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## Report of a Pest Risk Analysis for

### *Tomato leaf curl New Delhi virus*



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This summary is based on an EFSA pest categorization (EFSA PLH, 2020) and also includes information from the EFSA pest survey card (EFSA *et al.*, 2020) and the EPPO Datasheet (EPPO, 2021) on ToLCNDV. The EFSA pest categorization is available in the EPPO PRA platform (<https://pra.eppo.int/pr/102bcd27-6141-4811-bda3-493008e472af>).

Probability of entry, establishment, spread, and potential impact, with associated uncertainties, have been rated based on the EFSA pest categorization and reviewed by the Panel on Phytosanitary Measures. The EFSA categorization also refers to the Scientific Opinion on the risks to plant health posed by *Bemisia tabaci* species complex and viruses it transmits for the EU territory (EFSA PLH, 2013).

*Bemisia tabaci*, vector of ToLCNDV, is recommended for regulation by EPPO since 1989. Measures recommended for *B. tabaci* in 1990 were:

- Plants for planting (except seeds and tissue cultures): Place or site of production free for *Bemisia tabaci*. This recommendation for plants for planting is consistent with the conclusions of the EFSA plant health Panel in the Scientific Opinion on the risks to plant health posed by *Bemisia tabaci* species complex and viruses it transmits for the EU territory (EFSA PLH, 2013).
- No recommendation is made for other pathways (fruits, cut flowers and branches).

**This PRA report only focuses on the measures to be recommended for the virus.**

**Pest:** *Tomato leaf curl New Delhi virus* (ToLCNDV)

**PRA area:** EPPO region

**Assessors:** Prepared by the EFSA Panel on Plant Health for the EU.

**Date:** The EFSA pest categorization was prepared in 2020. The PRA report was prepared in 2021 on request of the EPPO Panel on Phytosanitary Measures (meeting by videoconference, 2021-04) so that it is valid for the EPPO region and reviewed by this Panel. EPPO Working Party on Phytosanitary Regulations and Council agreed that ToLCNDV should be added to the EPPO A2 List of pests recommended for regulation as quarantine pests in 2022.

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**Based on this PRA report, Tomato leaf curl New Delhi virus was added to the EPPO A2 List. Measures for plants for planting (except seeds) of cultivated Solanaceous and Cucurbitaceae hosts are recommended.**

| <b>STAGE 1: INITIATION</b>   |   |
|--|---|
| <b>Reason for doing PRA:</b><br>(References available in the EFSA pest categorization) | <p><i>Tomato leaf curl New Delhi virus</i> (ToLCNDV) has been added to the EPPO Alert List in 2015 as it was an emerging virus in the Euro-Mediterranean region. It was not considered as a high priority for PRA (against other pests absent from the EPPO region) but was maintained on the Alert List to follow its situation in the region. Following a request from the European Commission to EFSA to perform a pest categorization on ToCLNDV, the Panel on Phytosanitary Measures agreed to consider the outcome of the EFSA Opinion to prepare possible EPPO recommendations.</p> <p>ToLCNDV is a virus transmitted by <i>Bemisia tabaci</i> in a persistent manner and was first described on <i>Solanum lycopersicum</i> (tomatoes) in India in 1995 (initially as ToLCV-India). This virus was initially reported on solanaceous crops, but subsequently many reports of damage to cucurbit crops were also made. Following its discovery in India, other Asian countries reported the occurrence of ToLCNDV on a rather wide range of crops. In September 2012, symptoms caused by ToLCNDV were first observed on <i>Cucurbita pepo</i> var. <i>giromontiina</i> (courgette) in Murcia, Spain. In May 2013, similar symptoms were noticed in Almería province, and by autumn 2013, the disease was widespread in both Spanish regions. In January 2015, the virus was detected for the first time in Tunisia, causing a severe disease on <i>Cucurbita melo</i> (melon), <i>Cucumis sativus</i> (cucumber) and <i>Cucurbita pepo</i> (courgette) cultivated under plastic tunnels in the Kébili region (South-eastern Tunisia). Subsequently, it was also found in Morocco on courgette near Agadir and Taroudant (2017), in Greece (2018) and Portugal (2019). It was detected in 2020 in Estonia and France but has been eradicated (EPPO, 2021).</p> <p>It should be noted that ToLCNDV shows significant genetic diversity and that strains present in non-EPPO Countries are more damaging to Solanaceous crops (in particular tomato) and their introduction to the EPPO region should be prevented.</p> |
| <b>Taxonomic position of pest:</b>   | <p>Viruses and viroids<br/>Family Geminiviridae<br/>Genus Begomovirus</p>   |

## STAGE 2: PEST RISK ASSESSMENT

### PROBABILITY OF INTRODUCTION

#### **Entry**

#### Geographical distribution:

(Source: EPPO Global Database) last consulted 2021-07-29, details on distribution are available in Global Database).

**Africa** Algeria, Morocco, Seychelles, Tunisia

**Asia:** Bangladesh, India, Indonesia, Iran, Pakistan, Philippines, Sri Lanka, Taiwan, Thailand

**Europe:** Greece, Italy, Portugal, Spain.

#### Major host plants:

(see the EPPO Global Database and the EFSA pest categorization for references)

ToLCNDV has a broad host range encompassing Solanaceae, Cucurbitaceae, Fabaceae and Malvaceae species many of which are important crops and ornamental plants as well as wild species (weeds). The main crop hosts of ToLCNDV are *Solanum lycopersicum* (tomato) and cucurbits in particular *Cucurbita pepo* (zucchini), *Cucumis sativus* (cucumber) and *Cucumis melo* (melon) and can also cause severe yield losses in *Solanum tuberosum* (potato), *Capsicum annuum* (sweet pepper, chili pepper), *Capsicum frutescens* (chili pepper), *Solanum melongena* (eggplant) and *Gossypium hirsutum* (cotton). Wild plant hosts may not show

conspicuous symptoms but can serve as virus reservoirs. Because of the broad host range and the polyphagous nature of its vector *Bemisia tabaci*, the range of host plant species may be larger than reported.

A list of hosts is available in EPPO GD <https://gd.eppo.int/taxon/TOLCNDV/hosts> (EPPO, 2021).

Which pathway(s) is the pest likely to be introduced on:

(see the EFSA opinion for references.)

**Pathways identified in the EFSA pest categorization are:**

**Plants for planting of susceptible hosts other than seeds.**

This includes several plants which are hosts of ToLCNDV that can be traded, mainly vegetable/ornamental plants. **The likelihood of entry with this pathway is high.**

**Viruliferous *B. tabaci***

These can be present on plants for planting, fruits and above-ground fresh plant parts e.g., cut flowers, cut branches, cut foliage, leaf vegetables (incl. herbs)<sup>1</sup>, In the EFSA opinion performed in 2013 on the risks to plant health posed by *Bemisia tabaci* species complex and viruses it transmits for the EU territory (EFSA PLH, 2013) **the likelihood of entry of Begomoviruses with viruliferous *B. tabaci* on ornamental plants for planting is considered moderate. The likelihood of entry of Begomoviruses with viruliferous *B. tabaci* on cut flowers and branches with foliage is considered low and very low on fruits and vegetables (e.g., leaf vegetables incl. herbs).** The Panel on Phytosanitary Measures noted that the likelihood of entry with tomato on the vine was low to moderate when imported fruits are packed at places of production, because of the increased risk of transfer.

**Seeds**

The EFSA Pest survey card on tomato leaf curl New Delhi virus states that ‘*while the seed transmissibility of begomoviruses is still debated (Pérez-Padilla et al., 2020), seed transmission of ToLCNDV has been reported for a distinct isolate found in chayote (Sechium edule) (Sangeetha et al., 2018) and was recently reported in zucchini from Italy (Kil et al., 2020). As reported by the EFSA PLH Panel (2020), ‘ToLCNDV infections of seedlings may arise from contaminated seeds and while this is not very likely in commercial production processes, this mode of transmission exists for ToLCNDV.’* **The likelihood of entry with this pathway is considered low.**

**The following pathway was considered by the Panel on Phytosanitary Measures as unlikely.**

**Underground plant parts:** Roots and tubercle vegetables. However, infected ware potatoes, if planted, could represent an entry pathway.

**Establishment**

Plants at risk in the PRA area:

Species that belong, among others, to the Solanaceae, Cucurbitaceae, Fabaceae and Malvaceae families are grown in the whole PRA area as vegetables or ornamental species. ToLCNDV host range includes wild plants which are also widely present.

Climatic similarity of present distribution with PRA area (or parts thereof):

ToLCNDV-ES is already present in open fields in several southern European countries (coinciding to areas where *B. tabaci* is present). Other strains of ToLCNDV are not expected to differ in their ecoclimatic requirements and would therefore be able to establish in the same areas.

Climatic conditions determine vector presence and abundance, and virus establishment in uncultivated host plants. The long-term establishment of ToLCNDV is not possible outside the areas where *B. tabaci* can potentially establish.

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<sup>1</sup> referred to in the EFSA categorization as vegetables and leafy herbs for consumption, or cut flowers and flower buds, foliage and branches suitable for bouquets or for ornamental purposes.

ToLCNDV outbreaks can occur in crops grown under protected cultivation. *B. tabaci* has been reported in Northern European countries, mostly as transient populations or from interceptions but also frequently under protected cultivation conditions. There, *B. tabaci* can occur in greenhouses only, or move outdoors when weather conditions in summer are favourable for insect populations to develop; winter conditions are enough to eradicate *B. tabaci* outbreaks in north of Europe.

Characteristics (other than climatic) of the PRA area that would favour establishment:

No information in the EFSA pest categorization

Which part of the PRA area is the area of potential establishment:

The potential establishment area is where hosts are grown (the hosts are grown in the whole PRA area).

### ***Spread***

*B. tabaci* is a very efficient vector of Begomoviruses and by far the most efficient means of spread of ToLCNDV on a local to regional scale. It is present in many countries, in particular around the Mediterranean basin.

There is uncertainty on the importance of mechanical transmission under field conditions.

Plants for planting (including scions and cuttings used for propagation or grafting) would also contribute to the spread on a local to regional scale.

## **POTENTIAL ECONOMIC CONSEQUENCES**

**How much economic impact does the pest have in its present distribution:**

(References are given in EFSA PLH (2020))

On the Indian subcontinent, ToLCNDV is a very destructive epidemic virus, causing complete yield loss in elite tomato cultivars, especially when infected at a young age.

In potato, this virus has been reported to be associated with the potato apical leaf curl disease characterised by a leaf crinkling, apical leaf curling and stunting accompanying by a conspicuous mosaic or chlorotic blotching of commercial potato varieties (Usharani *et al.*, 2004). The disease can reach up to 100% infection, causing heavy yield losses by severely affecting tuber size in susceptible varieties (Chandel *et al.*, 2010).

On eggplant, the virus is associated with the ‘eggplant yellow mosaic disease’ (severe yellow mosaic and mottling of leaves) with an incidence in India of around 60–65% throughout the year (Pratap *et al.*, 2011).

The virus is also a major cause of yellow mosaic disease in sponge gourd (*Luffa cylindrica*), causing up to 100% yield losses in infected plants (Islam *et al.*, 2011). On chrysanthemum typical Begomovirus symptoms of mosaic, and a leaf curl disease (mottling and downward leaf curl, bushy appearance and bloom, reduction in flower number) were associated with the presence of ToLCNDV associated with beta-satellites (Ashwathappa *et al.*, 2020).

Mixed infection with other viruses has also been noted resulting in most case in enhanced symptoms and impact (EFSA PLH, 2020).

In southern Europe (Spain, Italy, Greece) and North Africa (Tunisia, Algeria, Morocco), the virus (the ToLCNDV-ES strain) is rapidly spreading, causing a severe leaf curl disease of greenhouse and open-field cucurbit crops and severe damage in zucchini, cucumber and melon.

The ToLCNDV-ES strain present in Europe appears more adapted to Curcubitaceae hosts. In the Mediterranean basin, ToLCNDV-ES is only sporadically reported on tomato, eggplant and sweet pepper.

It should be noted that ToLCNDV shows genetic variability and several strains have been described, which might explain the differences in host plants affected between regions. In addition, molecular studies have shown that the presence or absence of beta-satellites might affect its pathogenicity.

**Describe damage to potential hosts in PRA area:**

*Extract from the Alert List datasheet*

Diseases caused by ToLCNDV on its different host plants generally include yellow mosaic, leaf curling, vein swelling, and plant stunting. On cucurbit fruits, skin roughness and longitudinal cracking have been observed. On fruiting crops, when the virus infection occurs at an early stage, affected plants are severely stunted and fruit production is significantly affected, if not suppressed. In the Indian sub-continent, ToLCNDV is reported to cause severe symptoms and economic losses, in particular in solanaceous crops (e.g. tomato, aubergine, chili pepper). Surveys conducted in India from 2003 to 2010, confirmed its occurrence in several cucurbit crops associated with damage.

Pictures can be viewed on the Internet: [CABAS-CSIC blog](#) or [Junta de Andalucía](#)

**How much economic impact would the pest have in the PRA area:**

Damage in the PRA area are expected to be similar.

**CONCLUSIONS OF PEST RISK ASSESSMENT**

**Summarize the major factors that influence the acceptability of the risk from this pest:**

**Estimate the probability of entry:**

Likely with moderate uncertainty

Although the pest has already been introduced in the EPPO region, the main risk for entry is with plants for planting of host plants. [in addition to viruliferous *Bemisia tabaci* that can be present on the host plants]

There is uncertainty about seeds.

**Estimate the probability of establishment:**

**High in the Mediterranean areas; low uncertainty (presence of hosts and vector)**

**Low in the northern part of the PRA area outdoors low uncertainty (survival of the vector during winter)**

**Outbreaks under protected cultivation are possible in the northern part of the PRA area**

**Estimate the probability of spread:**

High in the Mediterranean areas, low uncertainty (*B. tabaci* is present in parts of the PRA area)

**Estimate the potential economic impact:**

High in the Mediterranean areas, low uncertainty. Damage already occurs in part of the PRA area where the pest is present.

**Degree of uncertainty**

- Seed and mechanical transmission
- Host ranges with regard to the different intraspecies (i.e. strains) levels or in association with satellites
- Distribution and prevalence of ToLCNDV in the EPPO region
- Magnitude of the impact under EPPO conditions, particularly on hosts different from cucurbits

**OVERALL CONCLUSIONS**

**The pest presents a risk for the EPPO region.** It should be noted that the strain which is prevalent in the EPPO region is particularly adapted to cucurbits and is different from isolates reported outside the EPPO region, which are better adapted to solanaceous crops and could therefore pose additional risk for EPPO agriculture.

## STAGE 3: PEST RISK MANAGEMENT

### IDENTIFICATION OF THE PATHWAYS

Evaluation of the need for management measures for the different hosts: The natural host range for ToLCNDV includes several vegetables, ornamentals as well as wild/weed species. None of the weeds/wild species reported as hosts of ToLCNDV is traded (EFSA PLH, 2020). Experimental hosts (e.g. *Nicotiana tabacum*) have also been reported. The natural host range is very large, but the Panel on Phytosanitary Measures considered that management measures should only be recommended for cultivated Solanaceous and Cucurbitaceae host species (vegetable and ornamentals) except experimental hosts (<https://gd.eppo.int/taxon/TOLCNDV/hosts>).

This PRA report only focuses on the measures to be recommended for the virus (see introduction). The EFSA pest categorization refers to different pathways, but the most relevant pathway is plants for planting of cultivated Solanaceous and Cucurbitaceae hosts.

#### Pathways studied in the pest risk management

Plants for planting of cultivated Solanaceous and Cucurbitaceae hosts, except seeds

### IDENTIFICATION OF POSSIBLE MEASURES

#### Possible measures for all pathways

##### *Measures related to the crop or to places of production:*

Pest free area

Pest free place of production or pest free production site

##### *Measures related to consignments:*

None

##### *Measures upon entry of consignments*

None

### EVALUATION OF THE MEASURES IDENTIFIED IN RELATION TO THE RISKS PRESENTED BY THE PATHWAYS

#### Degree of uncertainty

Uncertainties in the management part are:

- Biology of ToLCNDV (seed transmission, list of host plants)
- Distribution and prevalence of ToLCNDV in particular of the different strains.
- Reasons for the number of interceptions of *B. tabaci*, and whether measures in place are sufficient to prevent entry through the *Bemisia* pathway

### IDENTIFICATION OF POSSIBLE MEASURES

| Pathway   | Measures identified for the exporting country  |
|---|--|
| Plants for planting (except seeds) of cultivated Solanaceous and Cucurbitaceae hosts. | Pest free area for ToLCNDV (1)<br>Or<br>Pest free place of production or Pest free production site# established according to EPPO Standard PM 5/8 <i>Guidelines on the phytosanitary measure 'Plants grown under physical isolation'</i> , to prevent entering of both the virus and the vector. |

# The choice between a pest free place of production and a pest free production site is a decision to be taken by the NPPO based on the operational capacities of the producers and biological elements.

#### (1) Requirements for establishing a PFA for ToLCNDV:

- To establish and maintain the PFA, detailed surveys and monitoring should be conducted in the area since the beginning of the preceding growing period and continued every year.

- Surveys should include high risk locations such as places where potentially infested material may have been imported (risk activity are detailed in the EFSA survey card),
- There should be restrictions on the movement of host material into the PFA, and into the area surrounding the PFA, especially the area between the PFA and the closest area of known infestation.

**The PFA is considered to be difficult to establish in a country where the virus and the vector are present, and where favourable climate conditions for the development of the vector are present.**

In addition to the measures to be implemented by the exporting countries, the Panel on Phytosanitary Measures encourages importing countries to implement the following measures:

Imported cut flowers and branches, fruits and vegetables with foliage are not stored or repacked at destination in facilities that also grow host plants of ToLCNDV.

#### **References:**

EFSA PLH (2013) EFSA Panel on Plant Health (PLH). Scientific Opinion on the risks to plant health posed by *Bemisia tabaci* species complex and viruses it transmits for the EU territory. EFSA Journal 2013;11(4):3162. [302 pp.] doi:10.2903/j.efsa.2013.3162.

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