A Simple Math Equation to Describe HLB Research Direction

By Harold Browning

Questions continue to arise regarding what areas of research should be pursued in seeking solutions to HLB. The simplest answer is "any direction that may lead to solutions." Pursuing short-term, temporary maintenance of tree health is critical, as it is the current tree inventory which will provide fruit production until longer term solutions like resistant trees are developed, tested and approved for use. Between these two timetables falls the development of alternatives to reduce Asian citrus psyllid (ACP), and potential "therapies" that may change the dynamics of disease onset in infected trees. With so many research project areas and approaches being investigated, how do they interact?

A simple consideration of the three elements that come together to define HLB disease may help explain why all of these approaches need to be pursued to achieve success, and why it is advantageous to pursue them in parallel. We can offer a math equation which might help illustrate the interactions, with the principal terms being:

- Transmission by vector populations: the numbers of psyllids in citrus groves
- Inoculum: amount of Candidatus Liberibacter asiaticus (CLas) bacteria present
- Susceptibility of citrus rootstocks and scions

Simply stated, **HLB intensity = Transmission x Inoculum x Citrus Susceptibility**

From 1998 until 2004, Florida had moderate populations of ACP and susceptible citrus trees, but little or no inoculum, so there was little or no disease. In 2005, infected trees were detected, but the numbers of infected trees were low, and thus HLB intensity was low. Progressively, the infection spread and HLB intensity increased dramatically. ACP populations were high, inoculum grew, and citrus plants remained susceptible to the disease.

The goal of HLB research must be to impact HLB intensity by reducing all three of the principal elements.

Incremental success with ACP suppression. This will be accomplished through improvements in use of pesticides, combined with biological control tools, use of attractants and repellents, and novel disruption to ACP populations that build on genetics and understanding biological processes.

Reducing Inoculum. CLas inoculum is high in Florida citrus as a result of increasing percentage of infected trees and groves. Research is attempting to deliver methods to reduce the inoculum pressure by developing therapies based on anti-bacterial materials and chemicals, genetic approaches to interfere with CLas growth and success, and to elicit increased tree defense.

Reducing susceptibility. Citrus susceptibility to CLas leads to broad incidence of disease, and will determine long-term tree response to infection. Through traditional citrus breeding and also search for CLas resistance or tolerance from non-citrus sources, researchers are developing and testing candidates that could lead to rootstocks and scions being less susceptible.

Combined, the 3 terms of the HLB disease equation describe our current situation. Progress in one or more of these areas will contribute to lower disease severity in the equation above. Some solutions are further out, but the implementation of results will progressively drive disease severity down.

Harold Browning is Chief Operating Officer of CRDF. The foundation is charged with funding citrus research and getting the results of that research to use in the grove.