Research progress for integrated canker management

By Jim Graham, Barrett Gruber and Clive Bock

Crop losses from citrus canker in 2013 for Hamlin oranges due to premature fruit drop or for grapefruit from unacceptable levels of fruit lesions were substantially higher than in the 2012 season due to more rain coincident with early fruit development from late April to early May. During this period, fruit are at the most susceptible stage of expansion — 0.25- to 0.5-inch diameter for Hamlins and 0.5- to 0.75-inch diameter for grapefruit.

In 2013, huanglongbing (HLB) caused premature fruit drop in Hamlins that overshadowed loss due to canker. Far less HLB-induced fruit drop occurred with grapefruit, but higher canker incidence in 2013 was among the major challenges for pack-out of fresh grapefruit.

To protect fruit against losses from canker, disease management for the most susceptible cultivars of grapefruit includes windbreaks, stringent leafminer control, and copper sprays to protect fruit during the entire expansion period from April to October. The purpose of this report is to update growers on performance of these tactics in grove trials testing integrated canker management.

**Efficacy of Windbreaks for Canker and Wind Scar Control**

For grapefruit, the objective is to maximize pack-out by minimizing canker incidence and severity on fruit. Despite above-average rainfall each month of the growing season in the Indian River district, windbreaks were as effective for reducing wind speed and fruit infection as in the drier season of 2012. In 2013 we evaluated 5- and 6-year-old red grapefruit blocks surrounded by 20- to 30-foot tall *Corymbia torelliana* windbreaks. In each block, weather stations deployed in east-west and north-south directions measured far fewer wind gusts in excess of 11 miles per hour in proximity to the windbreak, and less than 5 percent incidence of fruit with lesions compared to 75 percent incidence in the middle of the block most distant from the windbreak (Figure 1). Incidence of wind gusts and canker was also greater next to a gap in the windbreak where vehicles entered and exited the pump station in the block. The relationship between number of wind gusts and canker was similar to that measured in 2012 — the greater the number of gusts, the higher the fruit disease incidence.

In addition, as the number of wind gusts increased with distance from the windbreak, incidence of unsightly wind scar also increased. Each season, wind scar blemishes rank among the top grade defects for fresh grapefruit. These results confirm that windbreaks are a highly effective strategy for protection of fruit from physical damage as well as for reducing canker infection.

**Improving Performance of Copper Formulations**

Reducing wind speed below 18 miles per hour greatly increases the efficacy of the copper film for protection of the fruit surface from infection through natural openings and rind wounds. In our trials of fixed copper formulations (e.g. copper hydroxide and copper oxide) sprayed at 2 lb. to 4 lb. of product per acre (0.75 lb. to 1.4 lb. per acre of metallic copper) every 21 days, canker control does not vary greatly until the metallic copper drops below 0.5 lb. per application. At this rate and frequency of copper applications, the total metallic copper to achieve control may limit the number of copper applications per season. Alternatively, application of Nordox®75WG at 1.33 lb. per acre for the first five sprays followed by five sprays of Magna-Bon at 100 ppm per acre is as effective as the full rate of Nordox®75WG season-long (Figure 2). The higher metallic concentration in the fixed copper in April and May is necessary for protection of fruit against melanose (*Diaporthe citri*) and scab (*Elsinoe fawcettii*) until they become more resistant to these fungal diseases in June. The program that includes soluble Magna-Bon at...
20 percent of the copper metal per application results in use of 50 percent less metallic per season, a substantial reduction in copper loading of the grove soils.

**CANKER EPIDEMICS IN HAMLINS**

In young groves where trees have not yet grown together to form hedges, copper sprays are targeted to prevent early-season fruit infection as the stomates (through which the canker bacterium gain access) open at 0.25-inch fruit diameter. Early season spray timing in relation to fruit size and the application of formulations with sufficient metallic copper are recommended to protect the fruit at this most susceptible growth stage.

In 2013, late April and May were relatively wet, but canker-induced premature fruit drop was prevented during this period even though copper sprays ended in early July. Although the incidence of new canker lesions later in the season exceeded 10 percent in copper treatments, fruit greater than 1.5 inches in diameter are more resistant, so that late season lesions are smaller and only induce minor fruit drop. Similar to the results with grapefruit, protecting Hamlin fruit with Nordox®75WG early in the season for the first three sprays followed by two sprays of Magna-Bon was as effective as five sprays of 1.33 lb per acre of Nordox®75WG.

In 2014, our recommendation for young early oranges continues to be four to five copper sprays applied at 21-day intervals beginning when fruit reaches 0.25-inch diameter with follow-up sprays until July when fruit reaches 1.5-inch diameter. The good news is that as the trees develop into hedges, the grove becomes its own internal windbreak that reduces early season bacterial infection and fruit drop due to the disease. The bad news is that by the end of the 2013 season, 80 percent of the fruit drop was caused by HLB compared to just 20 percent due to canker. Obviously, crop loss from HLB can be much more serious depending on how soon after planting the trees become infected. Hence, stringent protection of young trees with soil drenches of systemic neonicotinoids and foliar insecticide sprays as recommended in the Florida Citrus Pest Management Guide (http://www.crec.ifas.ufl.edu/extension/pest/ <http://www.crec.ifas.ufl.edu/extension/pest/%20>) is essential.

**COPPER SPRAYS PROTECT FRUIT**

Because fruit grow more slowly than leaves, the copper film can protect...
for 14 to 21 days, after which expansion of the fruit exposes unprotected fruit surfaces. The Citrus Copper Application Scheduler helps determine if the copper residue on the fruit from conventional copper formulations is adequate for disease control. The program output graphically demonstrates reduction in copper residue based on time after application, cultivar and local rainfall. The model (http://www.agroclimate.org/tools/cudecay/) is most appropriate for the period from bloom to mid-summer, but can be used for the entire growing season.

Different copper formulations are equivalent in performance because the residual copper on the fruit surface differs little among those tested, except for Magna-Bon, a soluble product with low metallic copper (5 percent). Hence, applications of Magna-Bon later in the mid to late season lower the risk of copper phytotoxicity, an important fruit blemish in fresh fruit grapefruit and other specialty varieties.

**ALTERNATIVES TO COPPER**

FireWall™ (streptomycin; AgroSource, Inc.) is effective for canker control and reduces the risk of copper phytotoxicity for fresh grapefruit. In the 2013 season, FireWall™ received an Environmental Protection Agency (EPA) Section 18 Emergency Exemption for use against canker on grapefruit. FireWall™ is limited to two applications per season at 2 lb. per acre. Timing for the applications is in June after copper sprays for fungal diseases in April and May. If additional fungal control is needed, FireWall™ may be mixed with a strobilurin fungicide to avoid risk of copper phytotoxicity. A request for renewal of Section 18 FireWall™ has been submitted for the 2014 season and EPA approval is pending.

**INTEGRATION OF LEAFMINER CONTROL**

Leafminer galleries are very susceptible to invasion by the canker bacterium. Extensive infection of leafminer galleries by canker bacteria greatly increases inoculum, making the disease explosive, particularly on flush from July to the end of the season. Leafminer control on the summer flushes is difficult because the duration of flush susceptibility exceeds the residual activity of most foliar-applied insecticides. On younger trees, loss of leafminer control on summer flushes occurs when the flush production is ongoing and the neonicotinoids drop below a protection-providing level in the leaf. Loss of insect control is accentuated by erratic and continuous flushing activity, making the timing of foliar insecticide sprays problematic. Effective control of leafminer is made even more difficult by the intensive insecticide sprays required for psyllid control that have reduced the populations of biological control agents in the grove.

The mating disruption technique with the natural pheromone of leafminer is proving to be an effective possible tool for reducing the incidence of leaf damage in continuing field trials. This technique inhibits moths from reproducing by saturating the air in the grove with the actual chemical that the moths use to find each other for mating. In other words, the males which depend on the female’s pheromone to find her are confuse because it becomes analogous to trying to find a “smoke signal in a dense fog.” Importantly, mating is prevented before the moths can reproduce and therefore lay eggs. However, the technique is specific to leafminer and does not affect other pests, such as the psyllid. A commercial product for mating disruption of leafminers is available from ISCA Technologies (http://www.iscatech.com).

**SYSTEMIC ACQUIRED RESISTANCE (SAR) FOR CANKER CONTROL ON YOUNG FRUITING TREES**

In 2013, we demonstrated reduction in foliar infection and incidence...
of canker on fruit of grapefruit trees up to 8 feet in height with the combination of soil applications of Admire Pro® (imidacloprid), Platinum® (thiamethoxam) and Belay® (clothianidin), or with the commercial SAR elicitor, Actigard® (acibenzolar-S-methyl). Four drenches with Actigard® at a 45-day interval was as effective as 21-day interval sprays of Kocide 3000® for season-long suppression of foliar canker and fruit disease (Figure 3). Our findings are consistent with the current recommendation for comprehensive seasonal application of neonicotinoid insecticides for psyllid management on trees up to 8 feet tall. For best management, the timing for the application of neonicotinoids should be determined by the potential for insecticide movement in the soil by rainfall.

In 2013 Actigard®, which is not currently registered, was evaluated in conjunction with grower standard copper spray programs in two commercial operations under an EPA-approved experimental use program. In each grapefruit grove, four drenches of Actigard® at 60-day intervals between April and October produced better control of foliar and fruit disease than the copper program alone. This evaluation will be repeated in 2014 and efficacy data will be used to support a citrus registration of Actigard® for integrated canker management with copper sprays, which may permit reduction in the rate of copper for optimal control.

For additional information regarding management recommendations discussed, consult the Florida Citrus Pest Management Guide (http://www.crec.ifas.ufl.edu/extension/pest/).

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