Diseases in citrus nurseries and how to avoid them

By Megan Dewdney and Barrett Gruber

While the citrus nursery regulations implemented in 2007 considerably reduced pest and disease problems in nurseries, there continue to be problems with certain diseases because the nursery environment for growing young citrus trees is also ideal for many diseases. Basic principles of good nursery sanitation should be implemented in all nurseries to minimize the risk of pest and disease introduction and spread within the nursery.

The two diseases that are most frequently reported to be problems in our current nursery production systems are Asiatic citrus canker and Phytophthora root and crown rot.

Citrus canker is a bacterial disease (*Xanthomonas citri* subsp. *citri*) that finds the nursery environment perfect for spread. Young, rapidly growing leaves are highly susceptible to the disease, especially when they are damaged, as occurs in routine nursery operations. Overhead irrigation or other forms of water splash can also spread the bacterium and force it into the leaves through openings such as stomata. Symptoms generally are not easily visible until two weeks post-infection. So it can be difficult to associate an infection event with an event during nursery operations. Even at two weeks, the symptoms are subtle. Corky, raised lesions don't usually appear until about 20 days after the infection event. Current regulations require destruction of plant material and sanitation in the infected greenhouse when canker is found, but it is also the only way that the disease is likely to be controlled in a greenhouse environment once introduced.

Phytophthora root and crown rot (*Phytophthora nicotianae*) affects all aspects of nursery tree production, from seed germination to finishing with high-quality trees. The initial inoculum source of *P. nicotianae* in nursery production can be equipment or personnel that move the inoculum on shoes or tires from the outside environment. Foot and tire baths at the entrances of nurseries are the best way to reduce this inoculum source.

Once in the nursery, the organism is moved among trees by tools, clothing and hose nozzles that have come in contact with contaminated surfaces like the floor. The sporangia can germinate and infect root tissues directly or produce the mobile zoospores. The zoospores can swim through free water to susceptible root tissues and infect. The resulting infections allow the organism to grow and form more sporangia. If surface water is used to irrigate young trees, it can also be a source of inoculum and should be monitored quarterly for contamination.

The best solution is to use well or municipal water for irrigation. A new option for phytophthora control in nurseries is mandipropamid (Revus®), which recently received a 24(C) special local need label. Its use is restricted to non-bearing citrus grown in the greenhouse for phytophthora control. Read the label for rate recommendations. For resistance management, mandipropamid should be rotated with fluopicolide (Adorn®). Mefenoxam (Ridomil Gold®) does not have a label for nursery use and should never be used in nurseries.

Other diseases that are seen in nurseries on occasion include alternaria brown spot (*Alternaria alternata*) and citrus scab (*Elsinoë fawcettii*) on tangerines. These fungal foliar diseases are avoidable in the greenhouse setting because they require free water on leaf surfaces for several hours. Citrus black spot (*Guignardia citricarpa*) has never been identified in a Florida greenhouse nursery operation, but this fungus also needs free water for at least 12 hours. If sources of leaf wetness are eliminated, there should be few problems with the fungal foliar diseases.

THE KEY IS SANITATION

The key to avoiding most disease problems is sanitation. All employees should be trained from the time of hire to consider the nursery as a "clean" environment, and the principles of sanitation should be frequently reinforced by management. Common disease and pest recognition is vital for effective employees, and they should understand how these problems can be spread as a consequence

Table 1. Common disinfectants and factors to consider when selecting for nursery use.

Disinfectant	Factors affecting efficacy	Corrosive to metals	Residual activity
Bleach (10%)	• efficacy reduced by organic matter • degrades in sunlight; solutions need to be made fresh daily • water pH (optimal pH range for maximum efficacy is 6.5-7.5)	yes	low
Alcohol (70%)	• ineffective in presence of organic matter • alcohol will evaporate if not kept in a closed container, reducing efficacy	no	low
Hydrogen peroxide	• efficacy reduced by organic matter • degrades in sunlight	moderate	low
Quaternary ammonium	• hard water (>400 ppm (Ca) reduces efficacy	no	good

of their production practices. The University of Florida Citrus Research and Education Center (CREC) and the Citrus Health Response Program (CHRP) have a free nursery worker training program on how to avoid canker and phytophthora infestations. If you would like to schedule training or a refresher training for your employees, contact Jamie Burrow (jdyates@ufl.edu, 863-956-8648).

General nursery cleanliness

Keeping a nursery clean is a good way to prevent problems. Clutter can provide refuges for insects and other vermin. Weeds under benches or in pots can also support populations of harmful insects. It is also a good practice to eliminate any pruning or sprout removal debris from the nursery at the end of each day.

Diseased or otherwise abnormal trees should be removed from the nursery immediately, minimizing contact with healthy trees in the process. It is very important that diseased plants are completely removed from the growing environment. Remaining asymptomatic trees should receive an appropriate disease control treatment, such as copper applications, to prevent further infection and spread.

Tool and equipment sanitation

Tools used in day-to-day nursery activities such as pruners, trash and debris containers, budding knives, etc. should be cleaned and sanitized routinely with products listed in Table 1. Depending on the item, sanitizing should be done when moving among plants within or between benches, when moving from one house to another within the nursery, or at the start of each work day. All equipment should be resanitized if dropped or used in a non-clean area.

Irrigation equipment

Water is critical to any nursery operation, but it is also one of the easiest ways to move pathogens within a nursery environment. When using overhead irrigation, nurseries generally don't need to be concerned with sprinkler heads being a direct source of pathogen inoculum. However, when using drip irrigation or microsprinklers mounted near the surface of pots, some precautions should be taken. Any irrigation emitter in close proximity to growing media can become contaminated if the tree it is watering is infected with soilborne diseases like phytophthora. Prior to new plants being placed on a bench, the emitters or microsprinklers should be sanitized along with the bench, as described below.

Overhead irrigation can promote disease spread and infection in the nursery. The force of the water moves disease-causing propagules among plants, but also wets foliage leading to long leaf wetness periods. Long leaf wetness periods allow for increased infection by foliar diseases such as alternaria brown spot, citrus scab and canker. If overhead irrigation is used, it is best to schedule irrigation early in the morning so that foliage can dry as quickly as possible. Greasy spot and black spot could potentially be problematic in nurseries with overhead irrigation or no solid roof. While leaf litter should be removed from the floor before it supplies inoculum, spores can enter through ventilation openings, being much smaller than the openings of psyllid screen. Plants around the air-intake locations will be most at risk. Symptoms of either disease will be minimal in the nursery, but for black spot, the disease can potentially be moved by asymptomatic nursery stock. If a nursery is located near an area with black spot, it will be important to move to under-tree irrigation. Currently, there are no nurseries located in black spot affected areas.

Hose ends and hand-watering nozzles should never be in contact with the ground. The ground is not clean, and it is easy for watering nozzles and hoses to become contaminated if they contact it and quickly spread pathogens to a large number of pots. See Table 1 for products to decontaminate nozzles that have accidently touched the ground.

Benches

Benches should be considered a clean area, and dirty equipment should be kept off them. For example, containers used for disposal of plant trimmings

should never be placed on the bench top after they have been in contact with the ground. If plants are moved, they should never be placed onto the ground and then back onto a bench.

Since citrus is a relatively long-cycle nursery crop, bench sanitization opportunities do not often arise. Therefore, bench sanitization is very important when the opportunity occurs. Benches (and irrigation systems with drippers or microsprinklers) can be sanitized with any of the products in Table 1, but soil and other organic matter need to be removed for effective sanitization. Keep in mind that bleach fumes are toxic to workers and plants. Bleach should only be used in areas emptied of plants, and the area should be ventilated for at least 24 hours prior to moving plants back into the area.

Personnel

The nursery personnel are not direct sources of pests and diseases, but they can unwittingly move them throughout a nursery. Employees' hands should be washed before beginning nursery tasks and when moving among locations within the nursery. Unavoidable foot baths should be placed between sections of the nursery to limit pathogen spread within a nursery.

Nurseries should schedule when employees can work in certain areas. For example, budwood houses should be the nursery location with the best hygiene to ensure the cleanliness of propagation materials, and days should be planned so that workers never enter the budwood house after being elsewhere in the nursery on a particular day. Similarly, the seedling house is a clean location and work there should be carefully scheduled.

Additionally, every effort should be made to avoid working with wet plants. Usually, this is early in the morning, but if overhead irrigation is used, it could be any time of day. Again, water can move pathogens among plants extremely efficiently, and working with the plants when they are wet will make pathogen transfer easier. Irrigation should be scheduled around work activities such as tree staking and tying or sprout removal so that plant manipulations can occur while the trees are dry.

SUMMARY

Prevention is crucial for nursery pest and disease control. Most pest and disease risks can be minimized, if not eliminated, with good nursery sanitation and under-tree irrigation. It is important that all nursery workers are trained and actively participate in maintaining the cleanliness and sanitation of the nursery by following proper procedures for sanitizing tools and equipment, and cleaning up after themselves. However, if managers do not follow up when employees make mistakes, proper sanitation will not be maintained. Help with employee training is available through the CHRP program and CREC, so schedule today to help eliminate problems.

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Mike Roberts has been named general manager of the Griffin Fertilizer Company. He joined Ben Hill Griffin, Inc. in November 2011.