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Year-Long Control of Asian Citrus Psyllid by Air and Ground in Texas Proven Effective

M. Sétamou

Since its first detection in 2001, the invasive Asian citrus psyllid has spread throughout Texas and can now be found anywhere its citrus host plants are present in the state. The Asian citrus psyllid vectors the bacterium pathogen *Candidatus* Liberibacter asiaticus, causal agent of citrus greening disease, or Huanglongbing (HLB). HLB is one the deadliest citrus diseases in the world for which no cure is known yet. The detection of HLB in Florida in 2005, Louisiana in 2008, many southeastern states in the U.S., in Belize and Mexico in 2009 clearly shows that HLB has the potential to rapidly spread throughout the U.S. HLB has already caused a dramatic decline in Florida, where the disease is believed to have led to more than 20% of groves destruction.

Absence of Proof is not Proof of Absence!

In fact, because there is no cure known for HLB, removal of infected trees and aggressive vector control are the only options currently available for managing the disease problem. As of now, there is no firm detection of HLB in Texas, but generally, ***an absence of proof is not a proof of absence***. Also, the disease has such a long latency (2 to 4 years), before symptoms are often shown on infected trees. Such long periods of latency coupled with the prevalence of psyllids in Texas should be our wake-up call for adopting aggressive psyllid control programs in our groves. In South Texas, Orange jasmine one of the most preferred host plants of psyllids is abundant in dooryards, and HLB symptoms are not easy to identify in this host plant. All of these factors will contribute to serious outbreaks of HLB in the citrus belt of South Texas, should the disease be introduced.

In 2008, we developed and tested in collaboration with growers a year-long psyllid control program in selected groves in south Texas covering about 500 acres. Two types of grove-treatments were considered: 1) all blocks sprayed and 2) some sprayed blocks surrounded by unsprayed ones. For each treatment-grove, four foliar applications of insecticides were performed either by air or by ground. The first application was done as a dormant spray of Danitol® (a.i. fenpropathrin) in early February before the first flush and subsequent applications with a selected insecticide (Provado® [a.i. imidacloprid], Lorsban® [chlorpyrifos], or Mustang Max® [a.i. zeta-cypermethrin]) were performed just at the initiation of a new flush cycle in each grove. Contracted professional applicators did the aerial chemical application with fixed-winged aircraft delivering 12 gallons of spray volume by air (Figure 1). Ground applications were done within a maximum of 2-day period before or after the aerial application, except at the aftermath of hurricane Dolly late July to early August, when the groves were too

Figure 1. Fixed-wing aircraft spraying for Asian citrus psyllid control in citrus groves in Texas

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Armoring the Groves against Armored Scales

M. Sétamou

They are back, not that they had travelled far before. Just because their populations were at their lowest levels in citrus orchards, armored scales went unnoticed from spring to summer. The long period of drought followed by rains in September, have been the perfect conditions for rapid population growth of these armored scales. In fact, the dust brought about by drought has been detrimental for natural enemies of these armored scales, resulting in their population rapidly outpacing that of their natural enemies after the rains in September. The most abundant armored scale in citrus groves in recent weeks has been the California red scale (*Aonidiella aurantii)*.

California Red Scale

The California red scale is a soft, flattened, shield-shaped insect with a thin, waxy covering. This thin cover or the armor, actually gives its name to these scale insects. California red scale generally occurs on the outer canopy of canopy of trees and on fruit (Figure 1). An adult female gives birth to 100-150 mobile young, called crawlers, at a rate of 2-3 per day over 6 to 8-week period. These crawlers emerge from under their mother's cover and search for a suitable feeding site on fruit, shoot, twigs or leaves. During this wandering phase, crawlers can be blown by wind into neighboring trees or orchards. Once settled, the crawlers insert their feeding tubes into the plants and start taking up plant juices. At that stage, they secrete a white wax covering known as whitecap. After a period of feeding and growth, they molt but the cast skin remained attached to the scale cover, giving the cover its typical red color. Male and female scales can be distinguished based on the shape, size and color of the scale cover: ***the scale cover of males is elongated, smaller and paler than that of females which is circular***. Male scales later on develop into delicate winged adults that are attracted to the females and die soon after mating. Several generations of California red scales occur a year in Texas, each requiring about 60 days. Populations increase in orchards with time from spring to fall, resulting in high numbers when fruit are maturing.

California red scale damage plant tissue by removing plant fluids from their feeding sites comprising

Figure 1: California red scale infesting citrus fruit in Texas; inset is a close-up view of the scale

Twice stabbed lady beetle, predator Of California red scale

Aphytis parasitoid of California red scale

Figure 2: Common natural enemies of California red scale in Texas

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Dr Raul Villanueva, New Extension Entomologist in Weslaco

John da Graca

Dr. Raul T. Villanueva has been appointed as the new Assistant Professor and Extension Entomology Specialist at the Texas A&M AgriLife Research and Extension Center in Weslaco. He started to work on August 20. Before moving to Weslaco he was working as a Research Associate at North Carolina State University in Raleigh, implementing an IPM program against the leafhopper vectors of Pierce's disease in the coastal plains, the Piedmont and mountains of North Carolina. In addition, he worked with apples, evaluating reduced risk insecticides vs. conventional insecticides in the Mountains of North Carolina. You can go to: http://insects.tamu.edu/feature/raul_villanueva/index.html for more information about him. Raul received his Bachelor of Science degree in Agriculture in Lima, Peru, and he received his master's in Biology from the Queen's University in Canada. He obtained his Ph.D. degree in Entomology from the University of Florida.

His appointment in Weslaco includes citrus entomology, and we welcome him to the Lower Rio Grande Valley and look forward to working with him.

To De-green or Not to De-green?

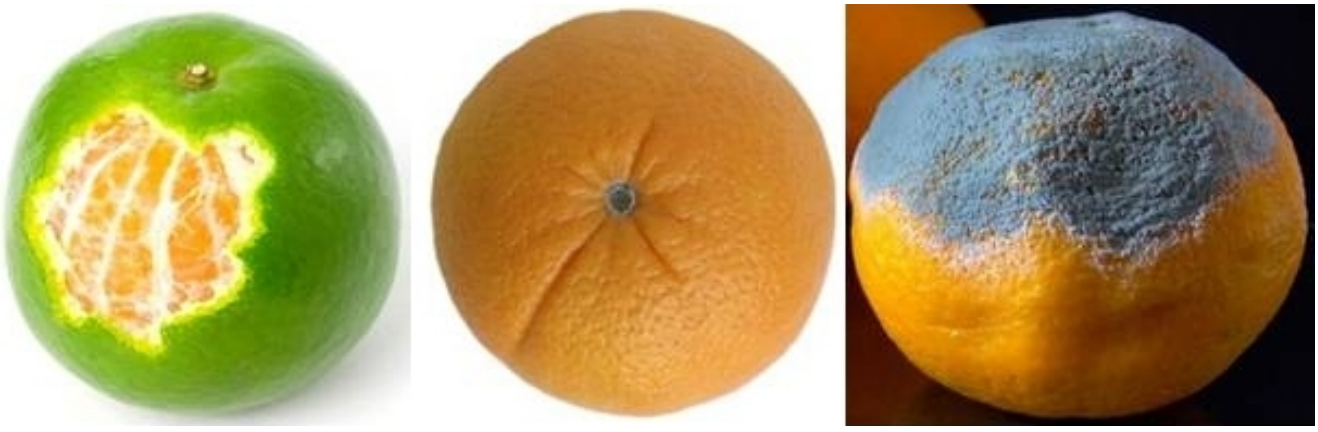
Mani Skaria

Green – a color created out of yellow and blue is common in nature. Green is the color of chlorophyll that makes plant food and eventually food for animals, including human beings. Except for some amphibians, reptiles, birds and insects, the majority of green is associated with plants. Green occupies a prominent place on many national flags as a symbol of peace, prosperity as in U.S banknotes, safety as in traffic light. However, in some cultures, green is considered unlucky, envy, and in nature green is a sign of unripe, for example green banana represents unripe whereas yellow banana is ripe.

A citrus fruit which is normally mature inside in the early season retains green rind until the temperature starts to fall. Unfortunately, consumers believe, or they were made to believe that yellow, orange or red citrus is the sign of maturity. This message is costing the citrus industry a lot of money via rotten fruit. Citrus fruit treated with ethylene gas to accelerate natural color break also initiates and then accelerates the growth and development of certain fungal spores that are embedded in fruit buttons. In the industry, it is known as stem-end rot. It is a very common phenomenon that ethylene treated or commonly called "de-greened" fruit result in fruit decay. Ethylene is like alcohol, it is stimulating but too much of it has a price to pay. A concentration around 3-5 parts per million, 80-85F, 90-95% relative humidity with one air change per hour is considered acceptable. However, many de-greening facilities are not well-calibrated. In the 2009 season, our packers and shippers are already seeing rotten fruit after degreening. It is especially true for some lemons that came from Mexico in this month. Imported lemons are showing significantly high incidence of stem-end rot.

Actually, de-greening is a step to make fruit look attractive to consumers. This attractive fruit, especially in the early season is delivered to consumers with a higher price tag. The price tag includes the loss of revenue from rotten fruit. It is the consumer that pays for the fruit, along with the grower who receives reduced revenue. Is it necessary to de-green citrus fruit and especially lemons and limes? A picture perfect green lemon and lime as in the above picture, free from blemishes look equally attractive as an artificially induced yellow lemon. In a global fruit market, the appearance of rotten fruit can have a huge economic impact. Consumers educated to realize that both the green and yellow lemons in the above picture are equally good quality may not demand an artificially accelerated color change. Moreover, a new marketing survey along with an educational effort on consumer color preference may be money well-spent.

Though green oranges can be sold in some countries, it is a hard sale in the U.S and Canada where people like an orange color for satisfaction. However, I want to make a simple point. The picture below represents a scenario that an internally mature fruit (left) can be ethylene treated to hasten an orange color development; however, it runs the risk of fruit rot commonly the stem-end rot with or without secondary infections with *Penicillium* fungus (right). As our packinghouses struggle to reduce fruit decay, the industry should work with consumer psychology to accept mature, but green, fruit.



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fruits, leaves, twigs and branches, and by injecting toxic substances. They cause yellowing of leaves, leaf abscission and drop resulting in defoliation in case of severe infestations and consequently decreasing overall tree growth. On fruit, California red scales cause deformed blemishes or discolored halos in fruit, thus reducing fruit grade in the packinghouse.

Control of California Red Scale

Armored scales in general, and the California red scales in particular, are often well controlled by natural enemies including predators and parasitoids. The most common natural enemies of these scales in Texas include the twiced-stabbed lady beetle and the parasitoid *Aphytis lingnanesis* (Figure 2). It is therefore important to preserve these natural enemies by avoiding disruptive operations such as over spraying of persistent broad-spectrum insecticides, and by controlling ants that can prevent these natural enemies from feeding on their scale hosts. However, some natural disruptive factors such as dust on plants which are hard to be prevent, can lead to outbreaks as seen in recent weeks in Texas. Hence, a rapid response with either a spray application of pesticides and narrow-range oils, or an inundative release of natural enemies should provide good control.

Horticultural spray oils such as narrow-range oils are also excellent for control of California red scale. Because petroleum-based oils can interfere with the fruit de-greening process in fall, it is important to use care when considering the use of this option for scale control late in the season. However, these oils are important scalicides during the dormant season or soon after scale crawlers are active in late winter to early summer.

For organic orchards, white petroleum oils or botanicals provide good control of armored scales. In addition to oils, insecticidal soap or a mixture of oil and soap can be sprayed. The use of kaolin in summer has been shown to dramatically **increase** populations of armored scales in Texas. Thus, growers should refrain from using kaolin in mid to late summer to avoid high armored scale populations in fall.

A couple of insecticides can be used to control California red scales. The most effective ones are pyriproxyfen (Esteem 0.86EC), chlorpyrifos (e.g. Lorsban 4E, Yuma), imidacloprid (Provado, Alias, and Merit), dinotefuran (Safari), thiamethoxam (Actara), methidathion (Supracide 2E). Insecticides such as acetamiprid (Assail 70WP), malathion (Malathion 57EC), carbaryl (Sevin 80S) also provide some good control. The decision to choose any insecticide will depend on many other factors including the pre-harvest interval of the chemical, prior chemical use during the season, and the type of pests occurring along the armored scale in the orchard. With these foliar sprays, thorough coverage is critical to obtain good control of California red scales.

Natural enemies, or beneficial insects, are commercially available for release against California red scale. Predators and parasitoids can be purchased for biological control in orchards. However, the parasitoid *Aphytis* sp. is the best option for inundative releases against California red scale. A release rate of 5,000 individuals of *Aphytis melinus* per acre, one to three times during the season is extremely helpful and should be a viable approach especially for organic growers. For organic growers experiencing high California red scale infestations in their orchards, it is recommended to make a knock spray first, then follow it with inundative releases of the parasitoid.

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wet for ground rig applicators to get in. Thus, a delay was observed for the ground application which was done 2 to 3 weeks after the aerial application during that period. Ground applications were made by collaborating growers using the same chemicals as the aerial application by at a spray volume of 200 gallons per acre.

Dormant Aerial Sprays are equally effective as Dormant Ground Sprays

Data on psyllid numbers were collected every 2 weeks by direct observations of flush shoots. When performed as “dormant sprays” aerial sprays provided psyllid control comparable to ground application in the two grove-treatments (Figure 2a&b). The dormant sprays provided good control of psyllid populations for 6 to 8 weeks before noticeable psyllid populations were detected in groves.

Coordinated Psyllid Control is Key to Long-term Control

In groves where all blocks were treated, psyllid populations made a comeback in 8 weeks after the dormant application (Figure 2 a). This time was shortened by 2 weeks in blocks treated surrounded by untreated blocks (Figure 2b). During the active growing season, the efficacy of spray applications was short lived in both chemical application methods, but more so in treated blocks surrounded by untreated ones. Therefore, to be effective, psyllid control should at least comprise a dormant spray application of chemicals, and be conducted in a coordinated fashion with no groves left unsprayed. It is important that growers located within the same area coordinate their psyllid control programs to be con-

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ducted within a week-period if possible.

Based on information from Florida, two dormant applications seem to provide the best results. We are therefore encouraging our growers to consider two dormant applications from now on, one done between November and December and the second one from January to February. This timing will also depend on each individual grower's grove care practices. For those planning to prune in winter, please consider applying your dormant spray 1 to 2 weeks after pruning.

Psyllid Control should be one of our Priorities

In a recent grower survey conducted in mid-2008, the Asian citrus psyllid ranked as the 12th most important pest in south Texas. At that time, only Florida had reported the presence of greening. But the situation has rapidly changed within a year with reports of the disease in many other U.S. states including Louisiana bordering our state in the east and in Mexico, our southern border. It is our hope that growers are measuring the threat presented by psyllids and HLB to our citrus industry. Not only psyllids need to be controlled, they have to be ***aggressively controlled***. Our long term industry survival will depend on it!

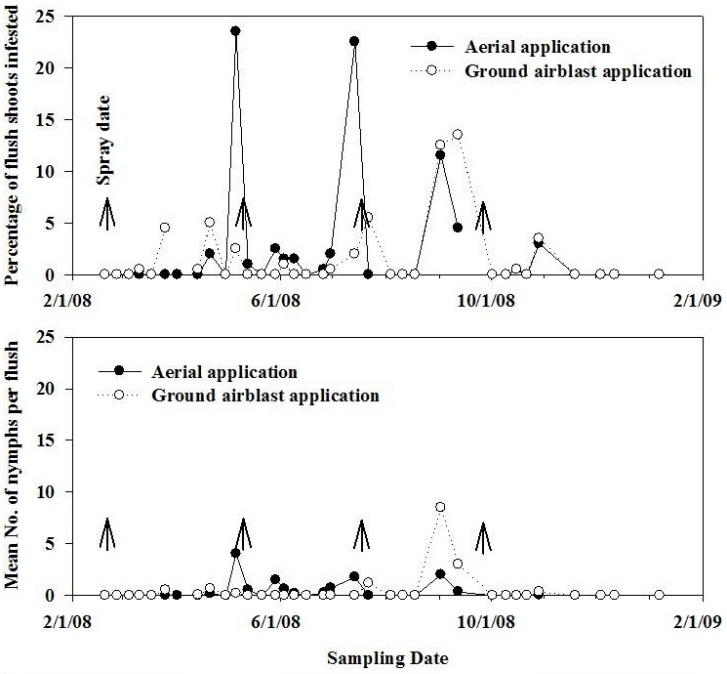

Figure 2a

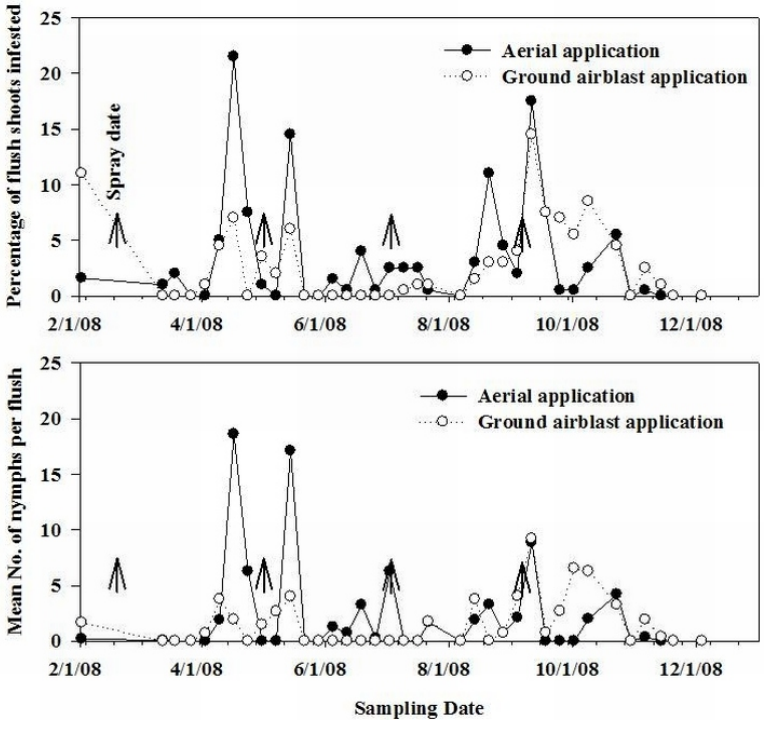

Figure 2b

Figure 2. Asian citrus psyllid densities and flush shoot infestation levels in treated groves for a year-long control by air and ground; a) all blocks within the area treated and b) treated groves surrounded by untreated ones. Arrows present time of spray applications

Citrus Greening/Potato Zebra Chip Conference Slated in McAllen (November 16-18, 2009)*

Rod Santa Ana, *Texas A & M AgriLife Ag. Communications Specialist*

A conference to address serious plant diseases in citrus and potato crops is drawing national and international attention, according to organizers. The conference will bring together researchers and industry leaders affected by what's commonly known as greening disease (Huanglongbing) in citrus and zebra chip disease in potatoes, said Ray Prewett, president of Texas Citrus Mutual in Mission.

The conference, officially known as the "Citrus Huanglongbing (HLB) and Potato Zebra Chip (ZC) Conference: Status of Diseases and Research Opportunities," will be held Nov. 16 – 18 at the McAllen Convention Center, 700 Convention Center Blvd., in McAllen, Tex. The fee for registration after Oct. 20 is $225.

"These diseases in potatoes and citrus are already causing serious economic losses in areas where they are established, and they are of great concern to areas threatened by them," Prewett said.

The conference has generated interest from scientists, producers and industry leaders in Texas, California, Florida, Arizona, Louisiana, Mexico and Belize. U.S. Department of Agriculture officials from Raleigh, North Carolina, and Beltsville, Maryland are also expected, Prewett said. "As word about this conference gets out, we're expecting interest from other areas as well," he said. Prewett said the decision to address diseases in two very different crops was based on scientific and practical motives.

"Both diseases are spread by related insects called psyllids, and are caused by related bacteria," he said. "Both are incurable, and are causing or threatening to cause significant losses to these two vital crops." Prewett said the practical reasons include the fact that many scientists are researching both diseases; the gathering will give them the opportunity to network and compare notes.

Dr. John da Graca, director of the Texas A&M-Kingsville Citrus Center at Weslaco, said the consequences of citrus greening are disastrous. "Many immature fruit fall off infected trees, while remaining fruit are lopsided, remain partially green, hence the term 'greening,' and taste bitter," he said. "Symptoms spread throughout the tree which slowly declines and can eventually die." The disease was first reported in a scientific paper in India in 1927 but may have been present since the 18th century, he said. "It spread by movement of infected plants throughout south and southeast Asia during the 20th century, was confirmed in Brazil in 2004 and in Florida in 2005."

The disease has been devastating for the Florida citrus industry, where more than one million trees have been removed as part of the effort to control it, da Graca said. It has since been found in dooryard trees in Louisiana, Georgia and South Carolina. It is also widespread in Cuba and has recently been found in Belize and the Yucatan state in Mexico. "Texas is now seriously threatened by this disease," he said.

Greening's vector, the Asian citrus psyllid, was found in Florida in 1998 and appeared in Texas in 2001, where it has been detected in over 50 counties across the southern half of the state, da Graca said. Psyllids spread to California in 2008 but so far, greening has not been detected in psyllids or plants in either California or Texas. "At this conference in McAllen our citrus greening discussions will focus on symptoms, surveys, psyllid control, regulations and other management strategies," he said.

Dr. Dennis Gross, a Texas AgriLife Research plant pathologist, coordinates a team of researchers studying zebra chip in potatoes with a grant from the Texas Department of Agriculture. "Zebra chip is a bacterial disease that alters the sugar levels in potatoes that caramelize when chips are fried, causing an off-taste and a burnt appearance," he said. "The disease is spread from plant to plant by the potato psyllid, an insect that injects the pathogen into uninfected plants as it feeds on leaves."

Zebra chip first appeared in Mexico in the mid-1990s and was reported in Texas in 2000 in potato fields throughout South Texas and the Rio Grande Valley. Most recently it has been detected in the South Plains and Panhandle regions. "Chipping potatoes are grown throughout the U.S. and have the potential to cause serious economic losses throughout the country unless we find some way to control the spread of the pathogen and its psyllid vector," Gross said.

Conference topics on zebra chip will include the latest information on disease management and control of psyllids, detection and spread in the field of the Liberibacter pathogen and the development of disease resistant cultivars, he said.

For more information, or to register for the conference, visit either the AgriLife Extension Web site at http://agrilifevents.tamu.e_Hlt242874837_Hlt242874838dBM_1_BM_2_u/events/details.cfm?Id=446 or the Texas Citrus Mutual Web site at http://valle_Hlt242875234yBM_3_ag.org .

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