

## Citrus Diseases Exotic to Florida: Witches' Broom Disease of Lime (WBDL)<sup>1</sup>

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Citrus is susceptible to a large number of diseases caused by plant pathogens. Economic losses due to plant diseases can be severe, but fortunately, not all pathogens attacking citrus are present in Florida. Major citrus diseases currently present in Florida include: *Alternaria* brown spot, blight, citrus canker, greasy spot, melanose, *Phytophthora*-induced diseases (foot and root rot, brown rot), postbloom fruit drop (PFD), scab, and *tristeza*. An exotic, destructive disease called citrus greening (Huanglongbing) has recently been found in Florida. Any exotic diseases, if introduced, will increase production costs and decrease profitability for Florida growers. Exotic diseases could affect the viability of the industry or the varieties that could be profitably grown. Background information for each exotic citrus disease is presented in a series of fact sheets to: 1) provide a basis for evaluating exotic pathogens that may pose potential risks to Florida citrus; and 2) create a decision-making framework to prevent their introduction and spread. This paper will discuss Witches' Broom Disease of Lime (WBDL).

### Why Are We Concerned About WBDL?

Witches' broom disease is a very serious disease of acid (Mexican) limes. The disease first appeared in Oman around 1975 and has spread extensively there. It is estimated that over 98% of limes currently grown in Oman are infected with WBDL. WBDL kills lime trees in less than 5 years and has become a major limiting factor for lime production in Oman. WBDL later appeared in the United Arab Emirates (UAE) and has recently been found in Iran. It has been reported recently in India, but it is not yet clear if the causal agent is the same. Presumably, WBDL poses greater risks in arid areas such as California with a climate similar to that in Oman and UAE. WBDL appears unlikely to pose a severe economic threat to Florida because our major scion cultivars are not susceptible. However, establishment of WBDL in susceptible cultivars is conceivable in Florida.

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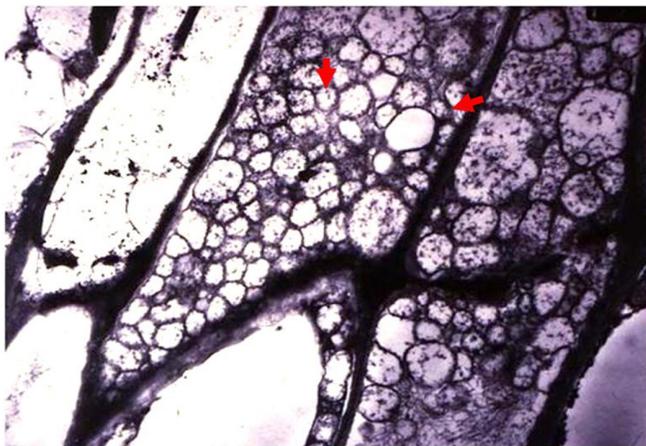
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## The Causal Agent of WBDL

WBDL is caused by a phytoplasma (a prokaryote lacking cell walls; formerly called mycoplasma-like agent) that is designated as *Candidatus Phytoplasma aurantifolia* (Figure 1). The WBDL agent can be observed in high concentrations in the phloem of infected plants by electron microscopy and is apparently closely related to sun hemp and sesamum phyllody phytoplasmas.



**Figure 1.** *Candidatus Phytoplasma aurantifolia* as indicated by arrows in the sieve tubes of lime leaves, causing witches' broom.

## Which Cultivars Are Affected By WBDL?

Mexican lime is especially susceptible to WBDL. WBDL affects sweet lime and citron plants in the field. WBDL has been transmitted experimentally by grafting to other cultivars such as Meyer lemon, rough lemon, Rangpur lime, *Poncirus trifoliata*, Troyer citrange, *Citrus macrophylla*, *C. ichangensis*, *C. hystrix* and *C. karna*. No symptoms have been seen in sweet orange, pummelo, sour orange, grapefruit or mandarins and attempts to experimentally infect these plants have failed. Persian lime (*C. latifolia*) was not infected in experimental trials.

## What Are The Typical Symptoms Caused By WBDL?

The first symptoms of WBDL in the field are one or more witches' brooms of thin proliferating twigs that have small, pale leaves (Figure 2). Additional

witches' brooms appear as the disease progresses and extensive die-back occurs (Figure 3). Trees die within 3-5 years. Symptoms may appear within 6 months in graft-inoculated plants and warm conditions favor symptom expression.



**Figure 2.** Witches' brooms of lime showing small and pale leaves as indicated by arrows.



**Figure 3.** Severe die-back of lime caused by witches' broom disease as indicated by arrows.

## How Is WBDL Transmitted?

Field observations suggest that extensive natural spread of WBDL has occurred in Oman and UAE, but it is uncertain if this is from citrus to citrus or from other hosts. It is suspected that a non-citrus host reservoir for the causal agent exists and may be the original source of infection. Transmission by a leafhopper (*Hishimonus phycitis*) that is common on citrus in Oman, UAE, and Iran is suspected, but has not been confirmed experimentally. The WBDL phytoplasma can be found in leafhoppers collected

from infected citrus trees. Witches' broom also can be graft-transmitted using tissue from witches' broom shoots as well as transmitted experimentally via dodder between citrus and periwinkle. A recent report indicates that WBDL phytoplasma can be seed-transmitted based on PCR tests, but needs further examination. More information on insect vectors and non-citrus hosts are needed to establish effective quarantines and to predict the potential spread if introduced.

### How Can WBDL Be Detected in the Field?

The distinctive symptoms of witches' broom expedite field detection in sensitive cultivars. The WBDL phytoplasma can be detected by electron microscopy of infected tissues and by serology using monoclonal antibodies. Molecular identification using DNA probes and PCR-based methods have been developed to detect the WBDL agent.

### How Can WBDL Be Controlled?

Budwood certification and eradication efforts are being considered in Oman and UAE to maintain acid lime production in these countries. Long-term approaches are aimed at developing resistant lime cultivars.

### What Can Growers Do?

As with other exotic pathogens, preventing WBDL entering Florida is much easier than trying to eradicate or control it. It is important to avoid bringing propagation materials from WBDL-infected areas to Florida. Any citrus propagating materials must be introduced through the Florida Department of Agriculture and Consumer Services, Division of Plant Industry.

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