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# Historical review of *Citrus tristeza virus* (CTV) and its vectors in Turkey

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**Abstract.** *Citrus tristeza virus* (CTV) has been officially reported from Turkey since 1963. After the first findings, technical and scientific studies were carried out in different citrus-growing areas, and this, to determine infected areas, discriminate between CTV strains and understand the presence and distribution of the CTV vectors, in the country. Today, it is very clear that CTV and its vectors (except *Toxoptera citricidus*) are widely distributed in Turkey; however, no report reveals the presence of severe CTV strains in the country. According to the latest monitoring results, the situation of CTV during the last two decades is under control but it is still considered as the most harmful threat to the Turkish citrus industry.

**Keywords.** Citrus – Tristeza – Turkey – Virus vectors – Virus.

## **Aperçu historique du virus de la tristeza des agrumes (CTV) et de ses vecteurs en Turquie.**

**Résumé.** En Turquie, le virus de la tristeza des agrumes (CTV) a été officiellement signalé en 1963. Après les premiers signalements, de nombreuses études scientifiques et techniques ont été réalisées dans les différentes zones agrumicoles afin de déterminer les zones infectées, discriminer les souches de CTV et évaluer la présence et la distribution des vecteurs de CTV dans le pays. Aujourd'hui, il est très clair que le CTV ainsi que tous ses vecteurs (sauf le *Toxoptera citricidus*) sont largement distribués en Turquie, mais il n'y a aucun rapport qui indique la présence d'une souche sévère de ce virus dans le pays. D'après les enquêtes récentes réalisées au cours des deux dernières décennies, la situation du CTV reste sous contrôle, mais il s'agit là toujours de la menace la plus grave pour l'agrumiculture turque.

**Mots-clés.** Agrumes – Tristeza – Turquie – Vecteurs de virus – Virus.

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## **I – Citrus industry in Turkey**

Citrus production in Turkey has increased over the last two decades due to high demands of local consumption and exportation. The total citrus production of Turkey is about 2.492.650 tons/year.

Citrus production is mainly concentrated in the Mediterranean, Aegean and Black Sea regions. Generally, sour orange rootstock is used in all areas because of its vigour and compatibility with common cultivars except for the Aegean region in which trifoliolate orange predominates.

The citrus industry faces many problems due to plant pests and pathogens. At present, about 15 virus and virus-like diseases have been reported in the Turkish citrus production area e.g. Psorosis complex, Infectious variegation (crinkly leaf), Chlorotic dwarf, Tristeza, Satsuma dwarf, Cristacortis, Concave gum, Impietratura, Gummy bark, Woody gall, Cachexia-xyloporosis, Exocortis.

## **II – Review of CTV History in Turkey**

CTV most probably has been introduced into Turkey via imported material from far-east Asia such as China to the Black Sea Region in the northern part of the country. For the southern part of the country, e.g the Mediterranean Region, another source of introduction could be Israel.

**1958.** Reichert reported that Turkish local citrus varieties were CTV free.

**1959.** Dickson and Flock published that CTV was present in the Mediterranean countries and most probably it has been present in the region since 1890.

**1961.** Cengiz observed some suspicious trees in Adana and Mersin whose symptoms could be attributed to CTV but he had no possibility to confirm his suspicion (Dolar, 1976).

**1963.** Norman as an FAO expert, made a visual survey throughout the Turkish citrus-growing areas. He observed some CTV-like symptoms in Adana, and reported that Turkey was a CTV-free country.

**1965.** Moreira did some biological indexing on Mexican lime and reported that all results were negative and that the Turkish citrus industry was free from CTV.

**1967.** Ozalp and Azeri were the first to report the presence of CTV on Satsuma Mandarins from the Aegean Region in Izmir province.

**1974.** A voluntary certification system was implemented under the control of the Ministry of Agriculture and Rural Affairs.

**1976.** Cengiz *et al.* reported that the first CTV - infected citrus trees were a Yafa sweet orange in Adana, and five mandarin trees in Mersin. The CTV detection in Adana was confirmed by biological indexing.

Dolar carried out a survey in the eastern Mediterranean region and reported 2.6 % of CTV infection. Most of the infected trees were 15 to 20 year - old Yafa and Washington Navel sweet orange trees, Duncan grapefruit and kumquats. Even grafted on susceptible rootstock all infected trees exhibited mild symptoms. No inverse pitting could be observed in the bud union of infected trees.

**1978.** Azeri and Hepper reported 16 % of CTV infection on Satsuma Mandarins in the Aegean Region.

**1984.** Azeri completed a survey in the Aegean Region (western part of Turkey). He reported the presence of five different CTV biotypes in the region by means of biological indexing. In comparison with the Mediterranean region, he attributed the smaller incidence of the virus to the use of trifoliolate rootstock and climatic conditions not favorable for CTV dissemination.

**1988.** Baloglu tested by ELISA 112 suspicious trees in the Mediterranean region, from which 71 were positive. All infected trees originated mild vein clearing symptoms when indexed on Mexican lime. A polyclonal antiserum was produced following partial purification of the virus. Electron microscopy studies confirmed the presence of CTV.

**1990.** Gullu carried out a general survey on navel sweet oranges and mandarins in the Turkish Mediterranean Region. Tristeza symptoms were observed both on navel and satsuma trees. The disease incidence ranged from 0.06 % to 2.1 % in Navel oranges; it was 0.08 % in Satsumas. The diseased trees occurred individually or in small groups and were older than 15 to 20 years.

In the same year Yılmaz *et al.* reported that the aphid species present in infected orchards was *Aphis gossypii*. Aphids were collected and used in successful transmission assays to Mexican lime. Although no symptoms of CTV could be seen on test plants, the virus was detected by ELISA. The virus could also be detected by ELISA in *A. gossypii* but not on *A. ruborum* or *A. solanella*.

**1993.** Yumruktepe carried out an aphid survey in the eastern Mediterranean Region. *Aphis citricola*, *A. Gossypii*, *A. craccivora*, *Toxoptera aurantii* and *Myzus persicae* were detected in the region. *A. citricola* and *A. gossypii* were found to be the major aphid species among the others.

**1996.** Akbulut *et al.* cloned and sequenced the capsid protein genes of five Turkish isolates of CTV. Cluster analysis indicated that the sequences were closely related to the known severe stem pitting isolate (B53) from Japan. These isolates also reacted with the monoclonal antibody MCA13, which reacts predominantly with severe CTV isolates. The biological characteristics of these isolates have not been assessed, and stem pitting was not obvious in orange trees in the field.

**1997.** Satar did experiments on the transmission of the CTV isolate from Mersin by *A. gossypii*. Transmission averaged 7.9 %, but greatly varied between 0.0 % and 21.5 %.

**1998.** Ulutas tried to obtain CTV tolerant rootstock plants via somatic hybridization. Yilmaz *et al.* (1998) used immunoprinting to detect CTV in samples from different Turkish Provinces.

**1999.** Ince detected CTV infection in field samples from diverse hosts from the Mediterranean Region using dsRNA.

**2000.** Kamberoglu produced a monoclonal antiserum against Turkish CTV isolates. The antisera produced were successful for the detection of local CTV isolates.

**2002.** Bozan conducted a new survey (using ELISA and DTBIA methods) to determine the incidence of CTV in the citrus-growing area in the East Mediterranean Region. The CTV incidence was found to total 0.04 % in the surveyed area.

### III – Conclusion

Citrus production is a vital branch of agriculture in the country. Improvement of production quality and control of the pests and diseases with environment-friendly techniques are the major strategies for a sustainable and profitable citriculture. CTV is endemic in the country and remains a major threat to the citrus industry due to the use of susceptible rootstocks. Apparently most of the characterized isolates appear to be mild. Although *T. citricidus* is not present, the other vectors such as *Aphis gossypii* can transmit the local isolates.

A voluntary certification system under the control of the Ministry of Agriculture and Rural Affairs is operating. For an effective control of CTV, research on tolerant citrus rootstocks and varieties, and the strengthening of quarantine measures as well as participation in international control and research activities are of utmost importance. Application of a harmonized certification system will be the major part of a control strategy.

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