Variable rate fertilization — getting started

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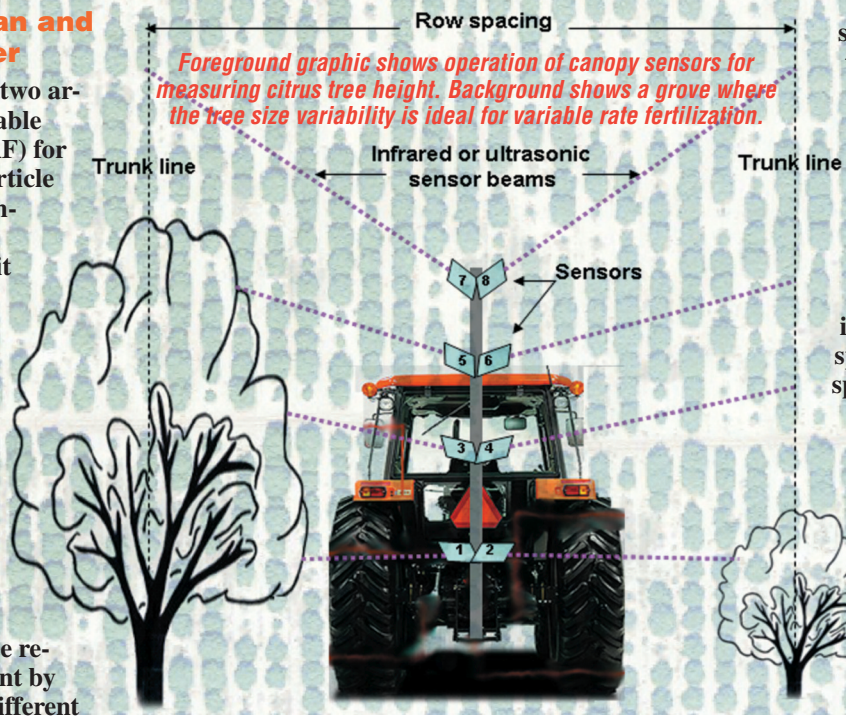

Foreground graphic shows operation of canopy sensors for measuring citrus tree height. Background shows a grove where the tree size variability is ideal for variable rate fertilization.

This is the first of two articles discussing variable rate fertilization (VRF) for Florida citrus. The article will introduce the concept of variable rate technology and how it can potentially impact Florida citrus production. The second article (scheduled for March) will cover suggestions for fine-tuning VRF.

Due to the recent spread of citrus canker and citrus greening in Florida, there will be more tree removal and replacement by nursery trees. With different sized trees in the grove, VRF becomes increasingly important.

Variable rate granular fertilizer spreaders use sensors, computers and GPS technology to continuously monitor citrus trees along the row in order to make adjustments to the rate of fertilizer delivered to each tree. Most importantly, spaces with missing trees are never fertilized, which significantly reduces unnecessary nutrients, fertilizer costs per acre and ground water pollution while discouraging weed growth.

Tree roots, the primary targets for fertilizer applications, are located approximately under the tree canopy. Thus the first assumption of VRF is simply that if a canopy and roots are not present, then fertilizer is not applied. The second assumption of VRF is that small immature resets should get less fertilizer than mature trees.

Since canopy volume is related to tree height and fruit yield, fertilizer rates can be adjusted based on tree height that is measured "on-the-go" by canopy sensors. Each sensor is responsible for a different range of canopy height, and the cumulative sensor result is used by the variable rate computer controller to adjust the fertilizer rate on each side of the spreader. Therefore, a fully grown mature tree will activate all sensors on its side and receive the full fertilizer rate.

Perfectly uniform groves with no gaps between canopies will not benefit from VRF. The VRF technology is most effective in groves with different tree sizes because VRF is designed to exploit that variability. Thus, a grove containing young trees with non-overlapping canopies, or a mixture of large trees, young trees, and/or resets will benefit the most from VRF.

WHAT ARE THE ADVANTAGES OF VARIABLE RATE FERTILIZATION?

- Up to 40 percent immediate fertilizer savings have been measured.
- Less fertilizer per acre means less freight and fuel costs.
- Less refilling of the fertilizer spreader.
- Reduced leaching of nitrate and other soluble nutrients.
- Reduced weed vigor due to lower nutrient availability.
- All trees higher than about three feet can be fertilized with one spreader.
- This smart technology is "green," leading to higher efficiencies, reduced carbon emissions and lower environmental impact.
- Payback of the investment in variable rate equipment is rapid, often in one season.

DISADVANTAGES

Disadvantages of VRF are few. The variable rate technology requires more skilled operators, maintenance and supervision than conventional equipment. With current designs, only dry granular fertilizers can be used, but both controlled release granular fertilizers and dry organic materials can be effectively spread with variable rate spreaders. Since many of the advantages of VRF are also true for liquid fertilizer, work is being done on variable rate technology for liquids in intensively managed fertigation systems that are not included in this article.

GETTING STARTED: ESSENTIAL EQUIPMENT FOR GRANULAR VARIABLE RATE FERTILIZATION

- A split chain fertilizer spreader with hydraulic chain motors and twin spinners with side deflectors.
- Independent regulation of left and right chain speeds with separate hydraulic valves and computer controller channels. Hydraforce® proportional valves and the DICKEY-john Land Manager II® controller are a good match for high performance VRF. The advantages and disadvantages of "dump valves" and "servo valves" will be discussed in the next article.
- A ground speed sensor (GPS, radar or wheel encoder) regulates fertilizer rates according to speed.
- At least one canopy sensor on each side of the spreader. More sensors allow more accurate resolution of tree size and intermediate fertilizer rates with potentially more savings. Single sensors will only save fertilizer where there is no tree but are a great way to start with a simple system. Differences between ultrasonic (e.g. TreeSee) and optical sensors will be discussed in the next article.

When purchasing a variable rate spreader, insist on rapid response times and look-ahead sensing using well-matched components. Before use, the computer controller needs to know

the fertilizer bulk density and the spreader's gate height must be adjusted to match the intended rates and ground speed. The row spacing and target fertilizer rates should also be entered, and the responsiveness of the control system can be set before each side of the fertilizer spreader is calibrated separately by collecting and weighing a sample of fertilizer dispensed by the controller.

Canopy sensor angles need to be adjusted to target the tree heights of interest and to achieve the correct synchronization of sensor signals with fertilizer release rates. Sensors with integrated automatic "look ahead" such as the TreeSee system do not need manual adjustment for synchronization. The rear spinner speed can be adjusted after the hydraulics have warmed up to achieve the desired distance of fertilizer placement in the tree row.

TYPICAL EXAMPLES

A DICKEY-john controller system on a 3-ton fertilizer spreader with four optical sensors per side was programmed to dispense variable rates on the right and fixed rates on the left. The spreader was used in two groves during 2006 and 2007 in order to make long-term comparisons between variable rate and conventional fixed rate fertilization. The Ridge grove shown required 23 percent less fertilizer when using variable rates. Average leaf N in July was similar at 2.89 percent and 2.91 percent for the variable and fixed rate rows, respectively. In a flatwoods grove, 38 percent less fertilizer was used by variable rates and average leaf N were 3.12 percent and 3.27 percent for the variable and fixed rate rows during July.

The greater fertilizer savings in the flatwoods grove was due to the more recent resets lost to CTV. Other leaf nutrients were also not significantly different and very adequate. These examples illustrate typical results of saving 23 percent to 38 percent of fertilizer by growers already using VRF while not detrimentally affecting citrus nutrition.

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