CARIBBEAN FOOD CROPS SOCIETY

46

Forty Sixth
Annual Meeting 2010

Boca Chica, Dominican Republic
Vol. XLVI – Number 2
T-STAR Invasive Species Symposium

PROCEEDINGS
OF THE
46th ANNUAL MEETING

Caribbean Food Crops Society
46th Annual Meeting
July 11-17, 2010

Hotel Oasis Hamaca
Boca Chica, Dominican Republic

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Toward a Collective Safeguarding System for the Greater Caribbean Region: Assessing Accomplishments since the first Symposium in Grenada (2003) and Coping with Current Threats to the Region

Special Symposium Edition
Edited by
Edward A. Evans, Waldemar Klassen and Carlton G. Davis

Published by the Caribbean Food Crops Society

ISSN 95-07-0410

Copies of this publication may be received from:

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c/o University of the Virgin Islands
USVI Cooperative Extension Service
Route 02, Box 10,000
Kingshill, St. Croix
US Virgin Islands 00850

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Proceedings of the Caribbean Food Crops Society. 46(1): 147-159. 2010

EFFORTS TO MITIGATE, CONTAIN AND PREVENT CITRUS GREENING IN BELIZE AND THE TRI-NATIONAL PLAN

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ABSTRACT: Belize was the first country in Central America to report the presence of HLB within its borders. HLB is a devastating disease of citrus. During annual surveys for exotic diseases, samples of the HLB vector, the Asian citrus psyllid, were collected from trees with HLB-like leaf symptoms. In 2009, of the 67 psyllid samples collected from around Belize, nine, from sites distributed throughout the country, were found to be positive for HLB.

When HLB was found in Belize, OIRSA (International Regional Organization for Agricultural Health) declared a regional emergency, and so other countries in Central America initiated surveys for the disease in their territories. In Belize, the Belize Agricultural Health Authority (BAHA) and the Ministry of Agriculture enacted legislation to declare HLB a notifiable disease; establish a national HLB Task Force; restrict the movement of nursery plants; and require that, from February 1, 2010, all citrus nurseries be covered with an insect-proof screened structure. In November 2010, BAHA followed up on this legislation by destroying plants in nurseries that were illegal (i.e., those not covered in the required screened structures). Several citrus plants producers are now establishing screened nurseries certified under the National Citrus Nursery Certification Programme.

After the establishment of an HLB-diagnostic laboratory, a delimiting survey for the disease was conducted between May and June 2009. This survey found a total of 270 HLB positive trees, mainly in back-yards, distributed throughout Belize. During this time, the Citrus Growers Association (CGA) launched a public awareness campaign promoting use of the internationally recognized three-pronged approach [(i) reduce inoculum levels, (ii) control the vector, and (iii) use disease-free plants] to prevent HLB from spreading and to reduce its impact on citrus production. In January 2010, the HLB Taskforce submitted a plan for HLB control (with focus on the three-pronged approach) to the Ministry of Agriculture for approval. To-date, the government has yet to put the required mechanism in place for funding. Despite these constraints, support from international organizations has been invaluable in providing essential technical support; networking opportunities for the development of an HLB control framework for Belize; and financing for on-the-ground activities such as infected tree removal in back-yards, HLB diagnosis, some vector control, public awareness and nursery screening. Additionally, most of the resources of the Citrus Research & Education Institute (of CGA) have been dedicated to activities dealing with HLB.

Citrus production in Belize is a significant foreign exchange earner for the country and the threat from HLB must be mitigated to ensure continued development of the industry. A major challenge of dealing with HLB is the way it affects trees over time and the current lack of a cure. With this comes the challenge for growers to accept the serious nature of the disease and to bring about the required changes, on an industry-wide scale, in their citriculture practices if its spread is to be effectively controlled. The response to HLB be must be standardized. It requires a legal framework to ensure funding, education for growers, and enforcement of regulations.

KEYWORDS: HLB, citrus, greening disease, Tri-national plan, USA, Mexico, Belize

RESUMEN: Belize fue el primer país centroamericano en notificar la presencia del HLB dentro de sus límites fronterizos. El HLB es una enfermedad devastadora de los cítricos para la cual no hay cura y todas las variedades son susceptibles.

Los sondeos anuales para las enfermedades exóticas que actualmente existen en la región de las Américas se habían estado conduciendo desde el 2004. Durante estos sondeos, especímenes del vector del HLB, el psílido asiático de los cítricos, fueron coleccionados de arboles con síntomas parecidos al HLB. En el 2009, de las 67 muestras de psílidos, nueve resultaron positivos y provinieron de sitios distribuidos por todo el país.

Cuando el HLB fue descubierto en Belize, OIRSA declaró una emergencia regional, la cual estimuló a los otros países centroamericanos a iniciar programas de vigilancia contra la enfermedad en sus respectivos países. En Belize, la Autoridad Beliceña para la Sanidad Agropecuaria y el Ministerio de Agricultura implementaron la legislación que declaró el HLB como plaga notificable, restringió el movimiento de plantas de vivero y requiere que a partir del 1ro de febrero, 2010 todos los viveros para cítricos sean cubiertos con malla contra insectos. Luego en Noviembre del 2010 la Autoridad Sanitaria de Belize aplico este reglamento de eliminar plantones de viveros ubicados a campo abierto, los cuales no cumplían con los requisitos establecidos.

Después del establecimiento de un laboratorio de diagnostico para HLB, se condujo un sondeo de delimitación de mayo a julio del 2009. El sondeo descubrió un total de 270 árboles positivos al HLB, principalmente en árboles de traspatio y distribuidos por todo el país. Durante este período una campaña publicitaria se inició promoviendo el enfoque de manejo integrado para prevenir la diseminación del HLB y reducir el impacto a la producción citrícola: remoción de arboles infectados, el control de las poblaciones de los psílidos, y el uso de plantas certificadas y libres de HLB.

El grupo técnico de trabajo sobre HLB recomendó al Gobierno de Belize en enero de 2010 la estrategia de controlar la diseminación de HLB para aprobación. Hasta la fecha el gobierno no ha implementar un mecanismo adecuado de financiamiento para el control de HLB. Las instituciones responsables para tratar la amenaza por el HLB dificultan en convencer a los líderes de la industria y el gobierno sobre la gravedad de la amenaza y por ende fondos nacionales para tratar el problema no han materializado. A pesar de estas limitaciones el apoyo por parte de las organizaciones internacionales han sido invaluables en proveer apoyo técnico esencial, oportunidades de enlaces para el desarrollo de un marco de manejo contra el HLB para Belice, y proveyendo el financiamiento para ciertas actividades de campo tales como remoción de arboles infectados, diagnostico, control del vector, divulgación, y la cobertura de viveros.

La industria citrícola beliceña es un generador significativo de divisas para el país y el HLB amenaza con destruirla si no se implementan medidas efectivas para reducir la diseminación de la enfermedad.

El reto principal en el manejo del HLB es en crear conciencia para todos los afectados, sobre la seriedad de la naturaleza de la enfermedad. El sustento de más de 500 familias agrícolas y un estimado de 10,000 trabajadores depende de la industria citrícola y el futuro de una contribución significativa a la economía del país dependen en el convencimiento de los líderes nacionales sobre la naturaleza de la amenaza que enfrenta la industria citrícola de esta enfermedad devastadora y sobre su apoyo para asegurar que los recursos requeridos sean disponibles para tratar esta.

PALABRAS CLAVES: HLB, cítricos, Enverdecimiento, Plan Tri-nacional, USA, México, Belize.

INTRODUCTION

Country-wide surveys for citrus diseases that were known to be present in the Americas but that were exotic to Belize have been conducted in Belize since 2004. It was during the 2009 survey that HLB, also known as citrus greening disease, was found to be present in the country (Manjunath et al. 2010).

Figure 1. HLB blotchy mottle symptoms have been found throughout Belize. The picture on the left was taken on Mexican lime trees in Hopkins Village, Stann Creek District. The picture on the right shows vector of the disease, the Asian citrus psyllid (ACP), *Diaphorina citri*, on a citrus leaf in Sarteneja Village in Corozal District The ACP is about 3–4 mm long.

HLB is considered the most devastating diseases of citrus (Bove 2006; Gottwald et al. 2007). Once a tree is infected there is no cure for the disease and all citrus varieties are susceptible. Trees will decline to uneconomic levels of production within 1–10 years, depending on the age of the tree (Gottwald et al. 2007). Infected young trees will decline rapidly (within 6 months to 2 years) while older trees will take longer to decline. The experiences of several countries in Asia and Africa have shown that if left unmanaged, the disease will wipe out an industry (Gottwald et al. 2007). The disease is now spreading through the Americas (Brazil, Florida, Dominican Republic, Cuba, Jamaica, and Central America), and is characterized by a blotchiness of the leaves (Figure 1), small and distorted fruit with low quality juice, leaf drop, tree decline, and eventual economic and physical death. All of these conditions are due to the blockage of the phloem tissue of the plant, by the HLB bacteria, which restrict the movement of nutrients through the tree (Bove 2006). The disease is spread by the Asian citrus psyllid (ACP), *Diaphorina citri* Kuwayama (De Graça 2008).

In South Africa in the 1960s, citrus production areas had to be abandoned because HLB was not adequately controlled (Piertersen 2010). In Brazil, areas that have been devastated by HLB are now being converted to sugarcane (Juliana Freitas Astua, personal commuications), and in China, in areas where HLB is established, it is no longer possible to grow citrus (Xia and Sequira

2010). Senior officials in Florida are warning about the possible collapse of the citrus industry in that American state (Salisbury 2007).

The threat posed by HLB should not be underestimated. The institutions responsible for implementing disease control measures in the country require additional resources to fully implement the range of interventions required to educate growers and control the spread of the disease. The government needs to finalize the measures required to establish a mechanism to provide national funding to support HLB control activities and research.

Education and public awareness campaigns continue. Some financial support from the International Regional Organisation for Agricultural Health (OIRSA) and international liaisons through the Tri-National plan (United States, Mexico, and Belize) for ACP/HLB control are essential in providing technical support, networking opportunities, and some on-the-ground activities for the development of an HLB control framework for Belize.

IMPORTANCE OF THE CITRUS INDUSTRY TO BELIZE

The Belize citrus industry is the most significant agricultural foreign exchange earner for the country: earning around US$48.6 million in the 2007/08 crop year (Citrus Products of Belize 2008). There are around 45,000 acres of producing citrus in Belize (80% Valencia orange and 20% marsh grapefruit), with the vast majority (over 95%) being processed into citrus juices [frozen concentrates: FCOJ (orange juice) and FCGJ (grapefruit juice)], not from concentrate (NFC) juices, pasteurised juices, squashes, and other citrus by the Citrus Products of Belize Ltd. (CPBL), a factory that is 51% owned by the Citrus Growers Association (CGA). Exported products are sold in the U.S., Caribbean, European, and Japanese markets (Citrus Products of Belize 2010).

There are around 500 farm families who produce citrus fruits for a living in Belize and an estimated 10,000 workers (mainly migrant and seasonal workers recruited for fruit harvesting from El Salvador, Guatemala, and Honduras) who provide labor on the larger farms and in the processing factories.

The numbers used here to describe the citrus industry in Belize are small on an international scale, but a signficant proportion of the country's 350,000 inhabitants depend on citrus production for their livelihoods, and the industry makes an important contribution to the economy of the country.

Because citrus production in Belize uses relatively low levels of technology and grove inputs are expensive, average citrus yields in Belize have been low (e.g., 1.75 cxs (boxes)/tree/year for Valencia oranges) for many years (Citrus Growers Association 2009). The country's production for the 2008/09 crop year was 6.6 million cxs (90-lb [41-kg] contract boxes) although the processing factory (CPBL) has the capacity to process 10m cxs. Such low levels of productivity mean that the cost of producing and processing citrus in Belize is relatively high. This difficult situation is likely to deteriorate further if HLB is allowed to undermine the industry's strategy to reach the 10m cx production target: a production level necessary for increased efficiency. If adequate measures are implemented to limit the spread of HLB, however, then a 10m cx production in the future could still be realized. Unless steps to reduce the spread of HLB and to mitigate the disease's impact on citrus procution are implemented, the sustainability of citrus production in Belize will be threatened.

HOW HLB WAS FOUND IN BELIZE

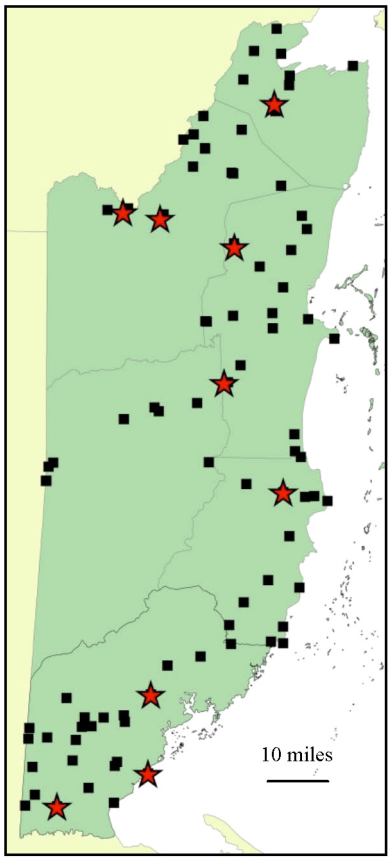

Figure 2. Sixty-seven psyllid samples (■) from around Belize were collected for HLB analysis during the January 2009 survey. Nine of the samples (★) were found to be positive for HLB.

Since 2004, the Citrus Research & Education Institute (CREI), together with Belize Agricultural Health Authority (BAHA), has been conducting annual surveys for exotic diseases (i.e., diseases present in the region, but not known to be present in Belize). The aim of such surveys was to allow for the industry to be pro-active when finding a new disease, and so permit timely implementation of plans to reduce the spread of the disease and thus mitigate any impact the disease might have on citrus production. The diseases included in these surveys in Belize have been HLB, citrus canker, citrus leprosis virus, and citrus variegated chlorosis (CVC).

For each survey, 67 sample sites were selected around the industry (Figure 2) in back-yard citrus as well as in commercial groves. At each site where the survey was conducted, if the survey crew observed HLB like symptoms (blotchy mottle [Figure 1], yellow veins etc.) samples of the ACP (first reported to be in Belize in 2002 [Halbert 2004]) were collected in sample tubes and sent in alcohol to the University of California for HLB analysis (Manjunath et al. 2010).

Analysis on the psyllid samples collected in the years 2004 to 2008 did not detect the presence of HLB, but for the samples collected during the 2009 survey, nine of the psyllid samples were found to be positive for the bacteria *Candidatus* Liberibacter asiaticus: the bacterium that is associated with HLB (Manjunath et al. 2010). These positive HLB psyllid finds were in diverse locations around the citrus industry (Figure 2) eliminating any possibility of containing the disease to one area.

While the work of Manjunath et al. (2010) had shown that HLB was present in Belize the regionally recognised confirmatory tests for new HLB finds are conducted in the USDA Beltsville Agricultural Research Center, Beltsville, Maryland (United States). To fulfill this requirement, leaf tissue samples were collected from each of the sites where HLB positive psyllids had been found and sent to the Beltsville laboratory for HLB testing. Of the nine leaf samples that were sent to the USDA for testing, five were confirmed to be positive for HLB.

INITIAL RESPONSES TO HLB

Regional Emergency Declared

Following the discovery of HLB in Belize, OIRSA declared a regional emergency, and this released funding from OIRSA to CREI and BAHA for the implementation of a nationwide delimiting tree-survey in Belize for the presence of HLB (see below). This emergency declaration also stimulated the other countries in Central America to initiate HLB surveys within their borders.

Emergency Legislation Implemented

In June 2009, the Government of Belize passed an SI (Statutory Instrument: A type of emergency legislation) declaring HLB to be a notifiable disease (this requires any person finding an HLB-infected tree to make a report to BAHA, and provides the basic phytosanitary measures to follow) and making it illegal to move citrus plants around the country. The latter provision became necessary as work in Florida has shown that the spread of ACP through an industry (and by implication, HLB) is facilitated through the movement of retail-trade ACP host plants (Halbert et al. 2008). It would seem reasonable that, based on this research, the un-regulated movement of citrus plants in Belize would lead to a wider, more rapid spread of HLB around the country. The need to restrict nursery plant movement became especially critical as all citrus nurseries in Belize were unscreened and located in areas where the incidence of HLB was thought to be at its highest. In October 2009, a follow-up SI was signed by the Minister of Agriculture requiring all nurseries in Belize to be screened beginning February 1, 2010. Screening nurseries in an ACP-proof structure is the only internationally recognized way of producing plants that are free of HLB. In November 2010, BAHA enforced the legislation requiring citrus nurseries to be screened by destroying plants in a large number of nurseries that were operating illegally. A number of nursery owners are now working to establish fully operational screened nurseries to produce the top quality plants that the industry needs and that meet the requirements of the legislated Belize Citrus (nursery) Certification Programme.

HLB National Task Force Established

The SI signed into law in June 2009 also created a National HLB Task Force with the responsibility to formulate a costed plan to address HLB, to oversee the implementation of the plan, and to advise the government on the best practices and policies required to control HLB. The HLB Taskforce is comprised of members representing the Belize Agricultural Health Authority, Ministry of Agriculture, Citrus Research & Education Institute, Citrus Growers Association, International Regional Organisation for Agricultural Health, Caribbean Agricultural Research & Development Institute, University of Belize, and citrus nursery producers.

In January 2010, the HLB Taskforce submitted a plan (see below) for HLB control to the Ministry of Agriculture for approval. There have been subsequent consultations and modifications to the plan, but to-date the Ministry has not approved all aspects of the plan, and the government has yet to put the required mechanism in place for funding all aspects of the plan. Recognizing the seriousness of the HLB disease threat, most of the resources of the Citrus Growers Association's research arm, the Citrus Research & Education Institute, have been dedicated to HLB activities since finding the disease in the country.

National HLB Diagnostic Laboratory Established

A national laboratory for HLB diagnosis leaf samples was established in August 2009. The Citrus Growers Association established real-time PCR capacity, and trained its staff for this purpose. The laboratory is recognized as the only official laboratory to test for HLB in the country. The lab provided free sample processing diagnosis for growers (from funding provided by OIRSA). Growers were trained in the identification of HLB symptoms and encouraged to scout for HLB symptoms in their groves and bring samples into the laboratory for HLB analysis.

The Delimiting Survey

The OIRSA-funded delimiting survey, conducted from May to June 2009, for HLB covered the whole of Belize (implemented by CREI and BAHA). The survey initiated from each known HLB-positive psyllid detection focal point and progressed outward in a five-mile radius (Floyd and Krass 2006). Tree inspections for HLB symptoms were then implemented in five-mile radii until a new HLB-symptomatic leaf was found — the new HLB-symptomatic leaf find becoming the new focal point for the survey. The survey also focused on high risk areas such as points of entry and areas along the borders.

This process continued until the all the citrus industry groves had been surveyed for HLB. Survey teams collected HLB symptomatic leaf tissues from trees in commercial groves and back-yards throughout the country.

The tissues were analysed through PCR analysis in the CREI laboratory for the presence of *Candidatus* Liberibacter asiaticus, the bacteria initially found to be associated with HLB disease in Belize.

The survey showed that HLB was widespread within Belize, although not at high incidences within commercial groves. Of the 1,018 samples tested, 270 were found to be positive for HLB, with the Stann Creek District showing the highest levels of infection (Table 1). Figure 3 plots the analysis results on a map of Belize and reveals that, at the time, HLB positive trees were found in back-yard trees (red/dark triangles) with only a small number of commercial groves (red/dark squares) being infected. Therefore, although commercial groves were not found to be widely infected with HLB, HLB-infected trees have been found in all areas of Belize, except in areas of the Cayo District, west of Belmopan (Figure 3 [circle 1]).

Public Awareness

Educating growers about the discovery of HLB has been one the main priorities for Belize and the CGA. Regular workshops were held throughout the country and public appearances were made in national media shows. CREI staff provided training for growers on how to recognise HLB symptoms, and encouraged them to follow the three-pronged approach (Figure 4) to controlling HLB. Some

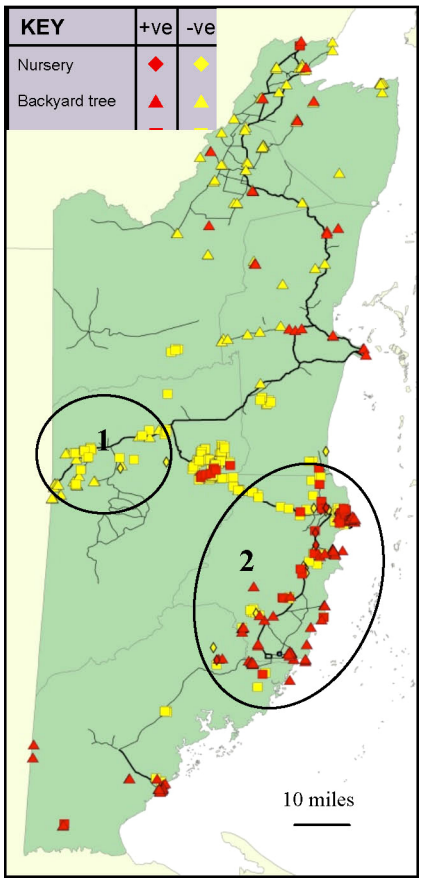

Figure 3. In HLB delimiting survey (May–July 2009), HLB-positive trees (dark red symbols) were found in most areas of Belize, except Cayo District (circle 1), with the highest incidence in the Stann Creek District (circle 2). Yellow symbols indicate where leaf samples were collected, but for which HLB presence was not determined.

Table 1. Delimiting Survey—HLB infection in citrus leaf samples (May to July 2009).

District	HLB Suspect Trees Tested	HLB Positive
Corozal	53	6
Orange Walk	47	5
Belize	42	17
Cayo	329	7
Stann Creek	428	203
Toledo	119	32
Total	1,018	270

of the tools used to train growers and increase public awareness have included a 2010 calendar (Figure 5) and posters (Figure 6).

Growers were encouraged to scout regularly for the disease and bring HLB symptomatic leaves into the CREI laboratory for diagnosis. Growers were also encouraged to implement collective control approaches for ACP. The model promoted in Florida to bring growers together to coordinate ACP control activities, referred to as Citrus Health Management Areas (University of Florida 2010), could be one approach adopted that is showing some success in that U.S. State.

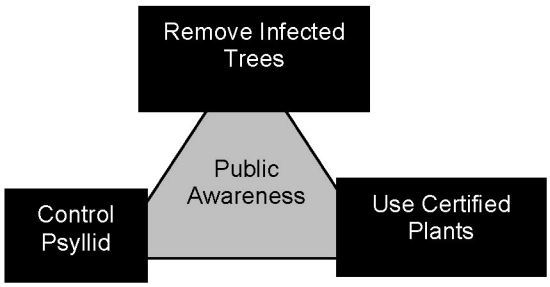

Figure 4. The internationally recognized three-pronged approach to controlling the spread of HLB.

Figure 5. 2010 Citrus Growers Association calendar published in Belize each month explaining in further details a different aspect of the disease including what to do to control its spread in the grove and through the industry.

INDUSTRY PLAN TO CONTROL HLB

Soon after HLB was discovered in Belize an industry plan was developed to control the disease. The plan was divided into three components (i) scouting for HLB diseased trees, (ii) controlling ACP, and (iii) providing the industry with HLB-free plants. At the time of writing, national funding for the implementation of most of this plan has not been secured. Lobbying of the national leaders to identify the finances necessary to deal with the threat posed to citrus production from this disease, continue.

The first component required forming HLB field scouting teams to provide training to growers in recognizing HLB symptoms in the field and working with growers to document and collate the data on the distribution of the disease around the country, encouraging growers to remove HLB infected trees and to map out disease incidences (and tree removal activities) to assess the progress of the disease over time and to determine the effectiveness of control strategies.

Approaches to control the Asian citrus psyllid (ACP) in Belize are planned to be in-line with those being recommended and developed by Stansly and Arevalo (2010) and the University of Florida. This approach requires one or two "dormant season" insecticide sprays 30 days apart. When citrus trees are dormant (during the dry season in Belize, which is February to May), although ACP adults will still be found in citrus groves, beneficial insects are not normally present in significant numbers (Stansly personal communications). Thus, effective applications of insecticides during this time would be expected to remove grove adult ACP populations but

have minimal negative impact on the population of beneficial insects. It is clear that removing populations of adult ACP in the groves before their peak breeding period (with the May/June leaf flush) while minimizing any negative impact on populations of beneficial insects is a promising strategy to control ACP.

In addition to the careful and strategic use of insecticides, approaches are also being considered to enhance or augment populations of beneficial insects and other biological control agents to control ACP populations outside the "dormant" period. Traditionally, there has been a low to minimal use of insecticide for citrus production in Belize. These practices have encouraged naturally occurring biological control agents to thrive in the citrus orchards in the country, and thus citrus pests (e.g., brown citrus aphid, citrus leaf miner, and citrus black fly) are not the significant problem in citrus orchards in Belize (Citrus Growers Association 2009) as they are in some other citrus producing countries. This important feature of citrus groves in Belize needs to be taken advantage of when developing strategies to control insect pests. *Tamarixia radiata* (a parasitic wasp that has been demonstrated to control ACP (*Diaphorina citri)* [Mann et al. 2010]) is present in Belize (Stansly personal communications) as are *Hirsutella* fungi (species not yet identified) which is another candidate being considered for ACP control (Meyer et al. 2007).

The third aspect of the three-pronged approach to HLB control is the production of certified citrus plants. The legislation enacted into law in October 2009 required all citrus nursery plants to be produced under the protection of a psylla-proof screened structure in Belize. It is estimated that Belize needs around 500,000 new citrus nursery plants a year and, since the BAHA enforcement of the law requiring citrus nursery screening (through the destruction of plants in illegal nurseries), several persons are now beginning the process of establishing nurseries covered in psyllid-proof screen in accordance with the requirements of the legislated Belize Citrus (nursery) Certification Programme (BCCP). The BCCP is being enhanced with additional personnel trained to conduct monthly nursery inspections and with the implementation of a loan portfolio specifically targeted at providing nursery owners with the financial means to establish certified citrus nurseries to provide the industry with the quality of plants it requires.

INTERNATIONAL ALLIANCES

In dealing with the HLB threat, Belize had been fortunate to be benefitting from international alliances through OIRSA, SAGARPA (the Mexican Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food), USDA (United States Department of Agriculture), and the University of Florida.

OIRSA-Belize HLB Control Programme

The Mexican office of OIRSA with the support of SAGARPA released US$700,000 to support Belize with two teams (one operating in the north of the country close the Mexican border and one operating in the south in the communities bordering the Stann Creek District citrus production areas) to scout for and remove trees infected with HLB in back-yards; control ACP in village communities; provide training for growers in recognizing HLB symptoms; provide some funding to laboratory reagents for HLB diagnosis; provide funding for staff to attend regional conferences, symposiums, and training events on HLB; and help with funding for public awareness materials and the construction of screened nursery, germplasm, and budwood facilities under the care of CREI. Much of the activities described in this paper have been funded under this program or through the original CREI resources.

Figure 6. Wall poster published in Belize to inform the general public and growers about how to recognize symptoms of the HLB disease. Other material released included brochures and fact sheets describing the disease and its potential impact on citrus production in Belize.

The Tri-National Plan

Through the initiative of the USDA's Citrus Health Response Program (CHRP), a tri-national grouping has been established between the United States, Mexico, and Belize, with the stated objective to "develop and implement a coordinated programme in the participating countries against HLB and ACP." Meetings have been held, between leaders from organizations responsible for plant health and the citrus industries in each of the countries to develop a plan; they have agreed to exchange experiences on controlling HLB and ACP.

The plan is broadly an agreement to conduct HLB surveillance; sample psyllids for HLB; remove HLB-infected trees, where possible; establish laboratories for HLB detection; control ACP; produce nursery stock in closed structures; and conduct training and outreach.

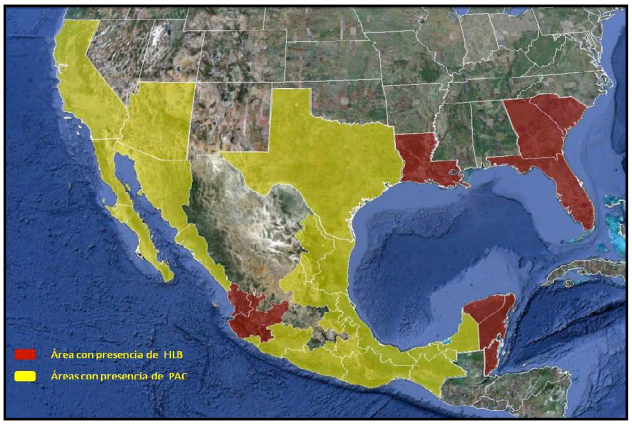

Figure 6. Presence of HLB in the United States, Mexico and Belize has brought the countries together to develop a Tri-National Plan to control the disease. Red colors, indicate areas with HLB, while the yellow colors indicate areas where HLB has not been found (June 2010).

Although the implementation of this plan has not, so far, provided any additional funding for the implementation of Belize's efforts to control HLB, the tri-national plan development activities have provided invaluable opportunities for Belizean officials to network and share their experiences as well as keep up-to-date with the current state of the activities in Mexico and the United States.

CONCLUSION

Belize was the first country to report HLB in Central America. Since finding HLB, legislation has been passed to restrict the movement of citrus nursery plants and to require nursery plant production to be conducted under screened conditions; some work has been implemented to remove trees infected with HLB. The National HLB Taskforce in collaboration with industry stakeholders has formulated a plan to control HLB. This includes (i) area-wide control of ACP, (ii) rearing and release of ACP parasitoids, and (iii) the establishment of teams to scout for and map HLB distribution around the country. Additionally, a national laboratory for HLB diagnosis has been established and a delimiting survey to determine the distribution of the disease has been conducted. Surveys for HLB are on-going. BAHA has taken major steps to ensure that only clean nursery material produced under screen is introduced into the industry. The government still needs to follow through with the actions necessary to increase the funding of the plan to control HLB, especially in the areas of ACP control and activities to determine HLB distribution. The international alliances provided by OIRSA and the Tri-national Plan activities have proved invaluable and continue to provide key support.

The future of citrus production in Belize relies on the industry and government offices coming together to coordinate the area wide approaches to HLB control described in this paper.

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