Grower Research REPORT
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Summary of Progress on Short-term Solutions to HLB

This report highlights progress on 49 projects that are directed at short-term solutions to HLB. This subset of projects is addressing the goals of the 2013-2014 Legislative Funding Initiative that is enabling CRDF to accelerate its efforts to support research that will discover, demonstrate and deliver solutions for use in Florida citrus in its fight against HLB. The report was developed by Dr. Tom Turpen, Research Program Manager from progress reports submitted for each project. This report reflects on the primary goals of providing tools that growers can incorporate into current practices to slow the decline of the existing inventory of citrus trees and to retain fruit productivity. At the same time, many of these projects also are providing tools that will enable growers to combat ACP and HLB infection on newly planted citrus trees. Specific projects are referenced with the project number in parenthesis.

With the short-term nature of these project goals, progress is being moved rapidly to field trials. Some of the projects in this subset are just beginning, while other projects have been under way for one or two years. This summary report is organized by the target of intervention of a new product or practice of disease control, primarily focused on the Huanglongbing (HLB) pathosystem, the bacterial causative agent *Candidatus Liberibacter asiaticus* (CLas) and insect vector, Asian citrus psyllid (ACP).

While the bacterial causative agent of HLB still cannot be cultured with a useful protocol, a close relative can be manipulated now in the laboratory and this system has been adapted for rapid screening of antibiotic activities. Over 150 compounds have been tested and several selected for further development (Triplett-767) both individually and in combination, and with heat treatment of trees in the field and greenhouse (Powell-617) (Reyes-586). Water suspensions of oil nano-emulsions are being investigated as penetrants for antibacterial compound delivery to the phloem (Powell-584). New formulations with improved bioavailability of copper are being analyzed for activity against HLB (Graham-417). Another approach is to begin with bacterial structures that are known to be essential for pathogenicity and target these functions by designing ligands that may be useful in antibacterial treatments. Wang (773) has chosen the SecA protein and Lipid A biosynthesis pathway, and has five (5) small molecules discovered with good disease control potential to date.

Wang (608) has an extensive collection of bacteria (>400) isolated from Florida citrus root and rhizosphere that can be cultured. This collection is being screened for beneficial properties including plant growth promoting and antibacterial properties.

Endosymbionts are bacteria living primarily in the animal alimentary canal. For a bacterial pathogen such as CLas that circulates in an insect vector, manipulating the gut flora of the insect is one promising target to break the cycle of disease transmission (Pelz-Stelinski-582).

The most dramatic reduction in psyllid populations has been achieved through coordinating grower practices through Citrus Health Management Areas (CHMAs). Several projects support this infrastructure including diagnostics system support, ongoing studies in basic psyllid biology including attractants, repellants, and pheromones as well as trapping and monitoring ACP. For example, Mizell (570) has created a trap that will preserve DNA for testing. These studies all contribute to better psyllid management. It is essential to

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UPCOMING MEETINGS

February 2014			
TBD	Research Management	CREC, Lake Alfred	
TBD	Commercial Product Delivery	CREC, Lake Alfred	
25	Board of Directors	CREC, Lake Alfred	9:30 am

maintain stewardship of existing products for ACP control through responsible coordinated use and rotation. Resistance monitoring has shown an overall drop in resistance to the major range of chemistries over 2011 and 2012 (Stelinski-765). Subtle effects of psyllid behavior may have dramatic epidemiological consequences. For example, ACP is actually attracted to CLas infected citrus and to uninfected plants exposed to volatiles from infected trees (Stelinski-766). Dawson (517) reports the important finding that psyllid nymphs may efficiently acquire CLas in locally infected flush before the bacteria moves more systemically in the tree. This has important implications for detection and control of disease spread. Conditions to improve the efficacy of kaolin clay as a feeding deterrent have been specified (Rogers-590). The search for new chemistries for ACP control has successfully yielded non-neurotoxic juvenile hormone (JH) analogs. Specifically, the well-known compound methoprene appears to be useful for psyllid control. Likewise, a collection of Bt endotoxins has been prepared and is being screened for utility in ACP control (Chougule-711). Efforts continue to reduce ACP populations by rearing and releasing the parasitic wasp *Tamarixia radiata* (Stansly-434). Another novel method of ACP biological control is based on entomopathogenic fungi and an auto-dissemination system. These dispensors are in field trials (Setamou-760).

HLB impairs the vascular system of the tree and results in dramatic early loss of fibrous roots (Graham-732). Three plant genes involved in the host response to CLas that are thought to be responsible for phloem plugging have been cloned in experiments designed to silence this response and ameliorate symptoms (Gowda-728). Plant growth hormones may partially mitigate this symptom (Brodersen-707) to reduce fruit drop. Graham (731) has shown that bicarbonate stress is a major factor that compounds root loss and impairs root function induced by HLB. This root stress is potentially exacerbated by the root pathogen *Phytophthora nicotianae* (Graham-545).

A field trial of over 70 rootstocks has identified several that are relatively tolerant to HLB and performing well with nutritional treatments in both the greenhouse and the field. Many trees are appropriate for high density plantings and will be released commercially on an accelerated timetable (Grosser-548) (Gmitter-615) (Gmitter-539). Both growers and plant breeders have observed relatively rare surviving individual citrus trees in a background of dying blocks. A comprehensive program is in place to understand this phenomenon, whether the phenotype is heritable or may be correlated with the soil microbiome, or simply represents a statistical distribution of variability (Gmitter-537).

Additional details of these projects can be found in the progress reports posted at citrusrdf.org.

CRDF Commercial Product Delivery Committee (CPDC) Reviews Delivery Projects

Periodic review of projects that have moved from research to delivery via the CPDC allows CRDF to keep projects with greatest promise moving forward. At its January 2014 meeting, the committee heard updates from the Program Managers and plans for implementing a series of field trials during the first quarter of this calendar year. Highest priority projects include those targeted to maintaining health and productivity of infected trees and secondarily, tools that will support the health of newly planted trees. Evaluating antimicrobial chemical candidates and commercial products containing active microbes are among approved field trials. The application of thermal therapy to infected trees appears to show effectiveness in restoring tree growth, and ongoing work is now developing practical ways to utilize this method. Other projects of interest include field trials to evaluate plant growth regulators for their ability to influence phloem regeneration as well as to limit pre-harvest fruit drop. Additional projects were reviewed and next steps towards implementation were discussed.

LINK	TITLE	RESEARCHER
	Does huanglongbing (HLB) or associated nutrient deficiencies change asian citrus psyllid (ACP) feeding patterns?	Dewdney