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Short communication

Scytalidium wilt of citrus

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Abstract

In July 1998, a sudden wilt of 'Star Ruby' grapefruit (*Citrus paradisi* Macf.) occurred in Israel in a region with a warm Mediterranean climate. The wilt of the middle and upper canopy of main limbs was accompanied by gum oozing from the affected branches. The bark of these branches attained a dark colour and the epidermis sloughed off easily revealing a mass of black powder, resulting from copious sporulation of dark conidia. Both the bark and the xylem were intensively colonized with mycelium. The fungus was identified as *Scytalidium lignicola* Pesante, based on the characteristic mixture of some colourless and dark conidia, produced in branched chains by conversion of the vegetative hyphae. Artificial inoculations induced typical disease symptoms and the fungus was reisolated, thus confirming Koch's postulates. Similar symptoms appeared in 'Star Ruby' interim segments which had been cut and top grafted with various citrus cultivars. This is the first detailed report of pathogenicity of *S. lignicola* to citrus trees. It is postulated that the disease developed after predisposition of 'Star Ruby' grapefruit trees by comprehensive pruning followed by extremely hot conditions.

'Star Ruby' is a common cultivar of grapefruit (*Citrus paradisi* Macf.) in Israel, where it is grown in various climatic regions. It is grafted on various rootstocks, to suit edaphic conditions. In July 1998, a sudden wilt occurred in several locations in the north of the Jordan valley, a region below sea level with a warm Mediterranean climate. Attention was focused on one location named Mesillot. The wilt was observed in the foliage of the middle and upper canopy of the main limbs of 10-year-old 'Star Ruby' trees (Figures 1 and 2), planted on ridges to avoid drainage problems. The wilt was accompanied by oozing of gum from the affected branches (Figure 3). The bark of these branches attained a dark colour and the epidermis sloughed off easily, revealing a mass of black powder (Figure 4), beneath which the wood had a grey colour. A cross cut in thinner branches without foliar symptoms revealed a greyish discolouration of the xylem. Microscopic examination of the affected branches revealed that the blackish colour of the bark resulted from copious sporulation of dark conidia. Both the bark and the xylem were intensively colonized with mycelia.

Figure 1. An orchard of 'Star Ruby' trees affected by Scytalidium wilt.

Analysis of the agrotechnical management and the climatic conditions of that season revealed that the trees in the affected plot had been intensively pruned in early spring (March), to lower the canopy and to increase light penetration into the inner parts of the trees. The

Figure 2. A main branch of a 'Star Ruby' grapefruit tree affected by Scytalidium wilt.

Figure 3. An infected branch showing gum oozing.

Figure 4. An infected branch showing a mass of black spores underneath the epidermis.

disease did not occur in neighbouring plots that had not been pruned. Shortly after pruning (early April 1998), extremely hot and dry weather prevailed for several consecutive days, with maxima ranging from 39 to 42 °C and afternoon relative humidity below 20%. After that hot spell the remaining foliage turned yellow, with a bronze hue, and the laminae curled and drooped. By July, when the disease became apparent, dense new foliage had developed.

Branches showing disease symptoms were removed by pruning, and the trees developed new foliage. In the summer of the following year, or after 2 years, the disease was observed on some trees that had been rescued in 1998, apparently because of incomplete removal of infected branches. Trees that were not affected in 1998 remained healthy in 1999. In July 2000, the disease was observed in some other 'Star Ruby' orchards in that area, where topping had been carried out in the spring.

A neighbouring orchard of 'Star Ruby' grapefruit, grafted on Volkamer citrus (*C. volkameriana* Pasquale), that had been planted in 1994, was prepared for a change of cultivar in late February 1998. The grapefruit trees were cut down to approximately 20 cm above the rootstock, and the stumps were whitened with a standard preparation. Several days later, the stumps were prepared for grafting by removing a thin layer, and were top grafted with 'Idit' mandarin, sprayed with chlorothalonil, tied, and covered with a plastic bag and a paper bag. The removal of the bags was adjusted to match budwood development. In July the developing shoots, approximately 1 m long, began to wilt. Gum began to ooze from the upper parts of the grapefruit interim segments, close to the cut end, and the bark and wood turned grey; underneath the epidermis there was a profuse accumulation of black spores. The rootstock did not show any discolouration or other symptoms in the bark or wood. By the summer of 2000, only 3% of the trees survived.

In Ro'i, an orchard had been planted in 1994 with 'Star Ruby' grapefruit grafted on Volkamer citrus. In early spring of 1999, the scion was cut down to approximately 20 cm above the rootstock, and was top grafted with 'Eureka' lemon (*C. limon* [L.] Burm.). A few months later the developing shoots, approximately 1 m long, began to wilt. Gum oozed from the grapefruit interim segments, and there was a profuse accumulation of black spores underneath their epidermis (Figures 5 and 6). These symptoms often appeared on the upper part of the grapefruit segment, close to the cut end. Three months after grafting there were several days with maxima ranging from 41 to 45 °C and afternoon relative humidity below 10%.

A similar fungus was isolated from all affected trees. It was identified at the International Mycological Institute, UK, as *Scytalidium lignicola* Pesante, on the basis of the characteristic mixture of colourless and dark conidia produced in branched chains by conversion of the vegetative hyphae. The dark brown conidia

Figure 5. Scytalidium wilt of a lemon shoot grafted on a 'Star Ruby' segment.

Figure 6. A segment of 'Star Ruby' grafted with lemon showing a mass of black spores underneath the epidermis (removed).

were either single cell, spherical or slightly elongated, measuring 5.1×4.8 μm (3.5–7.0 μm), or septate and elongated, measuring 6.9×4.9 μm (5.3–8.8× 3.5–5.3 μm).

Inoculations were made in the Ro'i orchard by placing several disks of a spore-bearing culture of *S. lignicola* in contact with the bark of 'Star Ruby' grapefruit scion, budded on Volkamer citrus, and grafted with 'Eureka' lemon. The inoculum, placed after lightly wounding the outer bark, was covered with wet cotton and wrapped with a plastic band. Five months later, inoculated plants showed wilt symptoms, and the bark revealed a mass of dark conidia of *S. lignicola*. The xylem underneath the inoculated area was grey. The fungus was reisolated and Koch's postulates were confirmed.

This is the first detailed description of *S. lignicola* affecting citrus trees. However, the disease symptoms and the pathogen are similar to those described by Fawcett (1936) on orange and grapefruit trees in California following a cold winter with frost damage. He suggested that the causal organism was *Torula dimidiata* Penz. (Syn. *Hendersonula toruloidea* Nattrass). Fawcett (1936) also reported observations by A.J. Olson of a similar pathogen on lemon and orange trees in California after a frost in 1931; Olson identified the pathogen as *H. toruloidea*. The arthroconidial state of *H. toruloidea* is a synanamorph of *S. lignicola.*

Scytalidium lignicola has been reported as the cause of diseases of some crops in Brazil. It causes a root black rot of cassava (Muniz et al., 1999), and a rot of spineless cactus, used for forage (Moura et al., 1998). This fungus has been shown to have an antagonistic effect against pathogens of forest trees (Ricard, 1977; Highley and Ferge, 1993).

Scytalidium lignicola appears to be a globally widespread organism in the natural microflora, where it is devoid of pathogenic nature. However, in limited cases biotypes of this species have been shown to be phytopathogenic. The rather simple taxonomic characteristics of this hyphomycete have probably been adopted by a wider range of phylogenetically diverse organisms. The pathogenicity of *S. lignicola* to 'Star Ruby' grapefruit suggests that this cultivar is extremely susceptible to this pathogen, after being predisposed by a heat shock. In the present case, as a result of intensive pruning the main branches became exposed to direct sunrays and the temperature on their surface could have been injurious, even though no sunburns occurred. The disease did not occur in any of the neighbouring unpruned plots. Likewise, when the trunk was cut and the canopy removed before top grafting, although the trunk has been painted with whitewash, it was exposed to an extreme heat stress. Furthermore, the pruning created cuts that might have provided entry to the fungus.

Soon after the pruning the cuts were wet because of discharged sap. It is clear that 'Star Ruby' grapefruit is stressed by hot weather conditions more than other citrus cultivars.

In July 2000 the disease was observed on related citrus cultivars. It occurred in the coastal plain on 'Marsh seedless' grapefruit, top grafted with 'Newhall' orange in the previous year, and in the Negev on 'Oroblanco' (*C. grandis* [L.] Osbeck × *C. paradisi* Macf.) top grafted with 'Satsuma' mandarin in March 2000.

A preliminary study has been conducted to assess the efficacy of a copper fungicide to prevent infection. 'Star Ruby' segments were sprayed with Kocide DF (0.3%) and subsequently inoculated with conidia of *S. lignicola*. After incubation in a humid chamber the fungus colonized all the segments.

The growth rate of *S. lignicola* on PDA was examined at a range of temperatures (Figure 7). Fastest growth was at 23 and 30 °C; slow growth occurred at 39 °C but not at 41 or 15 °C. These data suggest that the pathogen favours warm temperatures, but is not thermophilic, like some other species of *Scytalidium* (Mouchacca, 1997).

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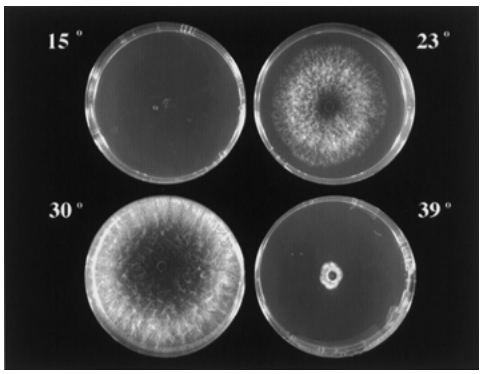

Figure 7. Growth of *Scytalidium lignicola* on PDA at various temperatures.

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