Texas A&M University-Kingsville

# Citrus Center

Weslaco, Texas

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## Citrus Greening Disease (HLB) Confirmed in Texas

*John da Graça, Mamoudou Sétamou, Mani Skaria and Madhu Kunta*

The Texas citrus history will remember Friday the 13th of January, 2012 - the date the 1st tree in the 13th row of a Texas citrus orchard was confirmed to be infected with greening (HLB).

**The first confirmed greening-infected tree in Texas – a 6-year old Valencia tree in a San Juan orchard**

### FEATURES



In late December, 2011, USDA-APHIS inspectors noticed a Valencia orange tree on the southern edge of an orchard in San Juan, TX, with HLB-like symptoms. They collected leaf samples and sent them to the Citrus Center's diagnostic laboratory. On January 7, 2012, the lab conducted a real-time PCR test on this sample, and obtained a result indicating the presence of the greening bacterium. The lab immediately conducted conventional PCR, and obtained a positive result. The results were reported to USDA-APHIS, who dispatched their team back to the area for official sampling for confirmation in their lab in Beltsville, MD – the confirmation was announced on January 13.

Citrus Center scientists accompanied the USDA inspectors in the field. The suspect tree was smaller than other trees in the orchard (Fig. 1) and had a range of greening-like symptoms – blotchy mottle leaf symptoms (Fig. 2), yellow veins, twig dieback, and lopsided fruit. An inspection of nearby trees indicated that greening was probably present in them, and samples were collected for PCR testing.

The Texas Department of Agriculture imposed a 5-mile quarantine zone around the affected orchard, which prevented the movement of citrus, including nursery stock out of the zone, and introduced measures to prevent the transportation of infectious material on harvested fruit. The USDA began a delimiting survey of all orchards in the area, sending samples to the Citrus Center for testing. The Citrus Center initiated a tree-by-tree survey in the Valencia orchard. This was extended to the grapefruit orchard across the street after the detection of HLB in trees there. Intensive surveys were then initiated throughout the quarantine area.

As of May, 2012, the only infected trees detected are in these two orchards. Citrus Center personnel are conducting monthly tree by tree assessments, noting trees with suspicious symptoms and bringing samples to the diagnostic lab. Thus far, the total number of confirmed infected trees is 63; 47 Valencia and 16 grapefruit. The tree locations have been mapped, and they are clustered in each orchard (Fig. 3).

The first find of HLB in Texas has a uniqueness compared to that of Florida, Mexico, and recently California, where the first finds were in residential properties. Furthermore, in California and Mexico, the pathogen was first detected in psyllids. In Texas, over 35,000 psyllids were tested prior to the first tree HLB-infected tree find, without detection – subsequently, one psyllid sample from the area has given a borderline positive result.

Following the confirmation of HLB in Florida, Texas began to take serious proactive steps. The most effective practical approach taken appears to have been the implementation of a voluntary area wide psyllid management program. This program had started in Fall 2009 and has been ongoing since then. The program comprises a coordinated psyllid control over a three week period in fall (mid-November to early-December) and in winter (mid-January to mid-February), plus targeted sprays of individual orchards during the active growing season at the beginning of a flush cycle and when psyllids are recorded in the orchards. The percentage of citrus acreage under the area-wide management has grown from 62% in February 2010 to 82% in February 2012, reaching a peak of 86% in February 2011. Psyllid populations have shown a dramatic decline since the launch of the program (Fig. 4). The lower psyllid densities in commercial orchards certainly reduces the risk of disease spread. However, growers need to continue their efforts of psyllid control as its populations can easily rebound with new flush shoot production and moreover, the rains in recent weeks in the Valley favor profuse flush shoot growth of citrus trees.

**Fig. 2. Typical greening asymmetric blotchy-mottle leaf symptoms on an inside twig.**

(Greening, Continued from pg. 2..)

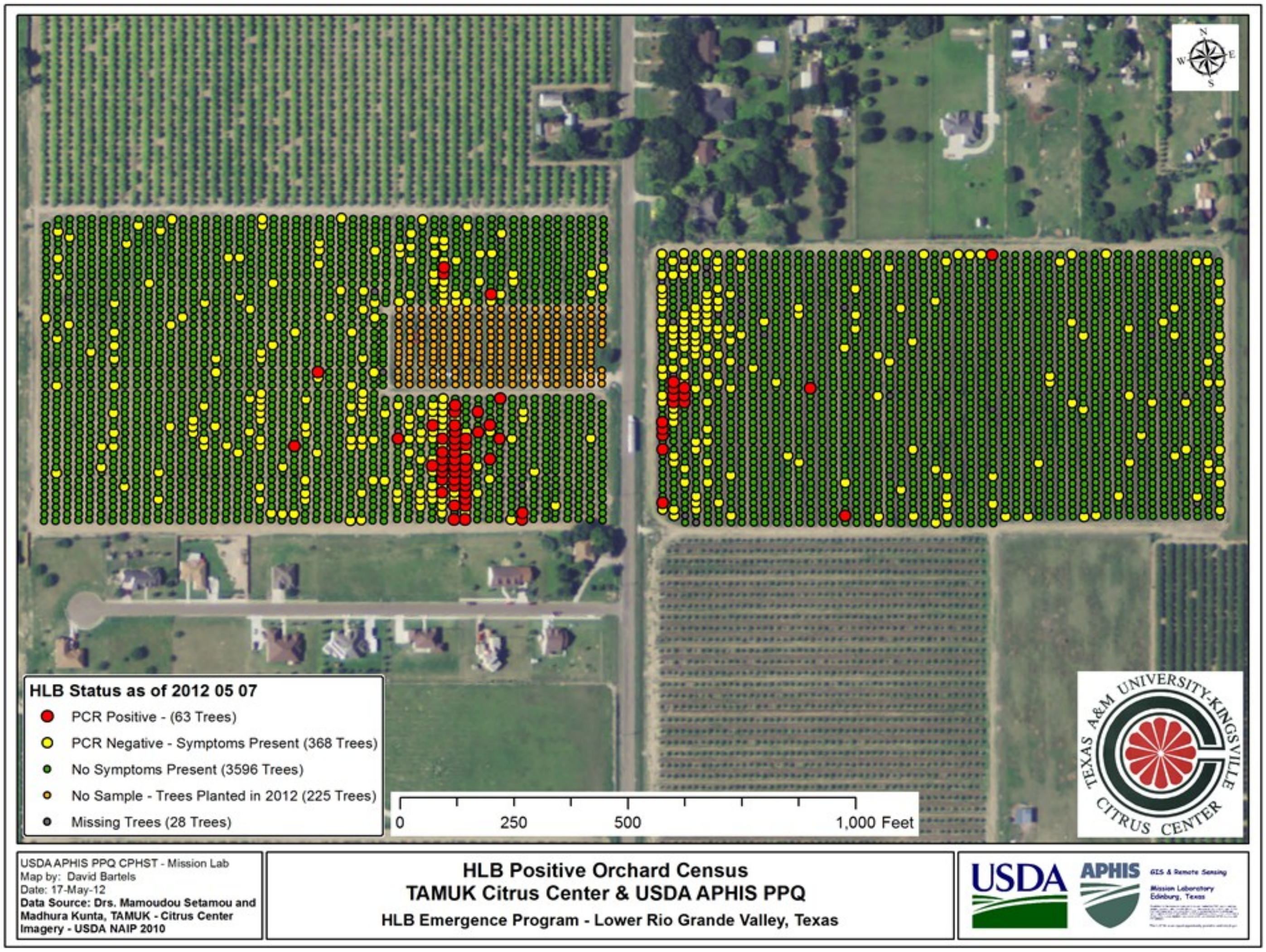


**Fig. 3. Map of the two greening-affected orchards in San Juan, TX (Left–Valencia; Right-Grapefruit)**

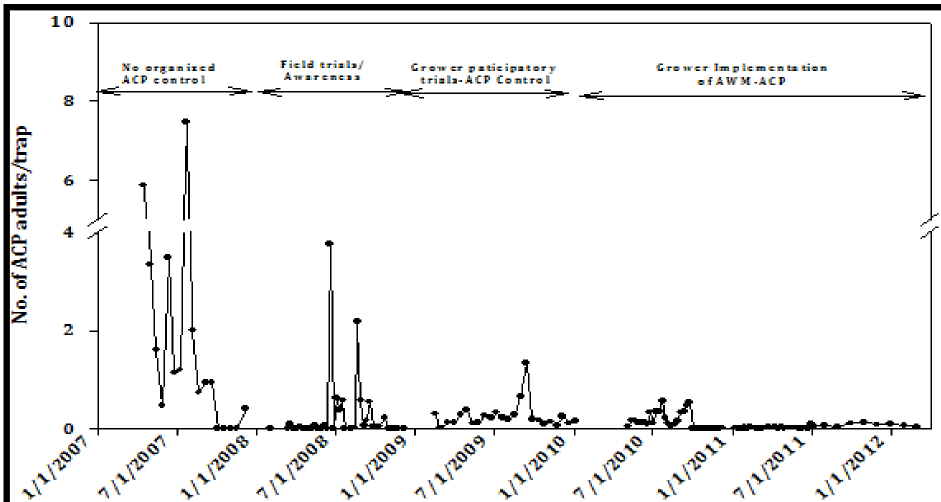


**Fig.4. Asian citrus psyllid population fluctuations in commercial citrus groves in Texas**

# Matting Grove Floor as an Effective Novel Strategy for Sustainable Management of Root Weevils

***Mamoudou Sétamou***

Citrus root weevils are important pests affecting commercial citrus in the Lower Rio Grande Valley of Texas. Root weevils belonging to three genera *Compsus*, *Diaprepes* and *Epicaerus* are commonly found damaging citrus in Texas. The golden-headed weevil (*Compsus auricephalus*) is indigenous to Texas with several morphotypes recorded (Fig. 1). The broad-nose weevil *Epicaerus* comprises at least three species recorded in Texas (*E. elegantus*, *E. mexicanus* and *E. texanus*, Fig. 2) and is considered to be indigenous to the LRGV and northern Mexico. The diaprepes root weevil (*Diaprepes abbreviatus*, Fig. 3) is an invasive species recorded for the first time in 2000 in Texas in Hidalgo Co., but in 2008 it was detected at another location in Cameron Co.

**Fig. 1. Golden-headed weevil (*Compsus auricephalus*)**

*E. texanus* | *E. mexicanus* | *E. elegantulus*

**Fig. 2. Broad-nosed weevil (*Epicaerus* spp.)**

**Fig. 3. Diaprepes root weevil**

**Fig. 4. Feeding damage (galleries) of Diaprepes**

***Complex biology***

All these root weevils are poplyphagous insect pests attacking citrus, ornamentals and other plant species found in South Texas. They have a complex but similar biology, with life cycle completed both above and below ground. Adults feed on tender leaf of their host plants causing leaf notching, and eggs are laid on these young leaves. Larvae that hatch, fall onto the ground and enter the soil to settle on roots where the larval development occurs–thus the name of **root weevils**. Newly hatched larvae feed on fibrous roots whereas larger larvae feed on the larger structural roots, forming galleries as they consume the outer bark, including the cambium layer (Fig. 4). Larval feeding damage hampers nutrient and water uptake by roots. In severe cases, the roots are devoid of their protective bark and dry up leading to tree death. More often the mines caused by the root weevil larvae serve as entry point for *Phytophthora* infection, thus exacerbating the damage caused by root weevils. After larval development, pupae are formed in the soil and after pupal development, adults weevils emerge from the soil. Adult emergence occurs almost year round in Texas, but peak emergence coincides with new flush shoot availability on citrus that generally occurs after rainfall and irrigation events. Many adult weevils are observed in spring (February-March), summer (June-July) and in early fall (September-October) corresponding to major citrus flush cycles in south Texas. Newly emerged adults are attracted to the dark silhouette of citrus tree trunk that they climb and start a new life cycle.

***Control methods***

Although leaf damage resulting from adult feeding on mature trees cause little or no damage economic to the trees, leaf feeding can result in complete defoliation of small trees, which will compromise their growth. By far, citrus root weevils are important because of the damage and their larvae cause to the root system of citrus trees both directly (feeding damage preventing nutrient and water uptake) and indirectly (facilitating fungal infection). Because of their economic importance, all these citrus root weevils must be controlled to prevent damage and economic losses to citrus orchards. Due to the fact that the life cycle of these root weevils is completed above and below ground, it is important for effective control to target all life stages. Adults can be controlled via foliar sprays of insecticides; while insect growth regulators are used to prevent successful development of eggs. Early larval instars can be

*(continued from page 4)*

controlled via soil chemical barriers on soil, but chemical control of older larvae is much more difficult to achieve.

Several chemicals can be used to control citrus root weevils (Table 1), but effective control requires good timing of spray application. We recommend targeting adult population at the beginning of flush cycles when most adults are more likely to emerge. In case of severe infestations two sprays of 4 weeks apart may be important during the same flush cycle. Larval control can be achieved with nematodes, but the success will depend on the type of soil. In any case, constant or severe infestations of citrus root weevils in a grove may require a soil application of fungicides for *Phytophthora* control.

***Matting of grove floor breaks the life cycle of citrus root weevils***

The use of insecticides has been the traditional method of citrus root weevil control. However, due to their limited residual control, these insecticides need to be reapplied frequently–or at least during flush cycles–to ensure that successful control is achieved. In light of the greater threat posed by citrus root weevils and diaprepes root weevil in particular, we've tested a novel management strategy. This control approach consists of deploying a plastic mesh on the grove floor to break the life cycle of the root weevils. We hypothesize that the plastic mesh as ground cover will prevent emergence of adults and soil penetration of larvae. Two methods of deployment were tested: 1) from the tree trunk to the drip line of trees [partial coverage], and 2) entire grove coverage [total coverage] (Fig. 5). Rows of citrus trees with bare ground served as control [uncovered]. The study was conducted in a heavily *Diaprepes*-infested citrus grove in Bayview, Cameron Co., TX. Using 10 ground tedder traps per treatment, we monitored *Diaprepes* population under the three ground cover conditions. A significant decrease was observed in diaprepes root weevil trap catches in the partially and completely covered sections of the grove compared to the uncovered area. The decrease was more dramatic when the entire grove floor was covered (Fig. 6). Comparing numbers of diaprepes root weevils caught in the uncovered section of the grove to the covered ones, we recorded a 5-fold and 16-fold decrease in the partial and complete coverage of the grove floor, respectively, over a 12-month period after the deployment of the ground cover. These results demonstrate that matting grove floor with plastic mesh is a viable approach for controlling diaprepes root

Table 1. Insecticides recommended for the control of Citrus root weevils in commercial groves

| **Pesticide** | **Active Ingredient** | **Application rate/ac** | **Maximum amount/ ac/yr** | **Restricted Entry Interval (REI) (h)** | **Pre-Harvest Interval (PHI) (d)** |
|---|---|---|---|---|---|
| Soil treatment | | | | | |
| Admire-Pro | Imidacloprid | 7-14 oz | 14 oz | 12 | 0 |
| Capture 2 EC or Brigade 2EC | Bifenthrin* | 16-32 oz | 32 oz | 12 | 1 |
| Brigade WSB | Bifenthrin* | 40-80 oz | 80 oz | 12 | 1 |
| Foliar spray | | | | | |
| Danitol 2.4EC | Fenpropathrin | 16-21 oz | $42^{2/3}$ oz | 24 | 1 |
| Imidan 70WP | Phosmet | 1-2 lb | 4 lb | 72 | 7 |
| Micromite** | Diflubenzuron | 6.25 oz | 18.75 oz | 12 | 21 |
| Mustang | Zeta-Cypermethrin | 4.3 oz | 17.2 oz | 12 | 1 |
| Sevin 80S | Carbaryl | $6^{1/4}$-$9^{3/8}$lb | 25 lb | 12 | 5 |

* Do not allow contact with foliage and fruit

**For better efficacy, add 1 gal of petroleum spray oil.

*(continued from page 5)*

weevil and root weevils in general. Through time we observed that trees that were declining at the beginning of the experiment due to extensive root damage by *Diaprepes* larvae, were recovering probably because of new fiber roots they are able to produce.

The use of the plastic mesh under tree canopy preserves moisture, thus allowing the trees to produce new feeder roots and explore the topsoil for nutrients. Another major added benefit of the plastic mesh as ground cover is the control of weeds and vines in groves. We therefore recommend the use of this grove floor matting system for groves as a sustainable way for managing root weevils. New groves can adequately be started with this system as illustrated in Fig. 6c in an ongoing study. Although better suppression of root weevil was obtained with complete coverage of grove floor, the drawback of this approach is that debris generated during hedging and pruning cannot easily be removed with this approach. Thus partial coverage of grove floor – up to the drip line – will be a viable strategy in established groves to manage citrus root weevils and possibly *Phytophthora*.

| a. Partial grove floor coverage | b. Complete grove floor coverage | c. Matting grove floor for young trees |
|---|---|---|

**Figure 5. Illustrattion of different deployment methods of plastic mesh to cover the grove floor for citrus root weevil control**

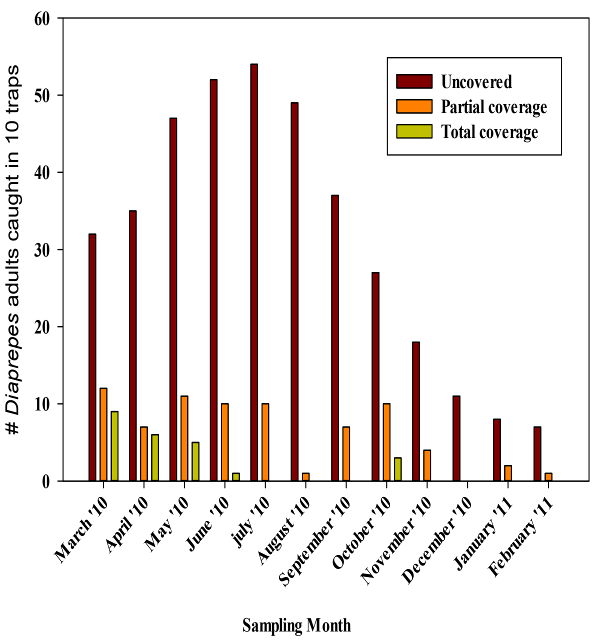


**Figure 6. Population fluctuations of *Diaprepes abbreviatus* in citrus groves under different ground cover strategies**

## Two More Masters Students Graduate

***Mani Skaria, Mamoudou Sétamou, Shad Nelson & John da Graça***

**L-R: Prasad Peddabhoini, Dr. John da Graça, Dr. Shad Nelson, Aditi Satpute after graduation ceremony.**

At the Spring commencement ceremony in Kingsville, two Citrus Center students received their masters degrees. Aditi Satpute, who came to Texas

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from India for her studies, conducted a research project under the supervision of Dr Skaria entitled *"Biological and biochemical characterization of a new pathogen of citrus,* Elsinöe australis*, in Texas".* Her work contributed to our understanding of sweet orange scab which impacted the Texas citrus industry during the 2010/11 season.

The second new graduate is Prasad Peddabhoini, also from India, who worked under Dr Setamou's guidance. His thesis was entitled "*Development of an "attract and kill" strategy for effective management of citrus leafminer (Phyllocnistis citrella Stainton) in Texas".* This pest continues to be a problem, and this work was an important step in developing a practical control strategy.

We congratulate our two new graduates, and wish them success in their future careers.

# Subtropical Plant Science Society Meeting Held at the Citrus Center

***John da Graça & Mani Skaria***

On February 29, 2012, the 66th annual meeting of the Subtropical Plant Science Society was held at the Citrus Center, with current society President, Dr Rod Summy (University of Texas-Pan American) moderating. An impressive list of speakers was on the program, which attracted over 80 participants.

The keynote talk was given by Todd Staples, Texas Commissioner of Agriculture who spoke on *"Border Security and Texas Agriculture"* – a topic of serious concern to the agriculture industry of the Lower Rio Grande Valley. An interesting observation was that many of the students took the opportunity to talk to the Commissioner.

Other speakers were John McClung (Texas Produce Association) who spoke on *"US/Mexico Produce Industry in Troubled Times"* and Dr Juan Landivar (Texas AgriLife Center Director, Weslaco & Corpus Christi) who outlined AgriLife Research programs in South Texas. After a coffee break and poster viewing, Citrus Greening (HLB) took center stage – Dr MaryLou Polek, Vice-President of Research of the California Citrus Research Board, spoke about California's preparations for HLB, and Dr Mani Skaria (Citrus Center) gave a report on *"Lessons Learned in Florida"*, based on a recent HLB workshop for scientists and growers from Texas held in Lake Alfred, Florida. David Ruppert, recently hired soil scientist in Kingsville, gave an interesting talk on soils and landscape observations in Haiti.

The poster session was also very successful, with over 30 presentations. Included amongst these were presentations from students from Kingsville, the Citrus Center, UTPA and Centro de Biotecnología Genómica (CBG) in Reynosa. Mexico. These were all judged for the student poster completion – 1st place was won by Ali Ali-Mahmoud from CBG, Amanda Garcia from the Citrus Center won 2nd place, and 3rd place went to another CBG student, Elizabeth Hernandez.

The Arthur T. Potts Award was presented at the end of the meeting. This year's recipient was Dr Bob Mangan, Director of the USDA-ARS Kika de la Garza Subtropical Research Center in Weslaco for his contributions to Valley agriculture, especially on Mexican fruit fly. The annual meeting the society then approved nominations for the 2012-13 board, with Dr John Goolsby (USDA) as President.

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# Hooked on Science – Citrus Center Mentors High School Students

***Juan Carlos Melgar***

The Weslaco Independent School District (ISD) has been very successful in promoting science among high school and middle school students this year. Amongst the 17 categories (including plant sciences, environmental sciences, microbiology or environmental management), 11 high school students from the Weslaco ISD got first place in their categories in the Rio Grande Valley Regional Science and Engineering Fair, held at UT Brownsville on March 2-3, 2012.

This year, six high school students from the Weslaco ISD developed, fully or partly, their

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science project at the Citrus Center. All of them qualified to State Fair Competition and three of them got first place in their categories. One of these students, Elizabeth Sigala (1st place in Plant Science) won the 1st Runner Up Grand Champion Award, and qualified for the Intel International Science & Engineering Fair. Her knowledge and the interest of her project titled "How do drought and salinity affect lemon trees in South Texas" drew the attention of the judges, especially this year, after South Texas suffered in 2011 one of the most severe drought in records. Elizabeth will attend, together with two science teachers and her mentor at Citrus Center (Dr. Juan C. Melgar), the International Science Fair, that will be held at Pittsburgh, PA in May. The International Science Fair is the world's largest international pre-college science competition and provides a forum for more than 1,500 high school students from 65 countries.

The six high school students, together with one middle school student, also participated at the Subtropical Plant Science Society Meeting, that was held at the Citrus Center on February 29th. At the meeting, they presented their boards, met other undergraduate and graduate students from the Valley and attended the talks by several speakers.


**From left to right: Joey Trevino, Marisa Gorena (both from Weslaco East High School, Elizabeth Sigala (Weslaco High School) and Israel Briones (Cuellar Middle School)**

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## Thank you!

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