Citrus Sudden Death: A New Citrus Disease in Brazil

G. W. Müller, J. D. De Negri, C. I. A. Vildoso, D. Mattos Jr., J. Pompeu Jr., J. Teófilo Sobrinho, M. A. Machado, S. A. Carvalho, and L. F. Girotto

ABSTRACT. A new disease affecting sweet oranges on Rangpur lime rootstock, named Citrus Sudden Death, was first detected in the southwestern part of Minas Gerais and northern part of São Paulo states in 1999. Initially, affected trees present pale green leaves, followed by pronounced leaf drop, twig dieback, and occasional sucker growth of both scion and rootstock. Finally, trees quickly lose all their leaves and die about 6-mo after early symptoms appear. Young fruits remain attached to the twigs of dead trees. Cambial yellowing in the rootstock can be observed but there is no graft incompatibility, and symptoms are more pronounced during the spring. Symptoms have only been found on trees 6-yr or older. The roots have fewer feeder roots, and root rot occurs. The cause of this disease is unknown. Neither fungi nor nematodes appear to be causal agents. *Citrus tristeza virus* does not seem to be the cause either, and associations with nutrient disorders are not completely understood. The spatial evolution suggests the existence of foci and airborne transmission. Graft transmission trials have been initiated.

In late 1999, a new disease affecting sweet oranges on Rangpur lime rootstock in the southwest of Minas Gerais State was reported (3). The affected trees initially present pale green leaves, followed by a pronounced leaf drop, twig dieback, and occasional sucker growth from both the scion and rootstock. In the final stage, all leaves drop and the tree dies with any young fruit remaining attached to the twigs (Fig. 1). Symptoms are more pronounced in spring, and trees die about 6-mo after initial symptoms appear. Examination of the cambial tissue shows yellowing in the rootstock, but no graft incompatibility (Fig. 2). The root system of affected trees has fewer roots than healthy ones, and there are different levels of root rot (Fig. 3). Valencia, Hamlin, Natal, and Pera sweet orange varieties are affected, but only when on Rangpur lime; trees grafted on Cleopatra mandarin, Swingle citrumelo and trifoliate orange do not show these symptoms.

The disease was first observed on a farm in Minas Gerais in December 1999 in a 12-yr-old orchard of Valencia on Rangpur lime. At that time, 518 of the 4,703 trees (11%) showed the described symptoms. Affected trees were arranged in a cluster. By August 2000, 767 trees presented the same symptoms and 210 were dead, totaling 977 affected trees (20%). In another orchard of similar age in this area the increase in incidence of disease rose with randomized distribution from 35% in February to 60% in May 2001. A 20-yr-old orchard of Natal sweet orange on Cleopatra mandarin adjacent to the first affected orchard did not show any similar symptomatology. However, 5 to 6-yr-old Natal on Rangpur lime inter-planted in this orchard are showing symptoms and dying. A similar disease is spreading in circle arrangement (3) in a plot of 23-yr-old Hamlin sweet orange on Rangpur lime located across the state border in the north of São Paulo State. The spatial evolution in all these orchards suggests the existence of foci and airborne transmission. Symptoms have not been observed in sweet oranges on Cleopatra mandarin, Swingle citrumelo, and trifoliate rootstocks.

The disease appears to have been originated in either of those two regions, since affected trees came from different nurseries, and sister trees planted elsewhere are still healthy.

Fig. 1. Twelve-yr old Valencia sweet orange trees on Rangpur lime showing stage 3, stage 2, and healthy (from right to left, respectively).

Attempts have been made to identify the cause. Treatments to control *Phytophthora* and *Fusarium* in 2000 were tested and presented no beneficial effects. Citrus-attacking nematodes were present in low numbers. Soil analysis indicated high phosphorus and micronutrient levels, and leaf analysis indicated higher levels of micronutrients in diseased plants. Some affected trees were cut back both severely and lightly. All trees began to sprout, then developed symptoms again.

The rapid death is reminiscent of quick decline of trees on sour orange rootstock caused by *Citrus tristeza virus* (CTV) reported more than 60-yr ago (2). Iodine-starch tests did not suggest accumulation of starch in the scion trunks just above the bud union, as is found in CTV-caused

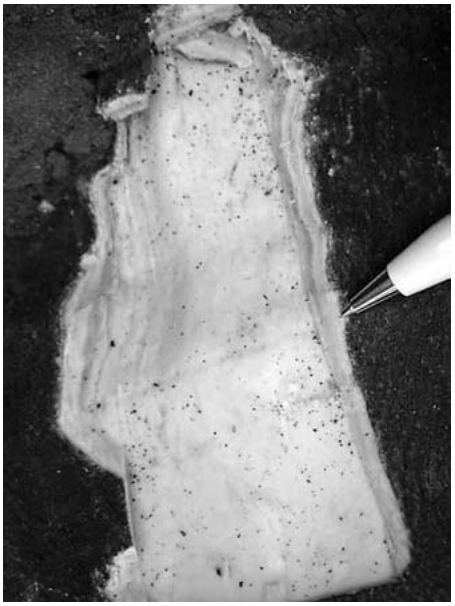

Fig. 2. Section of cambial tissue of disease Valencia sweet orange tree (ball-point pen indicates bud union; arrow shows yellow colored cambial tissue of the Rangpur lime rootstock).

decline (1). Examination of samples from affected trees by electron microscopy did show the presence of particles (Kitajima, pers. comm.), but biomolecular analysis did not indicate the presence of strains with characteristics different from presently known isolates (4). CTV has been infecting trees on Rangpur lime in Brazil for decades, and even the severe Capão Bonito complex does not kill the citrus tree (5). This

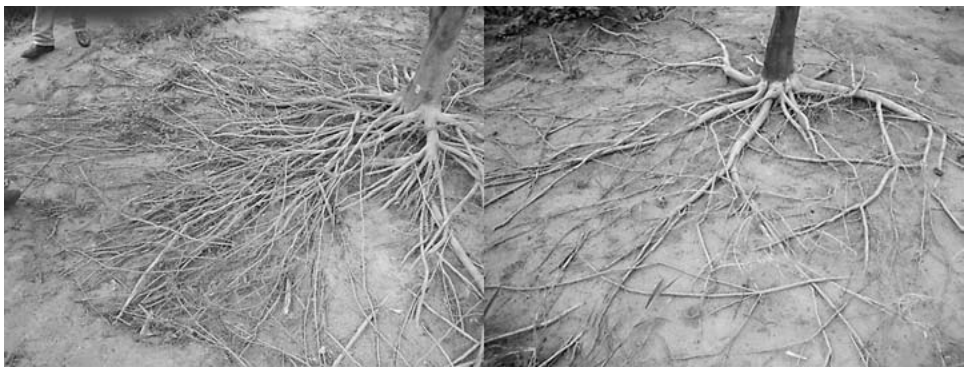

Fig. 3. Root systems of Westin sweet orange tree (left—healthy tree with dense root system and feeder roots; right—affected tree without feeder roots).

virus is usually more severe in cooler conditions (9), but the sudden death-affect orchards are in the hottest areas of these two states.

The early stages of the disease bear some resemblance to blight, and also Cleopatra mandarin rootstocks are not affected (7, 10). However, generally blight-affected trees do not die. Water uptake tests using a syringe (4) did not show any difference between healthy and diseased trees. The disease also has some similarities with the sudden decline of Valencia on Volkamer lemon rootstock in Venezuela, where trees die 8 to 10-mo after the onset of symptoms (6). It is also similar to the declinamiento problem reported in Misiones, Argentina, during the 1960s and the 1970s, where trees on trifoliate orange declined and died (8). The causes of these latter problems remain unknown.

In order to determine whether a graft-transmissible agent is responsible, budwood from healthy and infected trees have been grafted onto 1-yr-old Swingle citrumelo, Cleopatra mandarin, and Rangpur lime seedlings grown in a protected nursery. Also, 1-yr-old healthy Valencia on Rangpur lime trees have been inoculated with buds from infected trees. In addition, 4-mo-old Rangpur lime seedlings were grafted to symptomatic twigs, and after take the twig was detached from the parent tree so that it could grow on the new rootstock in a pot. Four-mo-old Valencia on Rangpur lime trees were colonized with aphids (*Toxoptera citricida* Kirk.) and white fly *(Aleurotrixus floccosus*) from diseased trees. No results are yet available.

The authors have been informed that this disease may also occur in other regions of São Paulo near the border with Minais Gerais State. Since it has the potential for becoming a serious problem, the transport of vegetative material (nursery trees, budwood, and seed) out of the affected areas has been forbidden.

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