2019).*
Host plants	So far, only economical damage on tomato plants (*Solanum lycopersicum*) *and pepper* (*Capsicum annuum*) (CAMBRÓN-CRISANTOS *et al.*, 2018) was reported. In inoculation trials, various plants proved to be potential hosts that show only minor symptoms even after infection. This includes tobacco plants (wild species and cultivated hybrids; *Nicotiana benthamiana, N. glutinosa*, hybrids of *N. tabacum), Chenopodium quinoa*, garden Petunia (*Petunia hybrida*), as well as wild species in Germany as *Chenopodium murale* and *Solanum nigrum*. At temperatures of more than 30°C and in case of cultivation in infested soil, *Capsicum annuum* with certain resistance characteristics shows a heavy over-reaction on the virus (necrotic lesions on roots and stems) which may lead to the dying of the plant. In trials, it was not possible to transmit the virus to potatoes (*Solanum tuberosum* cv Nicola) and eggplants (*Solanum melongena* cv Classic, cv 206) (Luria et al., 2017).

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Symptoms[5)]	Light to strong mosaic discolouring on the leaves; partly leaves that become narrower; crinkled brown or yellow discolouring of the tomato fruits. The fruits clearly lose their value or are not marketable. *Symptoms on pepper are the same (CAMBRON-CRISANTOS et al., 2018).*
Presence of the host plants in Germany[6)]	In Germany, big quantities of tomato plants are mostly cultivated in greenhouses for the production of seeds and fruits. Furthermore, there are half-yearly outdoor cultivations in private gardens, on balconies or in private greenhouses. Plants that possibly could serve as a reservoir also are present outdoors in Germany. Examples for potential reservoir plants are *Chenopodium murale*, *Chenopodium quinoa* (in Germany only cultivated in small quantities), the garden-Petunia (*Petunia hybrida*; important ornamental) and *Solanum nigra*.
Presence of the host plants in the Member States[7)]	The cultivation of tomatoes for the production of seeds and fruits is an important economic factor throughout Europe.
Known infested areas[8)]	Jordan (SALEM *et al.*, 2016), Israel (LURIA *et al.*, 2017)*Palestine (ALKOWNI et al., 2019), Mexico (CAMBRÓN-CRISANTOS et al., 2018), USA (California; CHITAMBAR, 2018), Sicily (EPPO, 2019).*
Pathways[9)]	Seeds and infested plants. In companies, the virus is transmitted very quickly by handling the plants mechanically. The virus can survive on many surfaces and may be transmitted from there to host plants. In the case of substrate-free cultivation, nutrition solutions may transmit the virus.
Natural distribution[10)]	Seeds
Establishment to be expected in Germany[11)]	Due to the intensive handling and the high plant density in greenhouse crops, companies with seed and tomato production under glass are endangered. A natural distribution or extensive outdoors establishing is not expected.
Establishment and distribution to be expected in the Member States[12)]	See above.
Known damage in infested areas[13)]	The virus can infest 100% of the plants in a crop. Due to the symptoms, the fruits of infested plants lose market value or are unmarketable. In Israel, the virus spread in tomato greenhouses almost nationwide within the period of one year.
Limitation of the endangered area in Germany	Companies that produce tomato fruits or seeds. Greenhouse crops.

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Damage to be expected in endangered area in Germany[14)]	Total loss in infested companies or production sites is possible.
Damage to be expected in endangered area in Member States[15)]	Total loss in affected companies or infested production sites is possible.
Control measures[16)]	Control takes place by means of typical measures against Tobamoviruses. Only use of virus-free seeds and planting material (LURIA *et al.*, 2017). When infested plants are present, sanitization measures are of first priority. Spread within the company happens very quickly by handling the plants. Substrates or nutrition solution, protective clothing, tools and containers should not be moved from infested production sites to healthy plants. The disinfection of hands, pots and cutting tools is possible with *disinfectants with virucidal effect (RICHTER et al, 2019)*. Non-metallic equipment is to be disinfected by means of a solution of household bleach. The viruses partly survive for months in clothes, plant remnants, substrates and on tools (DEEDI, o.D).Destruction of infested plants *has to be done via incineration (waste incineration). Composting is insufficient for the secure inactivation of the virus (RICHTER et al., 2019)*. When removing infested plants do not touch healthy plants. Unlike for other Tobamoviruses, so far no ToBRFV-resistant tomato breeding is available. Colonies of bumble bees *(Bombus terrestris) that had contact to infested plants need to be replaced*
Detection and diagnosis[17)]	When symptoms occur, viruses can be identified molecular biologically (RT-PCR for Tobamoviruses and further sequencing) (SALEM *et al.*, 2016).
Remarks	The virus was detected only in 2016. Thus, limited scientific information is available. Nevertheless, measures and pathways for other scientifically well-researched Tobamoviruses can be applied for the new virus.
Literature	ALKOWNI, R., O. ALABDALLAH, Z. FADDA (2019): Molecular identification of tomato brown rugose fruit virus in tomato in Palestine. Journal of Plant Pathology, 5 S. https://doi.org/10.1007/s42161-019-00240-7 CAMBRÓN-CRISANTOS, J. RODRÍGUEZ-MENDOZA, J. B. VALENCIA-LUNA, S., A. RANGEL, C. GARCÍA-ÁVILA, J. A. LÓPEZ-BUENFIL, 2018: First report of Tomato brown rugose fruit virus (ToBRFV) in Michoacan, Mexico. https://www.researchgate.net/publication/329924175_First_report_of_Tobamovirus_brown_rugose_virus_ToBRFV_in_Michoacan_Mexico (accessed on: 04-02-2019)

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Explanations

1) Compilation of the most important directly available information allowing a first preliminary estimation of the phytosanitary risk. This short assessment is necessary for the decision on a notification to EU and EPPO as well as the preparation of a complete risk analysis, for the information of the countries and as a basis for the possible initiation of eradication measures. Regarding the phytosanitary risk especially the possibility of the introduction into and spread in Germany and the Member States as well as possible damage are taken into account.

2) Taxonomic classification – also subspecies; in case that the taxonomical classification is uncertain the JKI-scientist initiates the taxonomic classification, as far as possible.

3) If so, which organism (which organisms) is (are) transmitted and does it (do they) occur in Germany / the MS?

4) If so, which organism serves as a vector and does it occur in Germany / the MS?

5) Description of the pattern of damage and the severity of the symptoms/damage on the different host plants

6) Presence of the host plants in protected cultivation, open field, amenity plantings, forest.
Where, in which regions are the host plants present and to which extent?
How important are the host plants (economical, ecological,..)? Possible origin

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Where, in which regions are the host plants present and to which extent?
How important are the host plants (economical, ecological,..)? Possible origin

8) f. e. acc. to CABI, EPPO, PQR, EPPO Datasheets

9) Which pathways are known for the pest and how important are they for the possibility of introduction? Primarily the transport of the pest over long distances is meant, normally with infested traded plants, plant products or other contaminated articles. This does not comprise the natural spread resulting from introduction.

10) Which pathways are known for the pest and of which relevance are they in respect of the possibility of spread? In this case the natural spread resulting from introduction is meant.

11) under the given prevalent environmental conditions

12) under the given prevalent environmental conditions (native areas and areas of introduction)

13) Description of the economic, ecological/environmental relevant and social damage in the area of origin resp. areas of occurrence up to now

14) Description of the economic, ecological/environmental relevant and social damage to be expected in Germany, as far as possible and required, differentiated between regions

15) Description of the economic, ecological/environmental relevant and social damage to be expected in the EU/other Member States, as far as possible and required, differentiated between regions

16) Can the pest be controlled? Which possibilities of control are given? Are plant health measures conducted in respect to this pest (in the areas of current distribution resp. by third countries)?

17) Description of possibilities and methods for detection. Detection by visual inspections? Latency? Uneven distribution in the plant (sampling)?