

**U.S. Department of Agriculture
Animal and Plant Health Inspection Service (APHIS)
HLB-MAC Funded Research**

| Project Title | Principle Investigator & Institution | State(s) receiving funding | Funding Level (most two year) | How this project meets an industry need |
|--|---|-----------------------------------|--------------------------------------|---|
| Early Detection: HLB infection must be detected early in order to prevent the spread of the disease. Trees are often infected for several years before current methodologies confirm the infection. | | | | |
| Standardization of antibody-based early HLB detection methods for near term applications | Ma/UC Riverside | CA, TX | \$428,154 | This project will compare several promising early detection tests that utilize tools useful in detecting human diseases in order to provide an early detection tool for growers. |
| Development of a root sampling protocol for early detection of HLB | Kunta/ Texas A&M Kingsville | TX | \$744,675 | This project will compare results of root versus leaf testing and provide a root sampling strategy to support early detection. |
| Canine Detection of Citrus HLB | Heiser / Coast to Coast K9 | FL | \$1,444,203 | Detector dogs have proven to be highly adept at detecting citrus canker and early results suggest they will be an effective early detection tool for HLB. The first year was a proof of concept and found the dogs greater than 99% accurate. Second year funding includes additional trained dogs, field testing, and a certification program. |
| Canine Detection of Citrus HLB | Louws / NCSU | FL | \$371,542 | Evaluation of detector dog training results and characterization of detected volatiles. |
| Sustainability: These projects takes individual management strategies developed over a period of time and uses them together in different combinations to provide growers with data on the best combinations of management practices. | | | | |
| Treatment of Bicarbonates in Irrigation Water and Soil in Florida Citrus Groves Affected by HLB. | Graham / UF | FL | \$172,916 | This project is designed to demonstrate the effect of acidification (lowering the pH) of the irrigation water and soil on overall tree health in areas high in bicarbonates. In so doing trees are better able to be productive even if infected with HLB. |

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| Integrated Management of HLB for Sustainable Citrus Production in Florida Using an Integrated Management Approach. | Wang / UF | FL | \$556,304 | This project will combine a number of promising management strategies and evaluate using them as an integrated management approach for sustaining production of trees in three different disease categories: uninfected and newly planted, mildly infected and still productive, and heavily infected with declining production. |
| High intensity management of a small, newly planted citrus grove utilizing ACP control, clean plant material, scouting, inoculum removal, and the tenets of area wide management | Rogers/UF | FL | \$615,208 | This project will demonstrate the effects of high intensity management of a newly planted grove in conjunction with several different horticultural practices in order to determine the best combination of practices. It will be maintained as a model grove for researchers and industry. |
| Control citrus HLB for new plantings in Florida with integrated management | Powell/UF | FL | \$526,460 | This project will combine a number of best management practices including nutritionals, chemotherapy, thermotherapy, and other practices to determine best combination for varied grove ages and conditions. |
| Widespread field testing of new HLB tolerant rootstocks | Bowman/others/ UF-ARS | FL | \$424,072 | Increased numbers of potentially tolerant rootstocks and scions will be tested in the field under varying conditions so that the most promising can be identified more quickly. |
| Rapid propagation of HLB tolerant scions and rootstocks to US citrus | Vidalakis/ UC Riverside | CA, FL | \$627,461 | This project will speed the propagation of previously tested tolerant rootstocks and scions to get seedlings into the hands of the growers more quickly. |

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| Tolerant Rootstock through CCPP for testing in CA and AZ | Vidalakis/ UC Riverside | CA, FL | \$779,514 | Root stock tolerant to HLB as tested in FL will be tested and cleaned through California's Citrus Clonal Protection Program in order to field test to determine the suitability of cultivars under California conditions. |
| Effect of Abandoned Grove Removal on Well-Managed Groves Including New Citrus Plantings | Walker / FDACS | FL | \$2,188,230 | In Florida the presence of HLB infected trees in the thousands of acres of abandoned or unmanaged groves is one of the greatest threats to the industry because these trees serve as a reservoir for the infected vectors (inoculum). These demonstration grove projects will determine the effect of removing the inoculum surrounding and within a large, well-managed commercial area. |
| Demonstration of new planting strategies | Murden / TX CPDM Corp | TX | \$863,396 | This project will demonstrate new planting strategies such as raised beds and mulching to increase tree health to decrease the impact of HLB. |
| Therapies for HLB infected trees: In areas with HLB, growers would like the ability to treat infected but productive trees in order to sustain productivity while longer term solutions are under development. | | | | |
| Field Trials of Soil Microbials to Combat HLB | Browning / CRDF | FL | \$636,201 | Several commercially available beneficial soil microbes, which showed promised in the lab and greenhouse, are being tested in the field to determine their effect on HLB infected trees under real life conditions. |

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| Large Scale Field Trial Evaluation of Citrus HLB Bactericidal Therapies | Browning / CRDF | FL | \$1,901,725 | Oxytetracycline and Streptomycin are being tested in field trials in order to determine their ability to cure HLB infected trees and collect information needed for registration considerations. |
| Field Trial to Evaluate HLB Control and Analyze Residues from Passive Trunk Injection of Penicillin-G | Hodges/ FL DPI | FL | \$679,579 | This is a limited field trial of Penicillin-G in order to test for residues (the first piece of information needed to determine if Penicillin could even be considered for further testing), metabolites and other by-products of the treatment. |
| AG Harvesters Citrus Steam Machine | Lint / AG Harvesters | FL | \$963,887 | This private company will build a machine that will deliver thermotherapy on a field scale instead of on an individual tree level, to return large number of trees to productivity quickly. |
| A Compact, Mobile, and Improved Tree Steaming System for Thermal Therapy of Individual Medium-sized Citrus Trees. | Ehsani / UF | FL | \$302,794 | This project will provide a scalable, compact and mobile system for treatment of HLB-infected trees and make the system accessible and available for use by growers and researchers. Already growers have built and are using this system and several commercial companies are offering treatment using this machine as a service. |

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| Hydrosolar field scale thermotherapy | ARA - private Industry | NC | \$962,729 | This project was selected through the Broad Agency Announcement announced through the Department of Homeland Security Science and Technology Directorate. It is a two year project that will utilize components readily available to growers to circulate solar heated water through tubing placed around the exterior of the tree base. |
| Evaluation of results of MAC funded thermotherapy projects; determination of ability of ACP to acquire HLB after thermotherapy | Browning/CRDF | FL | \$374,150 | This project will 1) evaluate the results of the MAC funded thermotherapy projects in a coordinated manner, 2) determine the ability of the ACP to acquire HLB from thermotherapy treated trees, and 3) serve as a model template for evaluating nearly any HLB treatment so that results could be compared across treatments. |
| Vector Control: The Asian Citrus Psyllid acquires HLB when it feeds on infected trees and then spreads the disease as it feeds on additional trees. Controlling the vector, therefore, is one of the essential tenets of a management program. | | | | |
| Release and Establishment in CA of <i>Diaphorencyrtus aligarhensis</i> , Parasitoid of ACP Sourced in Punjab, Pakistan | Hoddle / UC-Riverside | CA | \$330,563 | A second biocontrol insect shows great promise to control ACP and attacks a different life stage than the current agent, <i>Tamarixia radiata</i> . This project will produce and release this second parasitoid insect, <i>Diaphorencyrtus aligarhensis</i> , in California to further reduce ACP populations. |

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| Immediate Expansion of the Mass Production of Tamarixia radiata (Biological Control Agent of the Asian Citrus Psyllid) Using SKEETA Field Insectary Cages to Reduce Populations of the Asian Citrus Psyllid (Vector of the Citrus Greening Disease). | Ways / SKEETA, Inc. | FL, TX | \$185,500 | This entrepreneur built an improved field cage for the production of Tamarixia radiata, a proven ACP biocontrol agent in residential areas, especially those that are adjacent to commercial groves in Texas. The use of field cages on residential properties engages citizens in fighting HLB and has been wildly popular. Fifty three cages were installed in 2015 producing 636,000 biocontrol insects (see line 35). |
| Development and implementation of a novel attract and kill approach for the management of ACP in residential areas, active- and abandoned commercial citrus groves. | Setamou/ Texas A&M Kingsville | TX | \$545,150 | A novel attractant will be field tested to determine whether it is able to attract the ACP under field conditions. If successful this combination of attractant and insecticide will be an important tool for the industry because it will kill all stages of the ACP and can be used in residential and organic citrus . |
| Development and field-level testing of systems for dissemination of pathogen fungus to ACP on residential citrus | Setamou/ Texas A&M Kingsville | TX | \$321,777 | This project will combine a fungal biocontrol agent with several delivery systems to determine effectiveness in killing ACP. |
| Expansion of the ACP Biological Control Program in FL and Southeastern States | Smith / FDACS | FL, LA | \$535,500 | This one-year funding enabled the Florida Department of Plant Industry to more than double production of the biocontrol parasitoid for release in Florida and Louisiana. |

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| Development of Mass-Rearing Methods for the Parasitoid, <i>Tamarixia radiata</i> | Taylor / CRB-CA | CA | \$1,079,818 | ACP is present in many areas in California and the focus is on controlling the populations of ACP to prevent HLB infection of trees. Through this public-private partnership, private insectaries will be contracted to produce <i>Tamarixia</i> . Work at UC Riverside will ensure production of high quality parasitoids and determine more efficient methods for producing the parasitoids. |
| Augmentation of Production of Parasitoids of ACP at Existing CA Facilities | Morgan / CDFA | CA | \$102,365 | ACP is present in many areas in California and the focus is on controlling the populations of ACP to prevent HLB infection of trees. This funding will enhance the production and release capabilities of CDFA. |
| Strengthening the ACP Biological Control Program in Organic and Abandoned Groves and Residential Settings in TX | Prewett / TX CPDM Corp | TX | \$810,846 | These funds have repurposed ex-ARS greenhouses for production of <i>Tamarixia radiata</i> , the biocontrol parasitoid. Through the technology transfer from the USDA Flores project to the Texas Citrus Pest and Disease Management Corporation, more than 500,000 parasitoids have already been produced and released and an 80-90% reduction in ACP populations has been observed. |

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| Strengthening the ACP biological control program in organic and abandoned groves and in residential settings in Texas | Flores/USDA PPQ - TX | TX | \$149,000 | This first year funding resulted in a 7% increase in biocontrol production at Moore Field to 468,000 parasitoids and facilitated tech transfer to the Texas Citrus Pest and Disease Management Corporation - also funded (see above) where more than 500K parasitoids have been produced already. |
| Strengthening the Asian Citrus Psyllid (ACP) biological control program in organic and abandoned groves and in residential settings in Texas – Year Two | Flores/USDA PPQ - TX | TX | \$99,000 | Year Two funds resulted in nearly doubling biocontrol production and release in greenhouses for a total of 906,000; a substantial increase in field cage production (see line 27), and an 85% reduction in ACP populations. |
| Other | | | | |
| Stakeholder Suggestion portal | CIPM/NC State Univ. | NC | \$50,102 | Contract to modify and manage Stakeholder Suggestion portal (previously developed for USDA) resulting in an efficient process for submitting, reviewing and ranking Suggestions. |