Citrus Variegated Chlorosis (CVC) in Brazil—An Overview

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ABSTRACT. Citrus variegated chlorosis is currently the most serious disease of citrus in Brazil. It was first observed in São Paulo and Minas Gerais States in 1987, where trees showing decline, leaf drop, nutritional problems and small fruit were reported. In 1989, large numbers of the bacterium, *Xylella fastidiosa*, were found in xylem tissues. Several species of sharpshooters have since been identified as vectors. Attempted control measures include pruning disease branches, replanting orchards with certified healthy trees, and controlling vector numbers. A genome project to completely sequence the pathogen genome has also been initiated.

In 1987 a previously unknown citrus disease was observed in the Brazilian States of São Paulo and Minas Gerais (15). Trees were collapsing, there was significant leaf drop and apparent nutritional problems. The disease was named citrus variegated chlorosis (CVC). Since then, the disease has spread rapidly in Brazil, and has been reported in Paraguay and Argentina (3).

SYMPTOMS

Sparse chlorotic spots appear on the upper surface of the leaves, corresponding to brown gummy spots on the underside (15). Nutritional deficiency symptoms resembling zinc, potassium and boron are also present. A certain percentage of the fruit are small and hard, and have an intense yellow color. Diseased trees are stunted, with protruding branches. Young trees less than 5 to 6 yr old are more susceptible than older trees.

All sweet orange varieties are highly susceptible. Some mandarins and tangelos (Campeona, Clementine, Monreal, King) are tolerant, and initial studies indicate that pummelos, citrons and lemons are also tolerant (11).

CAUSAL ORGANISM

Initially there was concern that the disease may have been huanglongbing (greening), since the psyllid vector *Diaphorina citri* is present in Brazil (9). Samples were sent to INRA in France where in 1989 large numbers of organisms similar in appearance to *Xylella fastidiosa* were observed in the xylem (17). The presence of bacteria in the xylem was confirmed in Brazil (5), and in 1993 it was isolated in pure culture and identified as a strain of *X. fastidiosa*, similar to the causal organism of Pierce's disease of grapevine (12, 14).

TRANSMISSION AND PROPAGATION

CVC can be transmitted by grafting from diseased trees, by approach grafting (16) and by natural root grafts (13). The isolated bacterium has also been successfully inoculated into healthy plants. Re-isolation from these plants completed Koch's postulates (6). In the field, CVC is transmitted by several species of xylem-feeding sharpshooters. The main ones identified thus far are *Dilobopterua costalimai*, *Acrogonia terminalis*, *Oncometopia facialis*, *Bucephalogonia xantopis* and *Plesiommata corniculata* (10).

DETECTION

X. fastidiosa can be detected by ELISA (8, 14), DIBA (14) and by PCR (1).

TENTATIVE CONTROL MEASURES

Some growers have been pruning diseased trees, removing the dis-

eased branches 20, 50 or more cm below where leaf symptoms occur (2). This has reduced levels of infection in some orchards. Root applications of oxytetracycline were not effective.

Because of the large numbers of infected orchards, it has been recommended that new orchards should only be established from healthy material from registered nurseries which must have their trees in pots under insect-proof screen protection (4).

CURRENT RESEARCH

New studies on the epidemiology, distribution of the bacteria in the plant and effects of endophytes are under way, as are improved screening methods for tolerance and resistance. A genome project for *X. fastidiosa* is now underway in several laboratories in Brazil sponsored by the Fundação de Amparo a Pesquisa do Estado de São Paulo (FAPESP).

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