



Count 'Em Up

Yield monitoring systems for citrus mechanical harvesting machines create real-time data for maximum efficiency.

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Collecting yield data is the first step in precision grove management. It provides information that can help growers to make better management decisions. Growers are usually aware of total yield for a given block or entire grove, but yield variability from tree to tree or row to row is unknown. Yield monitors can provide and document the amount of yield variability at a smaller scale and can lead the way to manage the needs of each individual tree rather than treating the entire block of trees uniformly.

The Science Of Counting

Yield monitoring is the process of measuring fruit yield for a given location and integrating it with GPS-obtained coordinate information. A yield monitor consists of several sensors. The main one is the mass or volume flow sensor. Depending on the type, this sensor measures the volume or the actual mass weight of the fruit. Yield monitors calculate yield by dividing the fruit mass or volume flow rate that is passing through a mechanical harvesting machine for a given time by the covered area. The yield monitor uses the information from ground speed sensors along with the actual operating width of the machine which calculates the area covered by the machine for a given time. Finally, the latitude and longitude information that is obtained from a GPS receiver is tagged to the yield data. This information is usually collected and stored on a memory card every second.

There are several commercially available mapping software packages that can read yield data and create a yield map. In addition, the mapping software can overlay the yield variability maps on aerial images of the grove to provide an enhanced visualization of the data. This is helpful to understand the cause of yield variability. Eventually, they can be used to create profitability maps that show where grove profit was maximum or minimum or


which areas lost money. It is also possible to create application maps based on different management zones for different crop inputs.

A typical "string" of yield data contains the following information: Latitude, longitude, mass flow rate, GPS time, logging interval, travel distance, field ID, load ID, variety type, GPS status, quality of GPS data, and altitude.

In addition to yield variability, data obtained from yield monitors contains very useful information for other applications. The yield data can be used to extract machinery management related information such as field efficiency, machine operator performance, total downtime, and actual harvest time. The machine performance information can be very useful to the manager and help in making suitable management decisions to reduce costs and improve the efficiency of operation.

Ahead Of The Curve

Currently, there is not any yield monitoring system commercially available for citrus mechanical harvesting machines. Researchers at the University of Florida/Institute of Food and Agricultural Sciences' Citrus Research and

Education Center in Lake Alfred are currently developing such a system. They are investigating three different mass flow sensing systems to determine the most suitable sensor for the final product. An image-based volume sensing system, a direct weighing system using load cells, and a fruit counting system have been developed and tested under laboratory conditions. A prototype of a direct weighing concept has already been developed and installed on a mechanical harvesting machine to collect field data. The initial results are encouraging, and it is expected that a complete system will be ready by next season. 

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