



**Figure 1.** After 20 months growing in a 3-foot individual protective cover, a Valencia tree on Cleopatra mandarin rootstock has completely filled the bag space.

# Research update on individual protective covers

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It has been nearly three years since the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) started its studies on individual protective covers (IPCs). The objective of this study is to evaluate the feasibility of IPCs as a strategy to prevent HLB infection of newly planted citrus trees by excluding the vector psyllid.

The IPC made from fine mesh provides an alternative to soil drench and foliar insecticides, which reduce psyllid populations but do not effectively prevent infection. IPCs can be adopted for new solid plantings or for resets in groves where HLB and psyllids are present.

In February 2018, a trial was started at the UF/IFAS Southwest Florida Research and Education Center

(SWFREC) research farm in Immokalee. The trial consists of 90 trees of Valencia scion grafted on Cleopatra rootstock arranged in a completely randomized design. Trees were either not covered or covered with IPCs and received three different rates of neonicotinoid insecticides, including a non-treated control, every six weeks.

During this time, a multidisciplinary team of a citrus horticulturist, physiologist, pathologist and entomologist monitors tree growth, canopy density, leaf chlorophyll and carbohydrate content, as well as pest and disease incidences. Pests monitored are scales, aphids, leafminers, psyllids and others. Diseases monitored include HLB, citrus canker and greasy spot. HLB incidence was confirmed by measuring *Candidatus Liberibacter*

asiaticus (CLas) titers through real-time quantitative PCR.

Here, we provide an update on the information collected to date, implications and the next steps in the ongoing research.

## STEPPING UP BAG SIZE

After 20 months of growth, the small (3-foot tall) IPC bags were not enough to accommodate the expanding canopies (Figure 1). In August 2019, the old bags were replaced with new 8-foot tall bags. To avoid psyllid incursion, the larger IPCs were placed immediately after removing the smaller IPCs. Interestingly, branches that were bent because of the restriction of the small-size IPC started to unfold within a few days, and new growth was visible after just four days (Figure 2, page 20). After one year of growth in the 8-foot bags, trees remain negative for CLas and symptom-free. The non-covered trees are 100 percent infected and display noticeable HLB symptoms. No psyllids were observed on trees inside the IPCs, but scale infestation was present.

## LEAF DROP CONCERNS UNFOUNDED

There was concern among many growers and colleagues that trees with IPCs would be shedding more leaves than non-covered trees. However, after

monitoring leaf drop for almost two consecutive seasons, researchers found a distinct seasonal pattern. While leaf drop increased in fall and winter in the non-covered trees, it did not increase in the IPC-covered trees. A probable reason for this finding may be the consistent environmental conditions inside the IPCs. As a result, trees with IPCs developed a denser canopy than trees without IPCs within the three years of the study.

## PESTS AND DISEASE

Challenges with pests other than psyllids that were encountered with the smaller bags continued after the transition to the large-size IPCs. Researchers are still finding pests such as scales, mites and some citrus leafminers. It is therefore very important to scout IPC-protected trees regularly and apply insecticides as needed to manage these pests.

Interestingly, canker incidence was lower for trees with IPCs than without IPCs, while greasy spot was more severe while having the same incidence of affected trees.

## INCREASED METABOLIC ACTIVITY

As mentioned above, trees with IPCs had a thicker and greener canopy, and a higher leaf area compared to trees without IPCs. Leaves from trees with IPCs also contained more soluble sugars and significantly less starch, indicating that they are metabolically more active.

HLB-affected trees accumulate starch to the point that starch accumulation is a good indicator of HLB disease progression. Work in progress is aimed at understanding the biochemistry and physiology associated with these differences in foliar carbohydrates.

## FRESH FRUIT STUDIES

Studies have already been expanded to determine the effect of IPCs on the growth and performance of mandarin-type trees for fresh fruit production. Three field trials were established in the experimental grove at SWFREC with a total of 600 trees consisting of Sugar-Belle, Tango and Early Pride on sour orange and US-942 rootstocks.

The results from these trials will



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help answer important questions regarding horticultural performance, blooming and fruit set requirements for these varieties. With this information, researchers will be able to recommend management practices to maximize fruit production.

### LAYOUT ASSESSMENT

Finally, researchers are currently assessing different IPC layouts for more cost-effective psyllid protection. An edge-effect layout is based on the knowledge that infection and distribution of HLB are not uniform in a grove and that psyllid infestations are usually observed in trees located at the outer edges of groves. In a patterned layout, trees on exterior rows are all covered with IPCs, but trees on interior rows are covered in a pattern alternating between IPC-covered trees and non-covered trees toward the center of the grove.

These different patterns may have important consequences for pest management and may determine the most protective and most cost-effective layout.



**Figure 2.** New growth is rapidly established on a Valencia tree on Cleopatra mandarin rootstock four days after replacement with the larger 8-foot bag.

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