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Make it count with drones

Features - Nursery Equipment

Learn how unmanned aircraft systems are designed to help with plant inventory management.

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James Robbins and Joe Mari Maja



This is the second part of a three-part series. Read the first installment here: www.nurserymag.com/article/drones-in-nursery-production

There are several ways in which drones can be used to collect inventory data in nurseries and they range from simple to more complex solutions. This article reviews some methods.

Plant count from your monitor or photograph

One of the simplest solutions is to use a low cost drone (\$99 to \$750) with an RGB/normal camera to generate images of blocks of plants. Once the aircraft is on the ground you simply download the images to a computer. Assuming you captured the entire block of interest, you can print out the image and count the plants using a low-cost (\$28) digital counter pen (Fig. 1) in a climate-controlled office. The pen places an ink mark on every plant counted so it is impossible to miscount. If your area of interest cannot be captured in a single image you can use stitching software to merge multiple images. There are several options (e.g., Agisoft Metashape, Microsoft Image Composite Editor, Adobe Photoshop, ImageJ) for stitching images together but we have had good luck with Microsoft Image Composite Editor, which is free. For those with more technical skills, you can develop a method to count plants directly off your monitor. Wouldn't it be more fun and comfortable to count plants from a climate-controlled office? There are many advantages to this simple method; it is low-cost, immediately adoptable, you can easily store images for later analysis, almost on-demand or near real-time plant counts, and the method is more likely to give accurate plant counts during spring shipping season when production beds look like Swiss cheese and are difficult to ground count. Another advantage to consider is that when all of this work (i.e., drone flight, image collection and processing) is done in-house, you have no concerns about privacy and image data ownership. A downside of this method is that you cannot judge plant quality and grade; you are simply generating plant count.



Fig. 1. Use of a counter pen (\$28) to manually count plants from an aerial image.

Photos courtesy of James Robbins

Plant count using image-based software

This was the area of study that initially perked our interest in drones. The simplistic thought was we could collect aerial images using a drone that we could later analyze using object-based image analysis (OBIA) software (Fig. 2). Some of this software was developed for military applications to rapidly scan satellite images to identify objects of a specific type (e.g., a tank). The process usually involves training the software to look for objects that you are interested in, which in our case, are plants growing in either fields or containers. You typically segment out objects such as the ground cover or weeds

to simply focus on the plants of interest. Our research at the University of Arkansas evaluated two commercial software packages (eCognition, Feature Analyst) and a counting algorithm developed by a graduate student at the University of Florida. Our paper in the Southern Nursery Association (SNA) Research Conference in 2015 summarizes our progress up to that point compared to traditional manual methods under nursery conditions (sna.org/resources/Documents/15resprosec03.pdf).



Fig. 2. Illustration of container plant count using OBIA software.

Several companies offer plant counting services (e.g., DroneDeploy/Agremo, PrecisionHawk) for aerial images. Before you go down this route, there are few things to consider. One, make sure the image processing service has the experience counting nursery crops. Many of these services have honed their algorithm for row crops such as corn and soybean. You also want to know how well their software counts plants when the canopies are overlapping which is a common situation in nurseries.

Before engaging an outside service, you would also want to be clear ahead of time what kind of specifications they require in images (e.g., minimum number of images, resolution, format) and the limitations of their software. Keep in mind that you may not retain the rights to the information in your aerial images when they are processed by outside companies.

Plant count from RFID tags and a drone



Fig. 3. Merging RFID tags with a sUAS for plant inventory.

For several years this has been our vision to sweep over beds of nursery-grown plants with RFID tags to quickly and accurately generate plant count (Fig. 3). The delay has always been finding a small RFID reader (interrogator) that could be carried by a small drone. Just in the past two years we finally found readers that were suitable for our application. To work on this approach, we put together a team of researchers in collaboration with industry representatives (e.g., Avery Dennison). The project, which is partially funded by a grant from the Horticulture Research Institute (HRI), was supposed to start at

McCorkle's Nurseries in Dearing, Georgia, in March 2020 but has been postponed until 2021 due to COVID-19. The team has built a prototype system and performed preliminary testing of RFID tag transmission. An overview of our preliminary work was posted by the Southern Region of the International Plant Propagators Society (<http://bit.ly/SRIPPS-drones>). The general concept of merging sUAS with RFID has already been applied in applications such as indoor warehouses and outdoor car lots. Nurseries provide unique challenges that need to be investigated since there is water, dirt and foliage that can all influence RFID tag signal transmission. Integrating RFID tags will allow traceability of production information to crops from the moment they are tagged until they leave the production facility and beyond. The team also has an interest in collaborating with Arbre Technologies to evaluate gathering their Caliper-RFID data using a drone. A company in California (Senitron: senitron.net/rfid-plant-nurseries-autonomous-drones) advertises that they have already developed a system for nursery producers that merges a drone with RFID tags. The development of an automated plant counting tool for the nursery industry could decrease labor inputs, increase precision and save money.

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About the authors: Dr. James Robbins is professor and extension specialist at the University of Arkansas System, Division of Agriculture, jrobbin@uark.edu; Dr. Joe Mari Maja is assistant professor and research sensor engineer at Clemson University's Agricultural Sciences Department, JMAJA@clemson.edu.

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