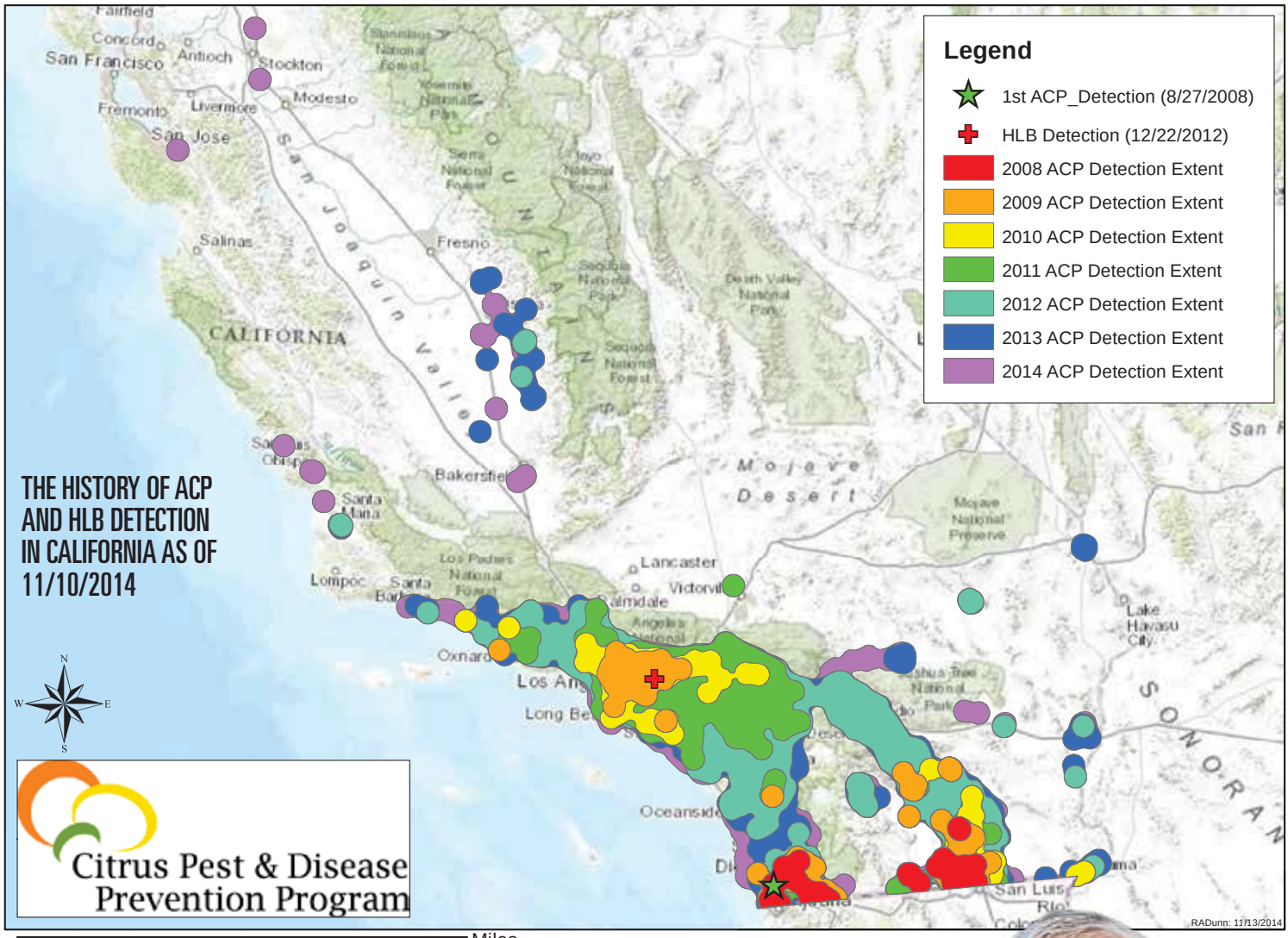

Figure 1. Annual timeline of ACP and HLB detection.

ACP AND HLB DETECTION IN CALIFORNIA

Ed Civerolo

The Asian citrus psyllid (ACP), *Diaphorina* citri, is an important insect pest of citrus. In addition to affecting young leaves directly, the ACP also transmits three species of bacteria, namely '*Candidatus* Liberibacter asiaticus' (CLas), '*Ca*. L. americanus' (CLam) and '*Ca*. L. africanus' (CLaf). These bacteria are closely associated with huanglongbing (also known as greening or HLB).

The ACP was first detected in California in San Diego County in 2008. Since then, distribution of the ACP has increased in Southern California, as well as in coastal and San Joaquin Valley citrus-growing areas. As of November 2014, it has been detected in Fresno, Imperial, Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, Santa Clara, San Joaquin, Tulare and Ventura counties. The yearly timeline for the distribution of the ACP is shown in **Figure 1**.

HLB is an economically serious disease that is a threat to citrus production in many tropical and sub-tropical citrus-growing regions worldwide. Occurrence of HLB has increased in recent years, especially in the United States, South America, Central America and the Caribbean region. Presence of the disease in Mexico also poses increased risk for introduction of HLB-associated Liberibacter bacteria into California.

In 2012, a single, but multi-grafted, CLas-infected citrus tree was found in a residential backyard in Los Angeles County. So far, no additional, confirmed CLas-infected or HLB-affected citrus trees have been found in California. Nevertheless, the presence of the ACP and the finding of a single CLas-infected citrus tree in the state pose a serious economic threat to the more than $2 billion California citrus industry, as well as to residential citrus growing.

Detecting and managing the ACP are critical for preventing its spread and establishment to non-infested citrus-growing areas or regions in California, thereby also preventing or limiting the spread of HLB-associated Liberibacter bacteria and establishment of HLB in California. In addition, it is important to detect and remove any CLas-infected or HLB-affected trees as quickly as possible before the ACP acquires and disseminates the HLB-associated Liberibacter bacteria. However, detection of CLas-infected or HLB-affected citrus trees is difficult. Prolonged incubation (i.e., up to several months or more depending upon a number of biotic and abiotic factors) following infection before detectable levels of Liberibacter are reached in infected plants, incomplete or non-uniform systemic distribution of Liberibacter within infected trees, and a prolonged period (i.e., one year or more) for characteristic HLB symptoms to develop all serve to limit early detection of infected trees by laboratory testing. Adult ACPs are tested for Liberibacter in the laboratory, as they can lead to potentially Liberibacter-infected trees. Laboratory tests for CLas-infected or HLB-affected trees based on citrus host responses to infection or disease development are being evaluated, but have not been validated to date.

Research is being conducted to develop early (i.e., pre-symptomatic) HLB and CLas detection technologies and platforms for diagnostic use in the field and laboratory. Promising technologies for the early detection of HLB are based on detection of citrus host responses specific to CLas infection or HLB disease development (e.g., production of volatile organic compounds or VOCs, small and micro RNAs, proteins, metabolites, hyper-spectral imaging). In addition, indirect detection of CLas by serology is based on assaying for specific CLas-secreted proteins that are distributed within the plant following infection. Efforts are underway to validate these methods under both environmentally controlled and field conditions.

The California Department of Food and Agriculture manages an extensive ACP and HLB surveillance program. In both residential areas and commercial groves, field inspectors examine citrus trees to find live adult ACPs. Yellow sticky cards are hung in trees to capture adult insects. Other ACP management tactics to prevent the spread of the insect include establishment of quarantine zones in areas around ACP finds, chemical control via foliar- and soil-applied insecticides, and development and implementation of potential biological control agents (e.g., predators and parasites that feed on different ACP life stages). A parasitic wasp, *Tamarixia radiata*, has been released at several sites in Southern California and is currently being evaluated for its effectiveness in reducing the ACP populations.

The CRB will continue to work with other pertinent government agencies and universities to seek new, innovative and effective methods for combatting this serious threat; and we will continue to keep you updated in the pages of *Citrograph*.

Ed Civerolo, Ph.D., is interim president of the Citrus Research Board.