Management Program for Citrus Tristeza in Cuba

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ABSTRACT. The presence of *Citrus tristeza virus* (CTV) and *Toxoptera citricida* Kirkaldy in Cuba for the past 10 yr has led us to take steps to extend the productive life of trees in commercial citrus areas. A management program has been established which includes a system for production of certified budwood, the eradication of CTV-infected trees, the use of tolerant rootstocks and the management of aphid vectors. Additionally, epidemiological studies and work on the characterization of CTV isolates are in progress. The program is updated systematically according to the epidemiological changes detected in each area. The results indicated that the overall virus incidence has increased with differences among the regions, with some areas having low incidence (7.73%) while others have a higher incidence (up to 53%). Outbreaks of the disease have not occurred, although there are isolated trees showing decline symptoms. This program has fostered the development of a citriculture which coexists with the virus and which has minimal possible economic losses.

In Cuba 53,000 ha are presently dedicated to citriculture, with sour orange being the predominant rootstock. The program for the management of virus and virus-like diseases was organized at the same time as the development of the citrus industry. The first measures were adopted in the years 1970-92, even before the appearance of *Citrus tristeza virus* (CTV) and its main vector *Toxoptera citricida* Kirkaldy (TC).

Beginning in 1980, a System for the Production of Certified Budwood (4) was established based on the process of shoot tip grafting *in vitro*. As a result of this program we have available a collection of certified germplasm from 135 cultivars (unpublished data). Considering the need to replace trees on plantations established on sour orange rootstock, the most widely used replacement rootstocks are: Carrizo and Troyer citrange, Swingle citrumelo, Cleopatra mandarin, Volkamer lemon and alemow, although this last one is used only for sour limes.

Since 1993, with the detection of the CTV-TC complex, the existing program of surveillance and eradication of infected trees for disease management was improved, with the network strengthened by the addition of new laboratories. This program provided the process for maintaining low virus incidence over several years (1).

In the year 2000, a new survey was begun with the purpose of determining the presence of trees showing tristeza symptoms. At this stage a modified immunoprinting-ELISA (2) procedure was standardized, including the substitution of nitrocellulose membranes with paper. The modified technique enabled expansion of the diagnostic process, increasing the number of analyses and updating the epidemiological situation in each citrus area faster and at lesser cost (unpublished data). The results of this survey indicate that increases in viral presence have occurred with respect to the survey in the 1990s and that differences among regions remain (Fig. 1). In all citriculture areas declining trees with symptoms typical for tristeza were detected.

An analysis was conducted comparing two citriculture areas from the Western and Eastern regions. In those areas, declining trees negative

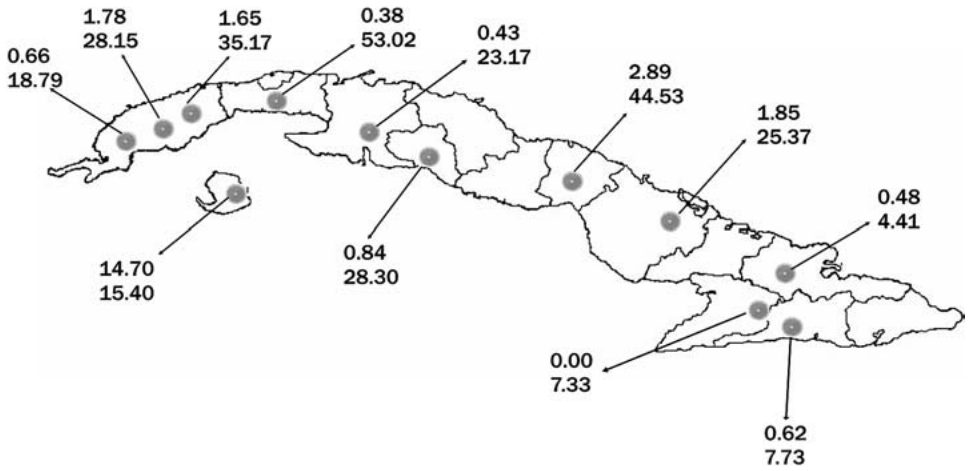

Fig. 1. Increases in *Citrus tristeza virus* incidence in Cuba as seen by comparing the percentage of infected trees obtained in the 1992-1995 survey (top number) and the survey in 2000-2004 (bottom number).

for CTV were detected, with a higher number in the eastern region. The results indicate that other biotic and abiotic factors may be causing decline or death of CTV negative trees. These regions have different cultural conditions such as the type of soil, agronomic technology and climatic factors, which may or may not favor the presence of aphids and thus have influence on the observed differences in CTV incidence. When the climatic variables were analyzed it was observed that the main difference was the rainfall, which was deficient in the Eastern area, where most plantations are on non-irrigated lands.

In the Banes citriculture area, where Mexican lime is cultivated commercially, trees with tristeza symptoms (declining and dead trees on sour orange rootstock) have been observed. Nevertheless, in the new plantations of this variety, now grafted on alemow, no trees with declining symptoms have been detected. In contrast, trees appear healthy and productive, in spite of being adjacent to areas with trees on sour orange rootstock.

On the other hand, in the epidemiological studies, seven orange and three grapefruit fields from five citrus areas were evaluated. In all zones, CTV dissemination found in the epidemiological studies corresponded with the increase in CTV infection percentages observed in the national survey.

Additionally, the molecular characterization of eight CTV isolates from different citrus areas was carried out by nucleic acid hybridization (3), single-stranded conformational polymorphism analysis (SSCP) and sequencing. The results indicated that the isolates constitute mixtures where the predominant sequences had a higher percentage identity with mild isolate groups. Preliminary serological characterization of these isolates found two different serogroups.

Regarding vector management, monitoring of plantations has been carried out and differences in aphid population levels among the different areas have been observed. Chemical pesticides are used only in nurseries or plantations where there is a high aphid population. There also is a group of biocontrol agents that maintain low population levels of aphid vectors.

Based upon the results obtained from the national survey and the epidemiological studies, manage-

ment measures have been adapted to the CTV situation specific to a given citrus area. In places where CTV incidence remains low, the eradication of virus infected trees is maintained. Meanwhile in areas with a high incidence, only trees with tristeza symptoms are eradicated, subsequent to confirmation of the presence of CTV.

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