

Yield Estimation with Digital Photography

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Citrus canopy measurements with ultrasonic and optical sensors are being used in Florida to control the placement and rate of fertilizers and pesticides with variable rate application (VRA) spreaders. Additional refinement of agrochemical VRA may also be possible if fruit yield could be measured and mapped on the tree canopies. In this study we developed a ground-based digital photography - ultrasonic system to non-destructively monitor and map mature fruit yield on orange trees. A color digital camera and DGPS mounted on a moving vehicle was used to capture georeferenced non-overlapping images of tree canopy in entire orchards. Images were stored on a laptop PC and were processed using red-green-blue (RGB) pixel ratios and thresholds to identify and quantify ripe fruit and green leaf pixels in order to estimate yield and canopy health. Tree canopy volume was measured with a mobile ultrasonic array and DGPS. Significant correlations ($R^2 > 0.9$) were achieved between the yield index (% fruit pixels x canopy volume) using the camera - ultrasonic system and the mass of manually harvested fruit in the orchard. Fruit pixel data from the camera and canopy size data from the ultrasonic system were highly synergistic, since the correlation of each individual component of yield data with actual fruit yield was much lower ($R^2 < 0.75$). The nondestructive yield monitoring system has proved valuable for measuring yield in citrus research plots and could be adapted for surveying tree canopy health.

Additional keywords: DGPS, image processing, canopy health