Exotic diseases

What might arrive on Florida's shores

By Megan Dewdney

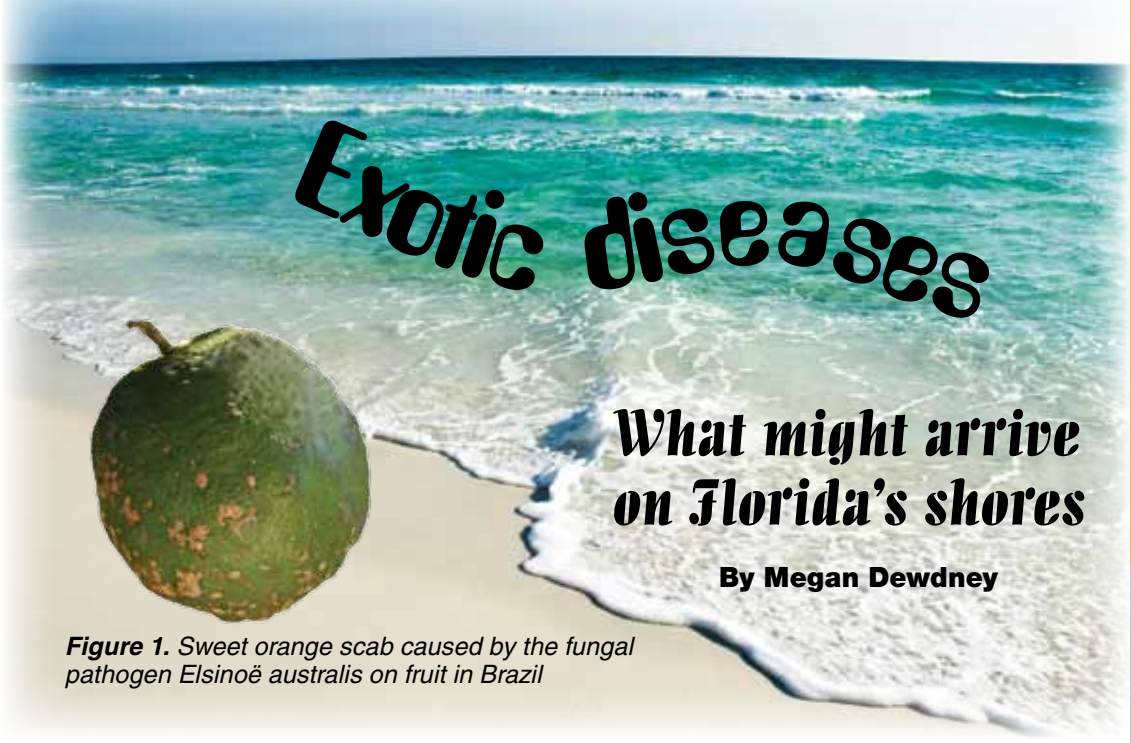

Figure 1. *Sweet orange scab caused by the fungal pathogen Elsinoë australis on fruit in Brazil*

Florida has had several devastating citrus diseases arrive on its shores in the last couple of decades including citrus canker, huanglongbing, and most recently, citrus black spot. Each of these diseases poses unique serious problems for the Florida citrus industry. While many of the most serious citrus diseases have already arrived in Florida, it is important to remain vigilant to prevent new introductions of exotic diseases that could further damage productivity and access to markets. The whole citrus industry needs to be actively involved in disease introduction prevention. This article is only a part of the effort and is designed to give background information and symptoms descriptions.

SWEET ORANGE SCAB

Sweet orange scab is a fungal disease caused by *Elsinoë australis*, a close relative of the fungus that causes citrus scab, *E. fawcettii*. Sweet orange scab infects sweet oranges, tangerines (mandarins), lemons and now grapefruit. The disease is mainly a concern for fresh-market citrus. Historically, sweet orange scab was found in the humid citrus-production regions of South America and South Korea. Most recently, a new outbreak was identified in eastern Texas in August 2010, and the disease has now been found as far east as Mississippi. It has been questioned whether sweet orange scab was a separate disease or if it was a type of citrus scab that infected sweet oranges. To answer this question, researchers used genetic tools to confirm that sweet orange scab was caused by a different species of

Figure 2. *Citrus variegated chlorosis, caused by the xylem limited bacterium, Xylella fastidiosa on (A) the upper and lower surfaces of leaves and (B) fruit (small green). Photos were taken in Brazil.*

fungus and was a separate disease.

Like citrus scab, sweet orange scab symptoms on fruit begin as raised warts-like pustules that are pink to tan (Figure 1, page 22). The pustules are a mixture of host and fungal tissue. How raised the lesions become depends on the host. On Temples, lemons and Satsuma mandarins, the lesions are quite raised, but on grapefruit and sweet orange, the lesions are flatter and could be mistaken for windscar. As lesions age, the color changes from tan to yellow-brown to gray and can crack. Until 2010, leaf symptoms of sweet orange scab had never been reported and were one of the ways to tell sweet orange scab from citrus scab. The leaf lesions, as reported from Texas, are raised, flat-topped and reddish to dark brown. Because lesion appearance changes based on time of infection, citrus scab and sweet orange scab can be very difficult to differentiate based on symptoms. The only definite way to identify it is to use PCR-based techniques that have been developed for this purpose.

Very little work on the disease cycle of sweet orange scab has been done, but it is assumed to be similar to citrus scab. Conidia form in fungal structures on the lesion surface. The conidia are splash-dispersed short distances so the movement of this disease in a grove without overhead irrigation can be very slow. Merely one to two hours are needed for conidia to form if the temperature is 75°F to 82°F when there is free moisture on the lesions. Infection can occur in five to six hours with moisture and temperatures between 70°F to 80°F. Lesions will appear between six to seven days. It is not understood how the fungus overwinters; when all of the fruit are removed from the tree, the disease will nonetheless occur the next season.

CITRUS VARIEGATED CHLOROSIS (CVC)

Citrus variegated chlorosis is a vascular disease caused by the bacterium *Xylella fastidiosa* that is restricted to the xylem. Most citrus species can be affected by CVC, but

sweet oranges are the most susceptible to the disease. Grapefruit, tangerines, tangerine hybrids and limes are moderately susceptible, and Rangpur lime, lemons, citron and pummelos appear to be tolerant to the disease. While the disease is not usually lethal to trees, the trees are unproductive when severe. The disease has been found in South America and Central America and has been recorded in Brazil, Argentina, Paraguay and Costa Rica.

The most common symptom is the interveinal chlorosis that occurs on the leaves. Generally the upper surface of the leaves has chlorotic lesions and the lower surface has brown spots corresponding to the upper lesions (Figure 2A, page 24). Young lesions can resemble zinc deficiencies, and as discoloration intensifies, the leaf tissues start to die. Often symptoms are sectored in part of the canopy, but can eventually affect the entire canopy. Many infected trees are stunted compared to healthy ones and flowering and fruit set are abnormal. Fruit on infected branches are very small and hard with high acid, rendering them unsuitable for consumption (Figure 2B, page 24). The fruit will sunburn easily and change color early.

The disease is naturally spread by xylem-feeding insects known as sharpshooters. Ron Brlansky of the University of Florida's Citrus Research and Education Center has experimentally confirmed that sharpshooters that feed on citrus in Florida are capable of acquiring and transmitting the bacterium. This means that non-native vectors would not be needed to spread this serious disease. The disease is also graft-transmissible, so clean budwood sources and nursery stocks are very important for keeping the disease out of groves. Nursery production practices implemented for huanglongbing control will help keep Florida groves safe from this disease.

Figure 3. *Citrus leprosis symptoms, caused by the citrus leprosis virus, on (A) leaves (B) twigs, and (C) mature fruit. Photos were taken in Brazil.*

CITRUS LEPROSIS

Leprosis is an unusual viral disease that is spread by *Brevipalpus* species of mites. The disease can be

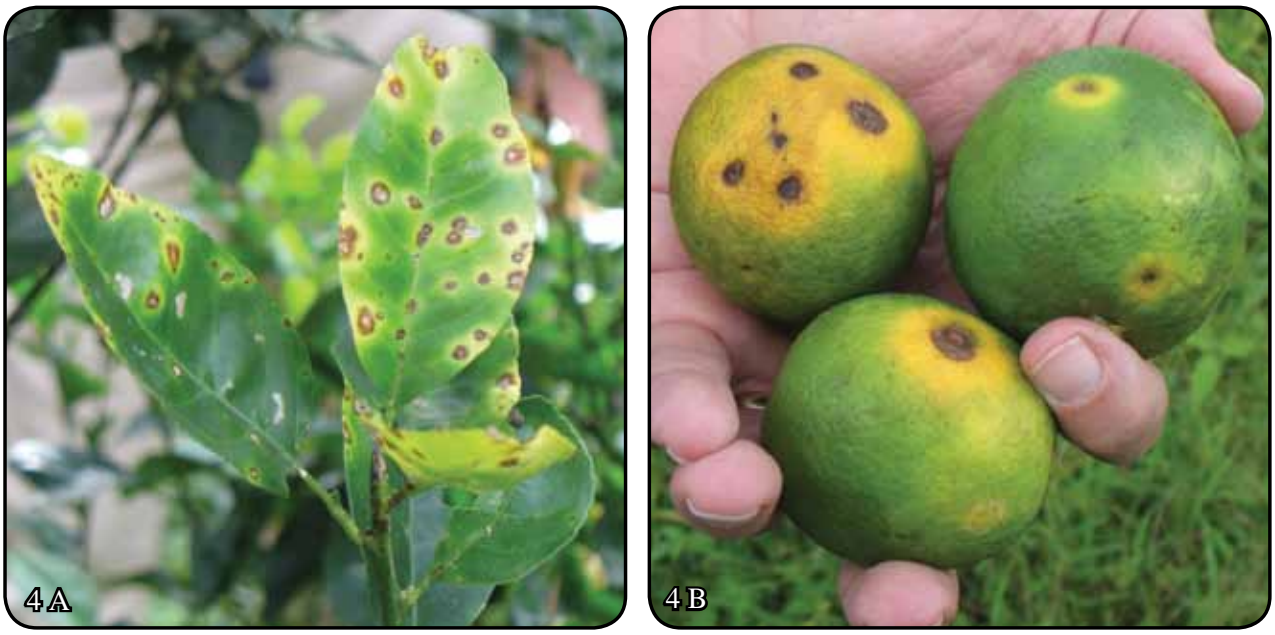

Figure 4. *Pseudocercospora fruit and leaf spot caused by the fungus Pseudocercospora angolensis on (A) leaves and (B) near mature fruit. Photos were taken in Ghana.*

severe, causing yield loss and damage to trees. Unlike many plant viruses, the *Citrus Leprosis Virus* is non-systemic and stays restricted to the area of the lesions. The disease is mainly found on sweet oranges, but has been reported on sour orange and tangerine varieties. The disease has been reported from countries in Central and South America, including Brazil, Venezuela, Colombia, Panama, Guatemala and Nicaragua. The disease was reported in Florida early in the 20th century, but it disappeared.

Leaf lesions start as chlorotic spots and can become brown in the center (Figure 3A, page 25). Lesions can become necrotic and usually remain flat. Infected mites feeding on twigs and branches can cause slightly raised, scaly lesions that can coalesce into psorosis-like bark scaling (Figure 3B, page 25). Fruit lesions can be flat or slightly depressed (Figure 3C, page 25). On green fruit, there is often a prominent yellow halo around a brown center. The halo will disappear as the fruit ripens, and the lesion center can become necrotic and cracked. There may be concentric circles in the gum-impregnated lesions. If lesions are numerous, the disease can cause significant leaf and fruit drop as well as twig dieback.

The main control method for this disease in nurseries and the field is to suppress *Brevipalpus* mite populations. Disease pressure is greatest when mite populations become elevated. Leprosis is not easily graft-transmitted and is unlikely to be spread through a nursery via grafting. The disease can be spread to new areas via mite-infested picking equipment and infected plants.

PSEUDOCERCOSPORA FRUIT AND LEAF SPOT

Pseudocercospora fruit and leaf spot is a fungal disease caused by *Pseudocercospora angolensis*. It has been found in sub-Saharan African countries, the Comoros Islands and Yemen, but not South Africa. All citrus types can be affected, but grapefruit, sweet oranges, navel oranges, pummelos and tangerines are considered highly susceptible. Lemons are moderately susceptible, and limes are the least susceptible. This disease is a major quarantine disease for European market access.

On fruit, the lesions start with nipple-like swellings with no halo, but as they age, become large, circularly- to irregularly-shaped with gray centers and a prominent yellow halo. In some cases, the lesions can coalesce to cover much of the fruit surface. Mature-fruit lesions are flat to sunken with dark-brown centers (Figure 4B). If fruitlet infection is severe, fruit can become mummified. When uncontrolled, the disease has led to total crop losses in countries like Kenya, but even when the disease

is less severe, yield loss occurs. The nearly circular leaf lesions generally occur singly and are smaller than fruit lesions. The lesion centers are gray to light brown and there's often a halo around the lesions. If infection is severe enough, the whole leaf may turn yellow and eventually abscise.

The life cycle of pseudocercospora fruit and leaf spot has not been fully determined, but some basic features are understood. The disease spreads long distances through windborne spores, and abandoned groves can be a major source of spores for managed groves. Planting material has also been used to inadvertently move the disease long distances. In the grove, spores are formed on old lesions that sporulate three to five weeks after a rainy period, causing lesions on new leaves and fruit. Fruit up to 1.5 to 2.0 inches in diameter are susceptible to infection. Within a grove, the disease moves via rain splash and wind-driven rain. Infection occurs when there is sufficient leaf wetness of at least 24 hours between 59°F and 86°F. Fruit become less susceptible as they age, becoming nearly resistant at 18 weeks post-petal fall.

All of these citrus diseases have the potential to be serious threats to the Florida industry. If you have suspicious symptoms in your grove, contact the Division of Plant Industry Citrus Health Response Program (DPI-CHRP) at (800) 282-5153 or your local Extension agent for an evaluation of the symptoms. You may prevent a major outbreak by making the response more rapid than if you do not call.

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Economics info available

The University of Florida-IFAS Citrus Research and Education Center Web site (www.crec.ifas.ufl.edu/Extension/economics) offers a variety of citrus economic information, including current citrus budget cost summaries, harvesting and packing charges, and citrus caretaker charges.

Coming events

The AGRItunity 2011 annual conference and trade show will be Jan. 29 at the West Central Florida Agricultural Center near Bushnell. The Pre-AGRItunity 2011 Farm Tours will be conducted Jan. 28; online registration is available (http://sumter.ifas.ufl.edu).

Also on Jan. 28, and in conjunction with AGRItunity 2011, a workshop will take place at the Sumter County Extension Office in Bushnell to help growers develop their own food-safety manuals. Attendance is limited. Contact Sarah White at (386) 362-1725 or sewhite@ufl.edu for more information.

WHAT'S SHAKIN'

Jim Syvertsen, plant physiologist at the Citrus Research and Education Center and the Tree Health project leader, conducted trials during three consecutive seasons (2007-2009) to determine if winter drought stress could delay flowering and fruit development of immature Valencia sweet orange. The objective was to determine if the bloom period could be delayed by a few weeks without negative effects on the quality of the current season's crop.

The trials were conducted during the months of December to March. After resuming normal well-irrigated conditions in the spring, there was shown to be little or no measurable physiological effects and no differences in current fruit yield, fruit size and percentage of juice or juice quality.

Visit http://citrusMH.ifas.ufl.edu to learn more about this and the other projects being done by the program.