Can *Diaprepes* root weevil be managed with physical barriers?

By Larry Duncan

Citrus grove management in Florida today bears no resemblance to that of just a few years ago. Tree nutrition and protection programs have become lavish in an attempt to slow the rate of decline caused by huanglongbing (HLB). Average production costs approaching $2,000 per acre in some areas reflect an increase of more than 50 percent due to HLB.

As if this weren't enough, the recent discovery that HLB causes a major reduction of the citrus fibrous root system has revealed the urgent need to manage other biotic and abiotic stresses that occur belowground.

Pest management programs targeting primarily the Asian citrus psyllid vector are inadequate in groves with other serious pest or disease problems of the root system. Moreover, some recommended practices for managing root pests and diseases may no longer provide the same level of beneficial response by trees, due to severe stress caused by HLB.

Diaprepes root weevil (Figure 1) has been a major pest in Florida citrus groves since its introduction into the state in the mid-1960s. The adult insect feeds and lays eggs in the tree canopy. After hatching, larvae fall to the soil where they develop during several months, feeding on progressively larger roots. Extensive feeding damage to roots enhances colonization by Phytophthora species, resulting in a serious, pest-disease complex.

The Diaprepes-Phytophthora complex is difficult to manage for two reasons. First, the feeding damage to the cortex of major roots does not heal. Even under conditions where weevils are few and undetected, the feeding damage accumulates over years until the root system can no longer support the tree.

Second, modern chemical and biological pesticides for weevil control are non-persistent, resulting in long periods suitable for recolonization between treatments. Adults emerging from soil throughout all but the coldest months replace those killed by sprays, and hatched larvae falling to the soil during most of the year replace those killed by applications of entomopathogenic nematodes. The use of appropriate Phytophthora-resistant rootstocks suited to particular soil conditions in combination with chemical and biological pesticides can provide substantial

Figure 1. *Diaprepes* root weevil

control of the Diaprepes-Phytophtora complex in regions such as the central ridge where weevil numbers tend to be naturally low. However, in some wetter, finer textured soils which favor higher numbers of *Diaprepes*, significant tree damage may occur in spite of these practices. The occurrence of HLB in groves with abundant *Diaprepes* can be especially devastating.

More effective ways to manage *Diaprepes* root weevil are clearly needed in regions where the insect is most damaging. Research by USDA and University of Florida scientists showed that some landscape fabrics can be used as barriers that prevent the small, newly hatched larvae from entering the soil while also preventing young adult weevils from escaping soil and moving into the tree canopy. Although this tactic has been studied only in small plots — not on a commercial scale — growers facing severe weevil infestations may want to consider the use of fabric mulch. So what is currently known?

Seven commercially available weed cloth materials were screened initially for the ability to keep weevil larvae out of soil. The products consisted primarily of spun and woven polyester and polyolefin materials. These fabrics were fitted over soil in pots, and neonate larvae were allowed two days to penetrate the fabric and enter the soil. Although two of the spun fabrics were very effective at blocking larvae from soil entry, they proved to be readily damaged by wind and traffic when tested in the field. A third, woven product (Lumite woven groundcover, Lumite Inc., Alto, GA) prevented soil entry by 99 percent of the weevil larvae and has proven to be durable in long-term field experiments.

The effectiveness of mulching with landscape fabric for weevil management has been studied in small plot experiments at several sites in Florida. Compared to trees in bare soil, mulched trees at the USDA in Fort Pierce grew 70 percent larger after three years. The trees were on single row beds, and fabric covered 2.5 feet of soil surface on each side of the trunk. The mulched trees actually tolerated weevil damage better than trees in bare soil, because weevil feeding damage to the roots in each treatment did not differ.

In trials initiated 14 years ago at the CREC near Lake Alfred and seven years ago in a commercial grove near Poinciana, fabric was installed with a width of 5 feet on each side of existing trees (Figure 2). Trees were newly planted at CREC and 20 years old at

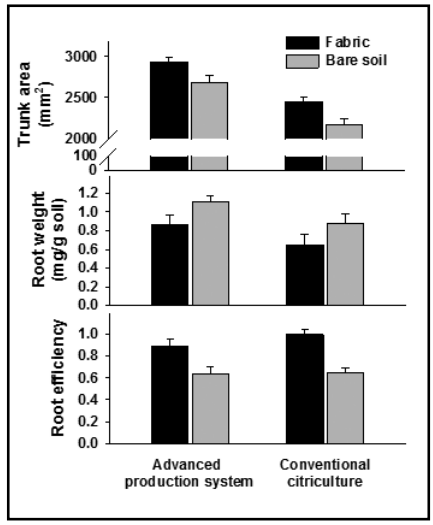

Figure 2. Effects of advanced production systems and landscape fabric mulch on the size of Hamlin orange tree trunks and root systems in the drip-irrigated (APS) and microjet-irrigated zones (conventional citriculture) and the relative efficiency of the root systems as measured by the trunk area to root weight ratio.

Poinciana. Five years after trees fabric installation at CREC, the in mulched plots had average trunk areas that were 31 percent larger than those of trees in bare soil. As few as 1 percent as many *Diaprepes* adults at the two sites were caught in ground traps installed beneath mulched trees compared to trees in bare soil. Adult capture rates from another set of ground traps placed 5 feet from tree trunks (at the edge of fabric in mulched plots) showed that adult weevils were not moving laterally beneath fabric to emerge at the fabric edge.

Fabric mulch plots were installed more recently in an ongoing experiment conducted by Arnold Schumann comparing conventional citriculture (CC) to an advanced production system (APS). Shortly after planting, the grove was found to be infested with *Diaprepes* root weevils. Sixteen months after planting, mulch treatments were installed to determine if the intensively managed trees (daily fertigation with drippers) would respond to the fabric barriers in the same way as conventionally managed trees (dry fertilizer, microjets). APS has been shown to be much more efficient than CC, using less water and fertilizer to grow larger trees with more fruit. Nevertheless, use of fabric mulch increased the growth rate of even APS trees.

At two years post mulching, compared to CC trees in bare soil, the girth of APS trees grown in bare soil or mulch were 24 percent and 36 percent larger, respectively (Figure 3, see page 16). Mulch also increased the efficiency of the root systems in both APS and CC, because while mulch increased the tree size in both systems, it reduced the abundance of fibrous roots. In this regard, the fabric mulch affected citrus root density and efficiency in much the same way as has been reported for some composted organic mulches.

In the APS trial, increased root efficiency resulted in reduced soil moisture and lower levels of all measured nutrient elements (N, P, K, Mg, Ca) except Na in the mulched, compared to the bare soil. Five-year-old trees in mulched plots yielded

Figure 3. Field plots to test the effectiveness of landscape fabric mulches for control of *Diaprepes* root weevils: A) fabric a few months after installation in September 2002, B) closeup of newly hatched *Diaprepes* larva placed on the fabric, C) fabric in April 2014, nearly 12 years after installation, D) closeup showing fabric integrity after nearly 12 years as a soil mulch.

significantly more fruit than those in bare soil, because tree survival in the bare soil was 8 percent lower than for trees in mulched plots.

These trials showed that fabric mulches consistently improved tree health in *Diaprepes*-infested groves. The results were similar to other studies showing that fabric mulches increased the growth rates and yields of perennial tree crops such as nectarine, apple, cherry and citrus, independently of soilborne pest or disease issues. Failure of fabric to prevent feeding damage in the trial at Fort Pierce may have resulted from the narrow (2.5 feet) soil coverage on each side of the tree trunk. However, this remains to be determined because none of the studies with wider mulch width have directly measured the weevil feeding damage.

The use of fabric mulches in citrus tree rows will create technical challenges and require substantial upfront costs for the fabric and installation. The landscape fabric currently costs 4.5 cents per square foot. For row spacing of 25 feet, the material cost of mulching to widths of either 8 or 10 feet would be $784 or $941 per grove acre (allowing 1 foot of buried fabric at each edge). The cost of application would be approximately $25 to $30 per acre.

The most obvious cost savings to help pay for mulching is that for herbicides. Eliminating herbicides from management programs will also reduce the potential for inadvertent chemical damage to the tree or crop.

Pesticide costs to manage the Diaprepes-Phytophthora complex were as high as $300 per acre per year a decade ago, although saving those costs does not strictly apply today due to the need to manage psyllids. Therefore, fabric longevity and the effect of mulching on fruit yield will be major factors in determining if mulching to manage the pest-disease complex is profitable. The research to date provides little information about these two important questions.

Fabric integrity in the longest of the trials reported here remained excellent for 5 to 6 years, after which some tearing of the cloth occurred due to traffic and occasional spots appeared where degradation due to UV radiation caused the fabric weave to be less tight. However as shown in Figure 3 C–D, much of the fabric expanse has remained in good condition during nearly 12 years.

Many other questions remain concerning the efficacy of fabric mulch for weevil control and optimum ways to install and protect the material. Enterprising growers could find the answers to most of them.

WHAT'S SHAKIN'

Pellenc, an equipment manufacturer in the agriculture industry, has developed mechanical harvesters for grapes. Its harvesters include both self-propelled and tow-behind models. The newest machine, the Optimum series, is a self-propelled, over-the-row machine using a flexible conveyor sorter that the company claims can help eliminate juice loss and maintain the berry integrity. Pellenc claims that this machine can efficiently, but gently, harvest grapes while removing 99.82 percent of any harvesting debris.

One of the distributors, Vine Tech Equipment, has downloaded a video on YouTube that shows the machine's capabilities. Visit http://www.youtube.com/watch?v=WBmFH7fNxnA to view the video or download from the website (http://citrusmh.ifas.ufl.edu).