

Research progress on management of

High incidence of citrus canker, caused by *Xanthomonas citri* subsp. *citri* (Xcc), can occur on any citrus cultivar depending on tree age, flush condition, leafminer control and weather conditions during the season. In 2011, crop losses in Hamlin due to premature fruit drop, and on grapefruit due to an unacceptably high incidence of fruit blemishes, occurred mostly on young fruiting trees. Fresh grapefruit financial losses have eased somewhat now that canker-blemished fruit is permitted to be packed for U.S. shipments. However, Florida's grapefruit shipments for the European Union still require pre-harvest grove inspections as well as post-harvest inspection for canker before fruit qualifies for packing.

In fresh grapefruit groves, the goal is minimizing canker inoculum potential to ensure an economically viable pack-out with few or no lesions. In young grapefruit groves, this goal is difficult if not impossible to achieve without windbreaks to reduce wind speed, inoculum spread and fruit infection experienced during typical Florida rainstorms.

In 2011, our 4-year-old red grapefruit trial was located in an 11-acre sub-block completely surrounded by a 20- to 30-foot-tall *Corymbia torelliana* windbreak planted one year after the grove was established. Starting at spring flush with copper sprays applied at 21-day intervals until mid-October, we measured an average of 15 percent incidence of canker-infected fruit compared to 63 percent in the non-sprayed trees. This level of disease control is the highest we have achieved since trials in young grapefruit groves began in 2007, despite almost 45 inches of rain from August to October (almost three times the average amount for these months).

Fortunately, the 2011 season in the Indian River area was marked by the absence of significant early-season rains, at a time when fruit were most susceptible (fruit 0.5 to 1.5 inch diameter). Consistent with previous trials in Florida as well as in Brazil and Argentina,

CITRUS CANKER

By Jim Graham
and Megan Dewdney

the effectiveness of the protective film of copper on fruit did not vary greatly among copper formulations applied at 2 lb. to 4 lb. of product (0.75 to 1.4 lb. of metallic copper per acre).

PROGRAM FOR EARLY ORANGES

Hamlin and early orange cultivars grown for higher color score (Early Gold, Westin, Ruby and Itaborai) continue to show much greater susceptibility than late- and mid-season cultivars such as Valencia (Fig. 1) and Vernia (Fig. 2).

In young orange groves where trees have not yet grown together to form hedgerows, copper sprays should be targeted to prevent early-season fruit infection as the stomates open at about 0.25 to 0.5-inch fruit diameter.

Our trial of 4-year-old Hamlins suffered considerable fruit loss in

2010, so the block started out with a high inoculum potential for the 2011 season. Even though copper sprays were well-timed to control canker, intense and ill-timed rains in April and May promoted fruit infection at the most susceptible stage (0.5 to 1.25-inch diameter) that resulted in up to 70 percent fruit drop by the end of the season. This outcome emphasizes the importance of early-season spray timing in relation to fruit size, and the application of a product or mixture with sufficient metallic copper to protect the fruit.

As in previous seasons, larger early-season lesions were identified as those responsible for the premature fruit drop, and late-season lesions had little impact.

In 2012, our recommendation for young early-season oranges will continue to be four to five copper sprays applied at 21-day intervals from the time that fruit diameter is 0.25 to 0.5-inch in late April, with follow-up sprays until fruit reach diameters of 1.5 to 2 inches in July.

In 2011, growers who started

their copper applications on Hamlins before the April-May rains had sufficient early-season disease control on fruit and experienced less fruit drop than in past seasons. Conversely, wind-exposed blocks where the grower either started late, skipped or delayed sprays had serious losses in 4- to 5-year-old Hamlins whereas Valencias of similar age and vigor showed minimal fruit infection and fruit drop (Fig. 1).

The good news from the results of our 3-year Hamlin trial is that as the trees develop into hedgerows, the orchard becomes its own windbreak, which reduces early-season canker infection and minimizes fruit drop. Hence, in older blocks, applications of copper beyond the early season may not be necessary or economically sustainable as fruit become increasingly resistant, particularly when the cost of additional sprays is compared with the value of the crop lost to fruit drop (Fig. 3, page 16).



Fig. 1. Fruit drop on 4-year-old Hamlin trees (left row), compared to Valencia trees (right row) due to early-season canker infection promoted by April-May rains, DeSoto County, November 2011



Fig. 2. Seven-year-old Vernia orange trees on Swingle forming a hedgerow with low canker incidence after three copper sprays per season for the last three years, DeSoto County, November 2011

ALTERNATIVES TO COPPER

Recently completed studies identified the potential for development of copper resistance in Xcc after long-term use in Florida citrus groves. Applications of FireWall™, a formulation of the antibiotic streptomycin, in July and August are effective for canker control on grapefruit, and reduce the risk for development of copper phytotoxicity on grapefruit at the critical time during July and August. Recently, the Florida Fruit & Vegetable Association and the Florida Department of Agriculture and Consumer Services submitted an application to EPA for a Section 18 registration of FireWall™ for use against canker on fresh grapefruit.

WIDER ADOPTION OF WINDBREAKS

Windbreaks are by far the single most effective means for reducing canker infection. Our collaborative research with Clive Bock and Tim Gottwald at USDA-ARS Fort Pierce demonstrated that when wind speeds exceed 20 mph, leaf damage and infection significantly increases, which defeats the protection provided by the copper film on the fruit surface. Reducing wind speed with windbreaks protects fruit because the peel and surface film of copper cannot be penetrated at lower wind speeds.

As in our field trial last season, fresh grapefruit growers who have established windbreaks are seeing improvement in their canker control programs. Groves without windbreaks have suffered repeated cycles of canker-induced fruit drop, and even debilitation of grapefruit trees at the 4- to 8-year-old stage.

Corymbia torelliana, a eucalypt relative, is gaining wider use in the citrus industry as a windbreak species. This tree has advantages, including well-developed branches that

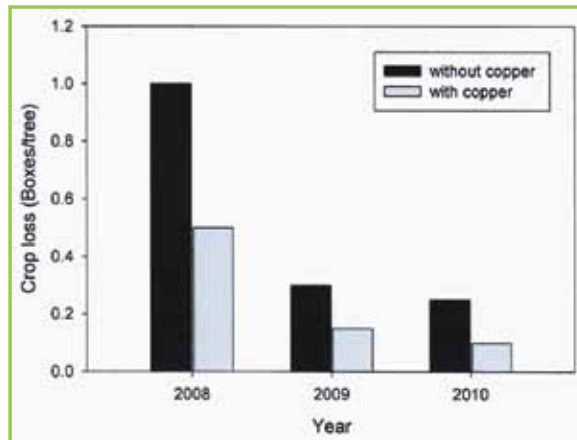


Fig. 3. Decline in crop loss (boxes/tree) as 6- to 8-year-old Hamlin trees developed hedgerows. Trees were sprayed four times each season with various copper formulations and rates (with copper), or left untreated (without copper). Copper reduced crop loss about 50 percent and justified the spray cost in 2008 and 2009, but not in 2010.

extend to the ground, and tolerance to adverse soils and freezes. Further information for selection and availability of tree species, grove designs and establishment requirements for windbreaks in Florida can be found at <http://www.crec.ifas.ufl.edu/extension/windbreaks/>

LEAFMINER CONTROL IS ESSENTIAL

Leafminer galleries are very susceptible to invasion by the canker bacterium. Extensive infection of leafminer galleries by Xcc greatly increases inoculum levels, making the disease explosive, particularly on flush from July to the end of the season. Leafminer control on the first summer flush is problematic since the duration of flush susceptibility exceeds the residual activity of most insecticides.

On younger trees, loss of leafminer control on late summer flushes occurs when the systemic neonicotinoids run out. That problem is accentuated by erratic flushing activity, making the timing of foliar insecticide sprays diffi-

cult for effective control. Leafminer has become even more problematic since the intensive sprays required for Asian citrus psyllid control have reduced biological control agents in the grove. Nevertheless, stringent leafminer control is essential to lower canker severity on leaves and to reduce fruit infection.

COPPER SPRAYS PROTECT FRUIT

Because fruit grow more slowly than leaves, the copper film can protect for 14 to 21 days after which time fruit expansion exposes unprotected fruit surface. The newly released “Citrus Copper Application Scheduler” will help determine if the copper residue on the fruit from conventional coppers is adequate for disease control. It graphically demonstrates reduction in copper residue based on time after application, cultivar and local rainfall. The model is available as part of AgroClimate (<http://www.agroclimate.org/tools/cudecay/>) or through FAWN (<http://fawn.ifas.ufl.edu/>).

The model is currently most appropriate for the period from bloom to mid-summer, but can be used for the entire growing season. We are collecting data to improve summer predictions.

Copper formulations are equivalent because the reduction of copper residue from the fruit surface differs little for the various products tested, except for the residue from Magna-Bon™, a soluble product with low metallic copper (5 percent). Magna-Bon™ has performed as well as film-forming copper products for control of canker in our grapefruit trials, but not so well in Hamlin trials. One major difference since 2008 is the absence of early-season rain events on the east coast in contrast to intense early rains in the south-central region where our Hamlin trials are located. The lower performance of Magna-Bon™ in Hamlins may be due to lack of metallic copper buildup on the fruit surface early in the season compared to the accumulation of copper residue on grapefruit after several sprays as the season progresses. Sampling of Hamlin leaves sprayed four to five times versus grapefruit leaves sprayed seven to eight times confirmed a large difference in Magna-Bon™ residue. Over time, we hypothesize that copper on the fruit surface may to some degree become locally systemic in rind tissues. This coming season, we will attempt to assay for copper activity in the rind by injecting Xcc bacteria to determine whether biocidal copper is internal as well as external.



Over 30 years in the citrus industry

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RESEARCH ON SAR FOR CONTROL ON NON-BEARING AND YOUNG FRUITING TREES

Repeated vigorous flushes of young trees render them extremely prone to leafminer damage with a subsequent explosive increase in leaf inoculum of Xcc, resulting in defoliation and fruit infection. We have documented consistent reductions of foliar infection and canker-induced defoliation on young non-bearing trees after soil applications with the neonicotinoids, Admire (imidacloprid) and Platinum (thiamethoxam).

Soil drenches of the commercial systemic acquired resistance (SAR) induction product, Actigard (acibenzolar-S-methyl), and season-long rotations with Admire and Platinum are also highly effective for suppressing foliar canker development on non-bearing grapefruit and orange trees. These findings are congruous with the recommendation to rotate neonicotinoid insecticides for psyllid control, their timing of application being determined by their leaching potential in soil, as noted by Michael Rogers in the January 2012 issue of *Citrus Industry*. Thus far, the level of canker control from soil-applied SAR inducers including Admire, Platinum and Actigard is comparable to season-long, 21-day interval sprays of Kocide 3000. Actigard is not yet registered for use on citrus, but we are currently working with Syngenta to develop efficacy data to support registration for non-bearing trees.

The major limitation of neonicotinoids as soil-applied SAR inducers is that they are not available for use on fruiting trees because of the potential for leaching into ground water at the higher rates of soil application required for larger trees. Non-insecticidal Actigard applied as a trunk application could provide an alternative to neonicotinoids to avoid the risk associated with soil application. A preliminary trial with young fruiting Hamlin trees demonstrated the efficacy of trunk application of Actigard, Admire or Platinum with a bark penetrant as an alternative to soil application. Trunk application was just as effective as soil drench for canker control on 6- to 8-foot-tall fruiting grapefruit or Hamlin trees.

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

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Successful Industry Relationships Depend on Open Communication

By Douglas Ackerman



During my first weeks at the Florida Department of Citrus (FDOC), I have had the privilege of meeting and speaking with many citrus industry professionals through visits to Florida Citrus Mutual, Gulf Citrus Growers Association, Highlands County Citrus Growers Association, Indian River Citrus League, and Peace River Valley Citrus Growers Association. These visits have provided me with a greater understanding of the opportunities and challenges our industry faces. I want to thank all of you for taking the time to attend these meetings and I look forward to working closely with you.

FDOC serves two customers: the traditional consumer who purchases citrus products and the Florida citrus industry. My goal is to build upon the existing foundation with these key audiences to establish successful, long-term relationships through open communication.

As your new executive director, I am fully committed to maintaining an atmosphere of transparency and accountability with the citrus industry. FDOC continues to explore additional ways to keep you informed. I encourage you to speak with your citrus commissioners who represent you on the Florida Citrus Commission (FCC) and invite you to attend the FCC meetings where you can provide input at the time of decision-making.

FDOC will also be involved in regional citrus organization meetings to provide updates about marketing activities conducted on your behalf.

I look forward to hearing from you. Please feel free to contact me with your comments and ideas at (863) 537-3999 or dackerman@citrus.state.fl.us.

“Take on the day with Florida citrus.”

The mission of the Florida Department of Citrus is to grow the market for the Florida citrus industry to enhance the economic well-being of the Florida citrus grower, citrus industry and the state of Florida. Douglas Ackerman, executive director, can be reached at (863) 537-3999. For more information, visit www.FDOCGrower.com



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