Huanglongbing (HLB) is a phloem limited bacterial disease of citrus caused by *Liberobacter asiaticum* and is generally terminal. We studied the process of leaf chlorosis and the reason(s) for phloem collapse. HLB-affected leaves were compared to nutrient-deficient chlorotic and healthy leaves using light and transmission electron microscopy. The major symptoms in leaves that indicate HLB disease are asymmetrical chlorosis, starch accumulation, and phloem necrosis. There were large amounts of starch accumulated in the mesophyll, epidermal, oil glands, and vascular bundle parenchyma in leaves from trees that had HLB. Starch accumulation occurred first in the spongy mesophyll and then in the palisade layer. The outer membranes of the chloroplasts were always retained, with no evidence of rupturing, even with large accumulations of internal starch. As starch accumulated, the internal membranes of the plastids degenerated. Phloem collapse and necrosis were observed in the petiole, mid-vein, and minor vein branches in HLB-affected leaves. Phloem necrosis was also observed in asymptomatic leaves before starch accumulation and chlorosis. In contrast to HLB, necrosis of the phloem in Zn- and Fe-deficient leaves was found to occur after the development of chlorosis. Bacteria in small numbers were observed in HLB-affected field plants in Indonesia and Florida and in greenhouse-grown plants. Bacteria in large numbers without block sieve elements were never observed. However, sieve elements, in necrotic phloem, were found to be totally occluded by an amorphous plugging material, similar to callose, as well as a filamentous plugging material that may contain significant amounts of P-protein like material, normally found in smaller amounts in sieve elements. Further identification of this plugging material is under way.

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(425) Soluble Carbohydrates Changes during Pedicel and Fruit Growth in *Citrus sinensis* var. *Salustiana*

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To establish the changes in the soluble carbohydrates content during the initial growth of pedicel and the fruit of *Citrus sinensis* var. *Salustiana*, plants growing under Mediterranean environment were evaluated in Valencia, Spain. Reproductive structures were collected from anthesis up to 118 days after anthesis (daa). Pedicels and the fruits dry mass (DM) were determined as well as levels of glucose, fructose, and sucrose, which were quantified by HPLC (% DM). In pedicels a maximum of 14% soluble carbohydrates at the time of anthesis was recorded. From the 62nd day until the end of the study, fructose and glucose levels were imperceptible and sucrose content stayed low and constant (5%), accordingly with the greater rate of growth in pedicel dry mass. During the initial growth of the fruit, the content in soluble carbohydrates was progressive, increasing steadily from 48 daa, in agreement with the exponential phase of increase in fruit dry mass. At the end of the study, 25% of reducing carbohydrates and 18.5% of sucrose was recorded in fruits, mainly in vesicles, replacing the pericarp as a reserve organ.

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(426) Leaf Ultrastructure of Huanglongbing Disease in Citrus

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The feeding of *Hyalodrosa vitripennis*, the glassy-winged sharpshooter, on *Citrus sinensis* cv. Navel and *Viitis vinifera* cv. Chardonnay was monitored in relation to free amino acids and proteins in xylem fluid. Mean consumption rate of *V. vitripennis* confined to feeding assemblies was significantly higher on 'Chardonnay' (2.01 mL/day) than on 'Navel' (0.44 mL/day). The concentration of free amino acids in xylem fluid was significantly higher than amino acids in protein form for both host species. For 'Navel' the major free amino acids were asparagine and proline, which represented 65% of the total amino acids. Similarly, glutamine/glutamic acid accounted for 70% of total amino acids in xylem fluid of 'Chardonnay'. To test whether leafhopper feeding induced changes in xylem fluid chemistry 20 glassy-winged sharpshooters were caged on shoots for a total of 10 days after which time feeding rate was determined and amino acids in xylem fluid were quantified. There was no significant difference in feeding rate between insect-infested and control shoots for both host species. Shoots of 'Navel' with leafhopper feeding had lower values of free and protein amino acids than on control shoots, although significant differences did not usually occur.