



Citrus Research and
Development Foundation, Inc.

2016-17 Citrus Industry Research Priorities and Gaps Analysis

Report from the Industry Research Coordinating Committee

January 2017

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2016-17 Citrus Industry Research Priorities and Gaps Analysis

Comprehensive Report January, 2017

Preface:

The By-Laws of CRDF define the purpose of the Industry Research Coordinating Committee and assign the Committee responsibility for recommending the research priorities for the Florida citrus industry to the Board that are outside the scope of work of the Research Management Committee. This committee will focus efforts on threats or opportunities for all elements of the industry that fall within its scope. This committee will perform a GAP analysis and, working with all elements of the Florida citrus industry, establish research priorities that fall within its scope.

Previous efforts to conduct analysis of ongoing research projects and compare those to industry needs were carried out by the Florida Citrus Industry Research Coordinating Council (FCIRCC). This committee annually conducted a gaps analysis and shared the results with the industry. In 2011, CRDF assumed the responsibilities previously associated with the FCIRCC, and a report representing the transitional efforts of IRCC to complete the analysis for 2011-12 was presented in August 2012, and a second report in 2014. This report represents the 2016-17 priorities, research inventory and gaps analysis.

Process for this cycle

The annual effort conducted by CRDF, IRCC informs the citrus industry and research leadership of areas of research prioritized by the Florida citrus industry as important as well as the current inventory of projects being conducted by various institutions. The ensuing Gaps Analysis leads to identification of priority areas that require attention, and for each gap, an action plan can then be developed. The appended files that complement the report are characterized as follows:

Appendix I. 2016-17 IRCC Citrus Research Priorities, as updated by IRCC in consultation with various industry segments, including growers, nurseries, harvesters, processors and fresh fruit packers. This spreadsheet serves as a quick reference to the priorities and sub-priorities. For ease in sorting the inventory and conducting the gap analysis, the priorities have been designated alphabetic (A-L) and the sub-priorities within each priority designated numeric (1-n). These designations are not necessarily intended to infer relative importance of the priorities or sub-priorities. All elements included in this evaluation have been identified as priority areas for research by IRCC.

Appendix II. 2016-17 U.S. Citrus Research Inventory, sorted and labeled by priority and sub-priority. This spreadsheet served as a primary resource for the research gap analysis.



**2016-17 CRDF, Industry Research Coordinating Committee
Florida Citrus Research Priorities – Top Gaps and Proposed Actions
Completed January 2017**

This section of the report reflects the final results and recommendations of the Industry Research Coordinating Committee and their efforts to accomplish the following for 2016-17:

- Organize citrus research priority input from all sectors of the industry
- Assemble an inventory of current research projects related to citrus (focus on Florida, but with information from federal as well as Texas and California citrus efforts)
- Review priorities versus level of effort (inventory) and identify gaps
- Discuss each gap and characterize needed actions
- Assist in implementing the actions approved by the CRDF Board of Directors.

The following six gaps were identified by the IRCC during their evaluation of the priorities of the industry and the available inventory of projects. The list of major priorities and their sub-priorities (Appendix I) provides the context for the gaps identified, compared to other priorities identified that currently appear to be addressed adequately, according to the IRCC efforts.

For each gap, there is reference to its placement in the overall priorities, summary of the discussion, and recommended action.

Gap #1: Priority A. Citrus HLB (Greening): Sub-element: All. With the continuing epidemic of HLB expanding in Florida's mature tree inventory, declines in productivity continue. Despite an array of previous and current research projects, the results to date have not successfully addressed the decline in productivity that affects growers, processors, packers and all aspects of the industry. The lack of available tools to collectively impact productivity is the most important research gap.

Discussion: While there are approximately 210 research projects listed in the U.S. Citrus Research Inventory assigned to the topic of HLB, the collective tools that have emerged to date are not adequate to stabilize and restore health to the current tree inventory in Florida. This gap can be described several ways, but includes the need to deliver useful information on which tactics will lead to improved returns to growers through improved productivity, and to take all steps to accelerate this process towards additional tactic delivery. Productivity on a per-acre basis is the standard unit to describe the HLB decline situation at present, but declines

in average brix and in fruit size represent other important metrics, and are factors that greatly influence market channels for citrus fruit and processed products.

Given a hiatus in post-production research to characterize the cumulative effects of progressive HLB-induced decline on productivity and complexities of this disease, there is little clarity on the specific disease factors (phloem plugging, root decline, and/or thinner canopy of smaller leaves, etc.) that most affect productivity. Further, we have limited knowledge on how prospective interventions individually and collectively impact productivity by changing symptoms of disease or reversing tree health decline. Lack of specific information in these areas may interfere with selection of best tactics to deploy to achieve the desired improvement in tree health at the grower level, and may impair the prioritization of research to advance additional solutions.

Action: Establish improved productivity as an overarching factor as research project results are evaluated and decisions are made on subsequent research and delivery programs. Prioritize research that is likely to directly affect productivity. Deliver the planned grower play book as soon as possible to guide growers in use of the best available tactics. Include research focused on establishing mechanisms responsible for lower productivity in portfolio review and requests for additional research, linking the declines in productivity with disease as affected by grower practices and disease management strategies.

Gap #2: Priority A. Citrus HLB (Greening): Sub-element 9. Culturing CLas as an important tool for developing solutions to HLB.

Discussion: The inability to culture the causal agent of HLB has limited research progress. Although there are continuing efforts funded by the USDA, limited progress has been made that will provide this research tool to the community.

Action: A concerted effort should be made to learn from culturing efforts to date and foster an organized approach to achieve this goal. There are available resources that can be directed to assist in this effort. The NAS study should be encouraged to recommend how to accelerate current efforts to culture the bacteria.

Gap #3: Priority B. Post-Bloom Fruit Drop: Sub-element 1. Rainfastness of PFD treatment products for use in preventing PFD losses at bloom.



Discussion: Research here in Florida and in other locations (e.g., Brazil) have demonstrated the critical importance of delivering fungicides to citrus during vulnerable periods to prevent widespread infection by *Colletotrichum*, leading to PFD. A range of materials are available, and previous research has pinpointed the relationship between bloom phenology, timing of rainfall events, and the incidence of disease. Control recommendations highlight the need to place fungicides on susceptible flower tissues at precise times, often coincident with rainfall. Seeking rainfast products may be as important as expanding the breadth of products available to suppress PFD.

Action: Developing formulations or specific products that were rainfast would greatly expand the ability of growers to control PFD during infection periods. The extended period of effectiveness is one benefit, but also the ability to apply immediately prior to rainfall episodes would strengthen grower ability to protect larger acreage.

Gap #4: Priority G. Citrus Black Spot: Sub-element 1. Life Cycle and Epidemiology as it affects both spread dynamics and treatment development and recommendations. Impact of single infected tree. Better detection of ascospores to confirm life cycle. Cooperation with Brazil in evolution of management tools and epidemiology.

Discussion: Citrus Black Spot has continued to expand in Florida, although at a controlled rate. The pattern of spread experience in Brazil predicts that more aggressive expansion might be expected at some point. Current regulatory and grower initiated practices are in place to slow the spread, but advanced understanding of the disease in Florida might better inform if we are doing enough/too much to interfere with disease spread. Research results from Florida indicate unique characteristics of the pathogen here, and additional research may clarify what this means in terms of spread dynamics and control.

Action: Engage the new group of plant pathologists to join with current researchers (primarily Dr. Megan Dewdney) to expand the research goals to include addressing the issues identified here. Having science-based information to assist regulatory action is vital. It is recommended that international counterparts be engaged in planning and serve in cooperative roles in ensuing research. Brazilian citrus scientists and growers have been addressing CBS for a lengthy period, and we should formalize the relationships to learn from their experiences.

Gap #5: Priority K. Integrated Pest Management: Sub-element 1. Develop rust mite control under intense psyllid control. Limited materials available, potential resistance.

Discussion: The situation with citrus rust mite in Florida has been largely ignored from a research perspective since HLB took center stage. Despite that shift, injury and losses to rust



mite continue. HLB interventions in general do not automatically cover rust mite management needs, and in an environment where input costs are escalated, rust mite management has not kept pace. The issues of limited materials available and the potential for resistance development are among the targets for further research.

Action: Establish a rust mite working group to investigate, update, define recommendations in the presence of HLB and current pest/disease treatments. This group of researchers, production managers, and perhaps registrants could define opportunities and needs, and might encourage a group effort leading to a set of rust mite research priorities.

Gap #6: Priority L. Emerging Pests and Diseases: Sub-element 1. Develop a rapid response/proactive approach to future exotic pests and diseases, with particular focus on Citrus Leprosis and Citrus Variegated Chlorosis (CVC).

Discussion: Use of multi-pest survey to address these (and other) diseases has been a component of CHRP, but this may need to be strengthened. There also is a need to increase local awareness of exotic diseases, including the disease biology/epidemiology, as well as practices and treatments that might be applied if disease occurs. We have learned with HLB that proactive information gathering will contribute to a quicker response.

Action: Knowing that exotic citrus pests and diseases are on the move, and include serious diseases such as CVC and Leprosis, Florida citrus should organize a more comprehensive proactive program for exotics. This effort necessarily needs to be multi-agency, and through research should import knowledge from other industries impacted by the target diseases. Research collaboration/participation in areas of occurrence of target exotics is one way to address the needs of Florida. Results should include advanced recommendations for early response to an exotic find, and should offer pre-emptive next steps to respond to a detection in Florida. Numerous mechanisms exist to strengthen preparation for a new disease find, and they should be employed to bring together the appropriate components to address this need.



A Key to Interpreting the 2013-14 U.S. Citrus Research Inventory, Appendix II

This description of the Research Inventory served as a reference as IRCC analyzed the research inventory and identified research gaps. It is included here to describe how the inventory of citrus research projects was assembled and summarized in the attached spreadsheet, Appendix II

Data Sources for the Research Inventory

Whenever possible, existing data sources were mined for this information, with help from institutional research leaders. The information represents the most currently available information, and was harvested in a way that allows us to periodically update the spreadsheet as new information becomes available. The primary sources of data included here are:

- CRDF project database, inclusive of all currently active projects funded by CRDF. This does not include any pending proposals. Projects recently completed (in June 2014) are included here.
- California Citrus Research Board (CRB) funded projects. This project information is hosted on the CRDF webpage in collaboration with CRDF and CRB.
- Texas Citrus Production Board (TCPB) funded projects. Likewise, this project database is hosted on the CRDF website.
- USDA, NIFA SCRI Citrus Disease Research and Education Funding Program; AFRI and other USDA Funding Programs
- USDA, APHIS, HLB Multiagency Coordination (MAC) Group funding program for “shovel-ready” solutions to HLB.
- UF, IFAS sponsored research database.
- USDA ARS Horticultural Research Laboratory.
- FDOC research projects database.
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There likely are active citrus projects not represented here, but this inventory is fairly comprehensive of research conducted in and for Florida. We will continue to update this inventory as data are available, particularly research projects from other citrus states, as well as international research efforts.

How is the Research Inventory information organized in Appendix II?

Most of the data structure is self-explanatory, but here is a key for the spreadsheet columns:

- A. Project Principal Investigator (PI)– the lead on the project
- B. PI Affiliation – The institution of the PI
- C. Project Title



- D. Total Project Funding
- E. Project Begin Date
- F. Project End Date
- G. Objectives
- H. Sponsor – Who is providing the funding for the research project?
- I. Project Topic

The project inventory is sorted and presented according to the IRCC priority and sub-priority that it addresses. Nearly all projects were assigned to an IRCC priority, and in some cases, a second priority was assigned as appropriate. Projects were sorted by priority and sub-priority in the spreadsheet. In this way, all projects addressing a given priority are together in the spreadsheet, and separated from others by the title rows.

What do the colors used in Appendix II mean?

- Primary IRCC Priority Labels are bolded and the row is colored orange
- IRCC Sub-priority labels also are bolded and color coded in lighter orange.

What are some of the other issues?

You will notice some priorities for which there is no project inventory listed. This also is true of some sub-priority areas for which no projects were identified. At the bottom of the spreadsheet are several projects that do not appear to address any IRCC priorities.

Due to the intentional duplication of some records in the inventory described above, it is not appropriate to assign precise sums of funding or total numbers of projects. Thus, we have not provided any statistical treatment of the inventory. It is preferable to review the content and determine if a research gap exists rather than rely on funding totals or number of projects to establish gaps

What was involved in the Research Gap Analysis?

The next step with the updated priorities and the sorted research inventory in hand was to identify the research gaps in meeting industry priorities. IRCC meetings were held to discuss and draft the group gap analysis, with individual committee members having an opportunity to begin identifying gaps in advance of the committee meeting. In addition to identifying potential gaps, consideration was given to what to do about the gap. The gap was characterized and potential actions to resolve each gap were discussed.

The ultimate goal for the Research Gap Analysis was to complete a report of recommendations to include the following for each gap identified:

- Characterization of the research gap
- If the gap was identified last year as well, what has been the progress in addressing it?



- The IRCC recommendation on what can be done to address the gap (commitment of funding, administrative attention, facilities, leadership, etc.)
- Who is positioned to implement the action item(s) identified

