

Citrus Tristeza Virus (CTV): A Virus that Kills Citrus Trees

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Received date: December 10, 2021; Accepted date: December 24, 2021; Published date: December 31, 2021

Citation: Dida K (2021) *Citrus Tristeza Virus (CTV): A Virus that Kills Citrus Trees*. J Res Plant Pathol. Vol.4 No.5:e002.

Editorial Note

Citrus Tristeza Virus (CTV) is a Closterovirus that causes *Citrus Tristeza*, which is the most economically devastating disease in the Citrus genus. As a result of the disease, millions of Citrus trees have died, and millions more have been rendered unsuitable for production. To depict the disease's devastation in the 1930s, farmers in Brazil and other South American countries coined the name "tristeza" which means "sadness" in Portuguese and Spanish. The virus's most effective carrier is the brown citrus aphid.

CTV is classically diagnosed by grafting sick plant tissue into a Mexican lime (*Citrus aurantifolia*). The Mexican lime's effects will be quite predictable. On the leaves, the symptoms start with clear veins that turn corky, then chlorosis and leaf cupping. More extreme stressors may cause stunting and stem-pitting as adverse consequences. The formation of aggregation of cross-banded inclusion bodies in the phloem of a diseased plant can also be used to detect CTV. Other diagnostic approaches include electron microscopy, Double-Antibody Sandwich Enzyme-Linked Immunosorbent Assay (DAS-ELISA), Tissue-Print ELISA, and PCR-based diagnostics. These methods examine the virus's microscopic structure (electron microscopy), the presence of antigens in its proteins (ELISA), and the presence of its RNA (RNA sequencing) (PCR).

CTV is a virus that infects just the phloem tissues of the host. It is distributed semi-persistently by vectors, which are mainly crop-inhabiting aphid species that penetrate the phloem to extract sap. The brown citrus aphid is significantly more

successful than other citrus aphids at transmitting the virus. Prior to the arrival of the brown citrus aphid in 1995, it was claimed to be six to twenty-five times more efficient in Florida than *Aphis gossypii*, the most efficient vector known. The narrow host range of the brown citrus aphid, as well as its predilection for creating winged forms in order to colonise new growth, contribute to its efficiency. *A.gossypii* has a far greater host range, including hundreds of plant species in Florida, and the virus cannot spread when it feeds on a new host.

Aphids are the major vector for CTV transmission. *Aphis gossypii* (melon-and-cotton aphid), *Aphis spiraecola* (green citrus aphid), and *Toxoptera aurantii* were the only vectors in the United States at first (black or brown citrus aphid). The oriental citrus aphid, *Toxoptera citricida*, spreads the virus significantly more effectively than these insects.

To acquire the virus, the aphids must consume for at least 30 to 60 minutes, and they must remain virulent for at least 24 hours later. *T. citricida* is significantly more efficient than other aphids at transmitting CTV strains that produce severe stem pitting or decline, which other aphids cannot. Even though *A. spiraecola* is less efficient, it has a greater population and hence has a better chance of spreading the virus. Only a few CTV strains have been shown to be transmitted by *T. aurantii*. With a transmission efficiency of 78%, *A. gossypii* is the most efficient of the three aphids, whereas *A. spiraecola* and *T. aurantii* have transmission efficiency of 0-6%. Experimental studies suggest that the psyllid *Diaphorina citri* could also be a significant vector. The CTV can be transferred from the original tree to the new one by grafting with CTV-infected budwood.