EPPO Datasheet: *Begomovirus coheni*

Last updated: 2024-05-15

IDENTITY

Preferred name: *Begomovirus coheni*
Taxonomic position: Viruses and viroids: Monodnaviria: Shotokuvirae: Cressdnaviricota: Repensiviricetes: Geplafuvirales: Geminiviridae
Other scientific names: *TYLCV, Tomato leaf curl Oman virus, Tomato leaf curl bigeminivirus, Tomato leaf curl geminivirus, Tomato yellow leaf curl Gezira virus, Tomato yellow leaf curl begomovirus, Tomato yellow leaf curl bigeminivirus, Tomato yellow leaf curl geminivirus, Tomato yellow leaf curl virus*
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EPPO Categorization: A2 list
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EU Categorization: RNQP ((EU) 2019/2072 Annex IV)
EPPO Code: TYLCV0



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Notes on taxonomy and nomenclature

The acronym TYLCV is often used to design distinct species of the genus Begomovirus, which all together cause similar yellow leaf curl symptoms on tomato. The species *Tomato yellow leaf curl virus* (TYLCV) is the most widespread. The present EPPO datasheet concerns only this species.

HOSTS

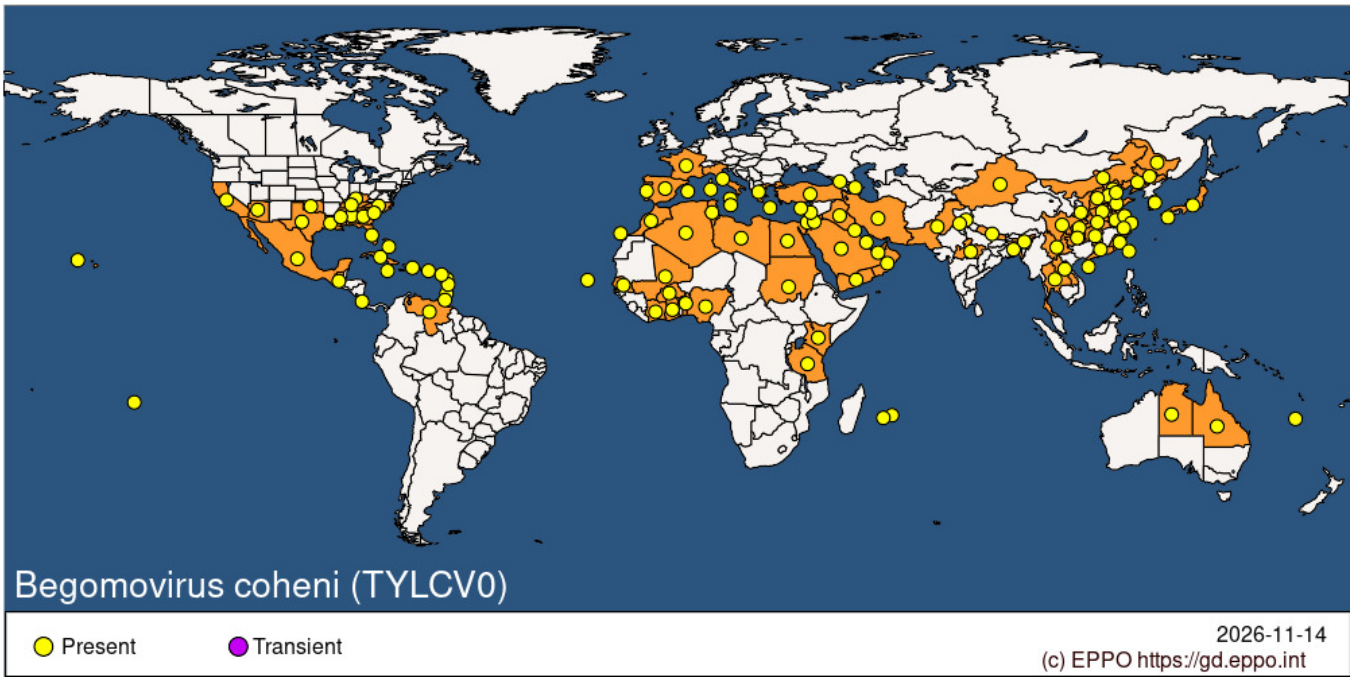
The main host of TYLCV is tomato (*Solanum lycopersicum*). Common bean (*Phaseolus vulgaris*), pepper (*Capsicum annuum*) and tobacco (*Nicotiana tabacum*) are the most frequently cultivated hosts that are naturally infected. At least 79 species in more than 20 different families have been reported to be hosts of TYLCV, in natural conditions or from experimental tests (Cohen *et al.*, 1966, Papayiannis *et al.*, 2011; Ying *et al.*, 2000).

Host list: *Acalypha australis, Acalypha virginica, Agastache rugosa, Amaranthus graecizans, Amaranthus retroflexus, Amaranthus viridis, Artemisia argyi, Asteriscus aquaticus, Baliospermum solanifolium, Begonia sp., Calendula arvensis, Capsicum annuum, Capsicum frutescens, Carica papaya, Centaurea sp., Chenopodiastrum murale, Chrozophora tinctoria, Citrullus lanatus, Convolvulus arvensis, Convolvulus humilis, Convolvulus sp., Cucumis sativus, Cucurbita pepo, Cuscuta sp., Cyamopsis tetragonoloba, Cynanchum acutum, Datura innoxia, Datura stramonium, Dittrichia viscosa, Erigeron bonariensis, Erigeron sumatrensis, Erodium ciconium, Erodium cicutarium, Euphorbia heterophylla var. cyathophora, Euphorbia pulcherrima, Eustoma russellianum, Glebionis coronaria, Glebionis segetum, Hirschfeldia incana, Lamium amplexicaule, Macroptilium lathyroides, Malva multiflora, Malva neglecta, Malva nicaeensis, Malva parviflora, Malva sp., Malva sylvestris, Malvastrum coromandelianum, Mercurialis annua subsp. ambigua, Mikania micrantha, Nicotiana tabacum, Passiflora edulis, Phaseolus vulgaris, Physalis ixocarpa, Plantago lagopus, Plantago major, Raphanus raphanistrum, Raphanus sativus, Ricinus communis, Scandix pecten-veneris, Scorpiurus muricatus, Sinapis alba, Sinapis arvensis, Solanum elaeagnifolium, Solanum lycopersicum, Solanum melongena, Solanum nigrum, Solanum tuberosum, Solanum villosum, Sonchus asper, Sonchus oleraceus, Sonchus tenerrimus, Urospermum picroides, Vicia faba, Vigna unguiculata, Viola prionantha*

GEOGRAPHICAL DISTRIBUTION

TYLCV is an Old World begomovirus, first described in the Middle East in the 1960s. It remained of limited geographical distribution, until the B biotype of its vector *B. tabaci* (now Middle East-Asia Minor 1 (MEAM1))

started to spread dramatically through the EPPO region in the 1980s (Czosnek *et al*., 1990) and then to other regions of the world. The spread of *B. tabaci*, particularly MEAM1 and MED (Mediterranean) species, was accompanied in the New World by the emergence of numerous begomoviruses of Solanaceae (e.g. tomato mottle bigeminivirus; EPPO/CABI, 1996b) and the spread of TYLCV to North America and the Caribbean region from 1994.



EPPO Region: Algeria, Azerbaijan, Cyprus, France (mainland), Georgia, Greece (mainland, Kriti), Israel, Italy (mainland, Sardegna, Sicilia), Jordan, Malta, Morocco, Portugal (mainland), Spain (mainland, Islas Baleares, Islas Canárias), Tunisia, Türkiye
Africa: Algeria, Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, Egypt, Ghana, Kenya, Libya, Mali, Mauritius, Morocco, Nigeria, Reunion, Senegal, Sudan, Tanzania, United Republic of, Tunisia
Asia: Bahrain, Bangladesh, China (Anhui, Beijing, Chongqing, Fujian, Guangdong, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jilin, Liaoning, Neimenggu, Shaanxi, Shandong, Shanghai, Shanxi, Sichuan, Tianjin, Xinjiang, Yunnan, Zhejiang), India (Assam, Himachal Pradesh, Madhya Pradesh, Punjab), Iran, Islamic Republic of, Iraq, Israel, Japan (Honshu, Kyushu), Jordan, Korea, Republic of, Kuwait, Lao People's Democratic Republic, Lebanon, Nepal, Oman, Pakistan, Saudi Arabia, Taiwan, Thailand, United Arab Emirates, Yemen
North America: Mexico, United States of America (Alabama, Arizona, California, Florida, Georgia, Hawaii, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas)
Central America and Caribbean: Bahamas, Costa Rica, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Guatemala, Jamaica, Martinique, Puerto Rico, Saint Kitts and Nevis, Trinidad and Tobago
South America: Venezuela
Oceania: Australia (Northern Territory, Queensland), French Polynesia, New Caledonia

BIOLOGY

Tomato yellow leaf curl begomovirus is transmitted by different species belonging to the Bemisia tabaci complex (EPPO/CABI, 1996a) in a circulative and persistent manner (McGrath & Harrison, 1995). The two invasive vector species of this complex, MEAM1 and MED, previously known as the B and Q biotypes, are efficient vectors of TYLCV (Sánchez-Campos, 1999).

Minimum acquisition and inoculation feeding periods range from 15 to 30 min, depending on the viral isolates (Cohen & Nitzany, 1966; Czosnek et al., 2002, Ioannou, 1985; Mansour & Al-Musa, 1992). The latent period inside the insect is 8-24h following acquisition (Cohen *et al.*, 1966, Czosnek *et al.*, 2002). TYLCV can persist in the vector for all its life following acquisition. Transovarial transmission of the virus has been demonstrated for MEAM1 and MED whiteflies (Wei *et al*., 2017). The replication of TYLCV in the whitefly vector was also demonstrated (He *et al*

., 2020).

In the plant, the virus is restricted to the phloem tissue and induces cytological changes. For details on these changes, see Channarayappa *et al.*, 1992. Symptoms appear from 12 to 15 days after inoculation (Ber *et al.*, 1990).

There are strain variations in TYLCV. *Tomato yellow leaf curl virus* regroups 6 different strains (TYLCV-IL, TYLCV-Mld, TYLCV-Ge, TYLCV-Bou, TYLCV-Ker and TYLCV-Iran). TYLCV-IL and TYLCV-Mld are the most widespread strains. Given the propensity for recombination among begomovirus genomes, recombinant genomes have emerged, particularly in the Mediterranean region where TYLCV and Tomato yellow leaf curl Sardinia virus (TYLCSV) co-infect tomatoes. Thus, Tomato yellow leaf curl Axarquia virus TYLCAxV), TYLCV isolates TYLCV-IS176 and TYLCV-IS141 are recombinants between TYLCV-IL and TYLCSV (Belabess *et al*., 2015; García-Andrés *et al*., 2006; Panno *et al*., 2018). Tomato yellow leaf curl Malaga virus (TYLCMalV) is a recombinant between TYLCV-Mld and TYLCSV (Monci *et al*., 2002).

DETECTION AND IDENTIFICATION

Symptoms

Tomato plants infected at an early stage are severely stunted; their terminal and axillary shoots are erect, and their leaflets are reduced in size and abnormally shaped. Leaves that develop soon after infection are cupped downward, whereas leaves developing later are prominently chlorotic and deformed, with leaf margins rolled upwards and curling between the veins. The effect on fruits depends on the age of the plant when infected. If infected early, plants lose vigour and stop producing marketable fruits. When infections occur at a later stage of development, additional fruits fail to set, but fruits already present ripen in a nearly normal manner. No flower symptoms are observed but flower drop is common.
Symptoms of thickening, epinasty, crumpling, and reduction of leaf size have been described on bean (Navas-Castillo *et al*., 1999). However, some cultivars were found to be resistant (Lapidot *et al.*, 2002). Symptoms also vary between peppers from mild to yellowing, leaf curling, cupping, twisting, and mottling. Many other host species are asymptomatic.

Morphology

TYLCV has geminate particles that are isometric and approximately 20 nm in diameter (Channarayappa *et al*., 1992). The genome is composed of a single-stranded circular DNA (Czosnek *et al*., 1988). The length of the DNA is in all cases about 2800 nucleotides. The DNA of several strains has been sequenced (Antignus & Cohen, 1994; Noris *et al*., 1994).

Detection and inspection methods

The disease may be difficult to identify due to the great variation in symptoms, particularly on species other than tomatoes. *Ty-1*-resistant tomato cultivars replicate the virus at low level and remain asymptomatic, but constitute a reservoir for other susceptible crops. The emergence of TYLCV recombinants can also make it difficult to detect the virus using certain molecular tests. Polymerase chain reaction with specific or degenerated primer pairs, followed by partial DNA sequence analysis is the most common method used for the detection and identification of TYLCV (EPPO, 2022). Certain serological tests, such as ELISA can be used for the detection of a number of begomoviruses but they are not specific at the species level. Other tests that can be used for the detection and/or identification of begomoviruses are described in PM 7/152 (EPPO, 2022).

PATHWAYS FOR MOVEMENT

In nature, TYLCV is transmitted only by the vector *Bemisia tabaci*, which can spread it between fields and glasshouses in infested areas. Transport of young plant seedlings between national or international production areas for transplanting constitute a pathway, if they were infected very early. Grafting also allows contamination of plants. Tomato fruits were shown to carry TYLCV which may then be transmitted by whiteflies (Just *et al.*, 2014; Delatte *et al*., 2003), Based on two molecular studies, TYLCV is not considered to be seed-transmitted (Rosa Dias *et al*., 2017;

Perez Padilla *et al*., 2020), although seed transmission was reported in previous studies (Kil *et al*., 2016, Kil *et al*., 2017 and Kil *et al*., 2018). There is a certain risk of movement via *B. tabaci* to other host plants (e.g. ornamentals), given the fact that the vector moves readily from one host to another and that begomoviruses are known to persist in the vector for all its life after acquisition. Moreover, thanks to the ability of whiteflies to transmit TYLCV transovarially, TYLCV can be spread by *B. tabaci* emerging from viruliferous eggs to healthy plants in the field, even if the eggs were laid on non-host plants for the virus (Wei *et al*., 2017).

PEST SIGNIFICANCE

Economic impact

The vector *Bemisia tabaci*, and especially the MED and MEAM1 species (previously called biotypes Q and B), is now very widely distributed throughout the world (EPPO/CABI, 1996a). TYLCV causes major damage affecting tomato production in many tropical and subtropical countries. Field cropping of tomato in the coastal plains of Lebanon stopped because of TYLCV (Abou-Jawdah & Shebaro, 1993). Yield losses reached 80% according to Mazyad *et al.* (1979). Whenever TYLCV is introduced into a new country where the vector is already present, it rapidly spreads throughout commercial tomato crops.

Control

Chemical control of the vector *B. tabaci* is difficult because of the resistance of whiteflies to most of the relevant pesticides, and the problem of residues on vegetable crops. Biological control agent against whiteflies were tested but their slow action and limited shelf life make them less effective than chemicals (Faria & Wraight, 2001). Different formulations of predatory insects and entomopathogenic fungi have been developed to control *Bemisia tabaci* but they must be present in relatively high numbers in the crop to be effective against this vector (Down *et al*., 2009). Cultural control measures include the choice of planting dates in order to avoid periods of high whitefly populations, the use of screens to exclude the vector, the elimination of virus sources, and the use of healthy transplants. Six resistance genes (Ty-1 to 6) have been identified (Yan *et al.*, 2018) but *Ty-1* is virtually the only gene introduced in the commercial cultivars deployed in the Mediterranean Basin. This gene reduces the virus accumulation and tomato plants are asymptomatic. However, the strong selection pressure exerted by *Ty-1*-cultivars has led to the emergence of recombinant viruses in the Mediterranean Basin (Belabess *et al*., 2016, García-Andrés *et al*., 2009, Urbino *et al*., 2020, 2022). Transgenic tomato plants with the capsid protein of TYLCV are resistant to the virus (Kunik *et al*., 1994). In addition to preventative measures and the use of resistant varieties, the concept of Integrated Pest Management (IPM), consisting of the use of different practices to control whiteflies and reduce virus sources, is the most successful strategy to control TYLCV (Horowitz & Antignus, 2011).

Phytosanitary risk

Establishment outdoors and spread of TYLCV are limited to regions with ecoclimatic conditions suitable for the establishment of *B. tabaci* populations. Because of the very high potential impact of TYLCD, tomato production in regions where the virus and the vector are present requires intensive crop management efforts to reduce impact. The use of *Ty-1* resistant tomato cultivars and the preventative measures adopted by growers counterbalance the negative effects of TYLCV in tomato crops, in most production areas, although constituting a selective environment for the emergence of resistance-breaking variants.

If the virus is introduced into a country where *B. tabaci* is established, the likelihood of serious crop damage and economic losses is high. For areas/countries where *B. tabaci* cannot establish outside due to the climate, the significance of TYLCV is low in outdoor crops but outbreaks can nevertheless occur under protected cultivation conditions.

PHYTOSANITARY MEASURES

Phytosanitary measures to prevent introduction from one country to another within the EPPO region may be difficult to apply because TYLCV and *B. tabaci* are already widely distributed. If TYLCV is introduced into a country, or if outbreaks occur because of particular climatic conditions the only possibilities for avoiding serious damage would be

to encourage careful monitoring of the situation within the country and the use of preventative measures by the growers. Plants for planting were considered a significant pathway for tomato plants grown under protected conditions in northern countries and management measures to ensure the freedom of tomato plants for planting were proposed (see EPPO, 2018).

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Datasheet history

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