Small Plays Have Big Impact

By Rick Dantzler, CRDF chief operating officer

It has taken a while for me to get a sense of why research takes so long, but I'm beginning to understand. A baseball analogy comes to mind. Most runs are scored with a series of base hits and smaller plays. Homeruns make a bigger splash, but base hits, steals and sacrifice flies score more runs.

And so it is with research. Occasionally something truly huge happens, but usually it is a series of smaller discoveries that leads to something growers can use. Take, for example, the relationship between root loss and bicarbonate as a factor that limits nutrient uptake.

In 2011, researchers knew that Liberibacter infected structural and fibrous roots, but how quickly the bacterium moved to the roots after initial infection in the leaf shoots was unknown. Greenhouse studies indicated that the bacterium moved to the roots before infecting the shoots. Researchers suspected that this infection caused rapid decline of fibrous root integrity, but weren't sure. They noted that even if aboveground symptoms appeared to be reduced by enhanced nutrition, damage to fibrous roots was still occurring. Hence, it was concluded that root health must be an integral part of any HLB management program.

In 2012, surveys determined that Liberibacter in roots was capable of multiplying and moving to other root tissue, causing significant root density loss *before* any indication of aboveground HLB symptoms or disruption of phloem in the shoots.

In 2013, researchers discovered that greater stress in HLB-affected trees was occurring in groves planted in poorly drained soils and/or soils high in calcareous materials (high levels of calcium and magnesium bicarbonate, which increase alkalinity). Even soils low in calcareous materials were stressing fibrous roots if irrigated with water high in bicarbonates. Bicarbonates were building up in the root zone and reducing root mass density, resulting in less tolerance of HLB.

In 2014, researchers confirmed a relationship between fibrous root density and reduction in fruit yields when irrigation water was in excess of 100 parts per million bicarbonates and soil pH greater than 6.5. This was determined to be because high bicarbonate in the irrigation water was causing lower root density than irrigation water low in bicarbonate. At the same time, it was discovered that acidification of soil or water reduced root zone pH and promoted release of calcium (Ca), magnesium (Mg), zinc (Zn), manganese (Mn) and iron for root uptake, improving leaf color and reducing twig dieback.

In 2015, it was determined that soil and leaf Ca and Mg were declining because of enhanced acidification. Mining of these nutrients from the soil was occurring, making them less available for uptake by the tree, so annual soil and tissue samples are now recommended to determine Ca and Mg requirements.

In 2016, researchers confirmed that acidification to reduce pH below 6.0 increased leaf levels of Ca, Mg, Mn and Zn, and increased yield. Better nutrient management practices followed. Today, fertigation mixes or slow-release fertilizers containing supplemental micronutrients, along with soil applications of Ca sulfate (gypsum) and Mg sulfate (Epsom salts), are recommended. And it was a number of small discoveries along the way that taught us this.

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