Minirhizotrons are used to measure root growth.

Root depth isn't what it used to be

By Evan Johnson, Tanyaradzwa Chinyukwi, Lorenzo Rossi and Davie Kadyampakeni

Huanglongbing's (HLB) detrimental effect on roots has changed how we think about root health and horticultural management of citrus in Florida. As part of the work studying nutritional responses described in this issue of Citrus Industry (see page 20), we are studying the effects of macronutrient and micronutrient fertilization on root health.

MEASURING ROOT HEALTH

The most common way to estimate root health is root density with soil cores. This gives a snapshot of the root uptake capacity in the sampled soil, normally the top 10 inches in microjet-irrigated citrus. In this study, we used minirhizotrons (clear plastic tubes) with a root scanner to measure root growth and dieback monthly. Measurements started about six months after the fertilizer treatments began.

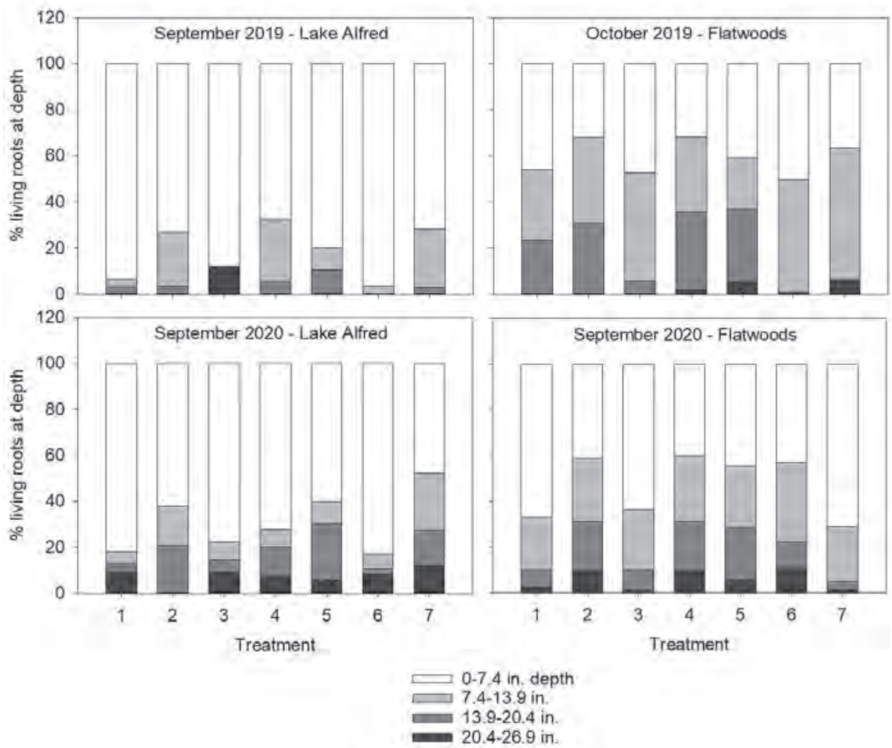
These minirhizotrons are about 39 inches long and allow the user to see deep under the tree to observe root growth. The angle of installation allows users to observe the wetted zone and any roots (including the tap root) growing down two to three times deeper than a standard soil core allows. This lets us look at multiple factors of root health. We can determine the seasonal growth and dieback dynamics related to treatments. This can tell us if the root flushes are synchronized, which is a sign of healthier roots. Sporadic root flushes, that often vary from tree to tree, occur when roots are stressed or damaged.

Root dynamics can be used to estimate root lifespan once enough samples are collected. Currently, we only have about one year of fully processed root data. This is not enough to observe clear treatment effects on seasonal root flush timings or root longevity. However, the depth of the minirhizotrons gives us a glimpse of the root system architecture based on the depth of root growth.

EARLY OBSERVATIONS

Different fertilizer programs change the distribution of root depths. We observed this at both the Ridge site and the Flatwoods site, as seen in the graphs 6 and 18 months after treatments began. [Treatment 1 is the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) recommendation.] Unfortunately, the treatments associated with deep root growth varied between sites, thus preventing a clear interpretation of the results at this stage.

Surprisingly, the roots grew deeper at the Flatwoods site than the Ridge site. There are a couple of possible explanations for this. Flatwoods roots are normally limited by the high-water point of the water table. The site used in this study had extremely high beds, which lowered the high-water depth and may have allowed for deeper growth in the richer Flatwoods soil. It might have been influenced by grove management before the study, since we



Percentage of living roots at 0–7.4, 7.4–13.9, 13.9–20.4, and 20.4–26.9-inch depths. Treatments were applied as follows:
1. Control with standard fertilization via fertigation of nitrogen, phosphorus, sulfur, molybdenum and copper according to UF/IFAS guidelines with no extra potassium, magnesium, calcium, manganese, iron, boron and zinc.
2. Standard fertilization + 1x macronutrient (MA) + 1x micronutrient (MI) (soil applied)
3. Standard fertilization + 1x MA + 2x MI (soil applied)
4. Standard fertilization + 1x MA + 4x MI (soil applied)
5. Standard fertilization + 2x MA + 1x MI (soil applied)
6. Standard fertilization + 2x MA + 2x MI (soil applied)
7. Standard fertilization + 2x MA + 4x MI (soil applied)

The 1x and 2x MA refer to UF/IFAS recommendations of the 40 and 80 pounds per acre of macronutrients calcium and magnesium and 220 and 440 pounds per acre potassium. The 1x, 2x and 4x MI refer to 5, 10 and 20 pounds per acre of micronutrients iron, manganese and zinc, and 11, 2, and 4 pounds per acre boron per year, respectively.

observed that nutrient management can alter root depth.

It is too early to know how these changes in root depth affect overall tree health and yield, but we will continue to watch as the trial continues. We will look for correlations between root depth, nutrient status and yield as the fertilizer programs continue. We hope this will provide more insight into what makes a healthier root system in the HLB era.

KEY CONSIDERATIONS

Although it is too early in the field trial to make clear root health claims, there are a few important considerations based on these results. Microjet irrigation concentrates the fibrous root system of healthy trees in the first 10 inches of soil in the wetted zone. This has led to a standard 10-inch soil core for root health assessment in Florida citrus. The lack of a dense fibrous root system may lead HLB-affected trees to change their root architecture to compensate for this loss by growing deeper roots.

Poor root densities from standard soil cores might not always mean poor root health under current conditions. If the near-surface root health does not appear to match the health of the tree, it is worth sampling deeper into the soil to look for additional roots. This is especially important when asking if a change in horticultural practices has improved root health.

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