New Generation of Precision Sprayers[©]

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In August 2013, OMAF and MRA invited representatives from the USDA's Agricultural Research Service and Ohio State University to demonstrate a new way to spray. The "Intelligent Sprayer", developed by a team led by Dr. Heping Zhu, was trialed for 40 nurserymen and industry reps during a day-long workshop at J.C. Bakker and Sons Nursery in St. Catharines, where attendees learned about the sprayer and about how they can improve coverage in their own operations.

Given the range of crops nurserymen grow; it is very difficult to achieve effective and efficient spray coverage with only one or two sprayers. The volume of spray, ground speed of the sprayer, and the orientation and volume of air required is significantly different when spraying whips, flowers, shrubs, or container crops. Therefore, to get efficient coverage every time they spray, the operator must re-calibrate the sprayer every time they move into a new crop. This is difficult, time consuming and in most cases, not feasible.

Fig. 1. The Intelligent Sprayer.

Dr. Zhu's variable-rate, air-assisted sprayer (Fig. 1) meets the challenge by automatically adjusting the spray volume in real time based on the plant height, distance from the sprayer and the density of the crop canopy. This is not like an airblast sprayer with electronic "eyes" that turn sections of the boom on or off. The Intelligent sprayer employs a single laser sensor and onboard computer to determine exactly how much pesticide is needed from each of 40 independently-controlled nozzles. The nozzles use solenoids to switch rapidly between on and off positions. This "pulse width modulation" allows the sprayer to apply just enough spray without recalibrating the sprayer. Five Intelligent Sprayers are operating in the USA right now. To date, they have reduced spray loss beyond tree canopies by 40-87%, airborne spray drift by up to 87%, spray loss on the ground by 68-93%, and spray volume by 47-73% in a growing season.

To demonstrate the intelligent sprayer, water-sensitive paper targets were placed deep inside the canopy of trees and shrubs as far as 20 ft from the alley (Fig. 2). These yellow

targets turn blue when sprayed. The Intelligent sprayer was pitted against the nursery's overhead boom sprayer and airblast sprayer. Papers were retrieved and replaced after each sprayer finished its pass. In almost every case, the Intelligent Sprayer achieved better coverage and less off-target waste with less spray, compared to the conventional sprayers (Fig. 3).

Fig. 2. Papers placed deep in canopy.

Unfortunately, the Intelligent Sprayer is not for sale at this time. The prototype cost more than $21,000.00 in parts, alone. However, there are things operators can do to improve the efficacy and efficiency of their current sprayers.

Ontario Ministry of Agriculture, Food (OMAF) and MRA have been testing crop-adapted spraying, which is a new method of optimizing airblast applications in orchards. This method is a series of sprayer adjustments to match the sprayer calibration to the size, shape, and density of the crop. Growers have reported pesticide savings of 20% or even 50% in apple orchards, with no significant difference in pest control compared to control blocks sprayed with conventional methods. Here are a few key points on how a spray operator can make their sprayers more "intelligent":

1) Use water sensitive paper as a cheap and easy way to assess spray coverage. Place papers in hard-to-reach areas to give a true assessment of what you are hitting and what you are missing. Papers can also be placed beneath and beyond the crop to assess wasted spray.

2) Tie a 25 cm length of flagging tape to the far side of the target canopy. As the sprayer passes, have a partner assess how the flagging tape behaves. The goal is to only just move the ribbon. If it stands our straight, you are using too much air. If it does not move, spray is likely not penetrating the canopy. You can then modify your practices

according, such as: changing your ground speed, changing your fan gear, or if you are using a positive displacement pump you can change your tractor gear (gear-up, throttle-down) to change fan speed.

3) To ensure each nozzle is operating correctly, perform a timed output test (i.e., collect spray for 1 min to determine the rate). Use in tandem with the water-sensitive paper, you may have to switch to a nozzle with a different rate.
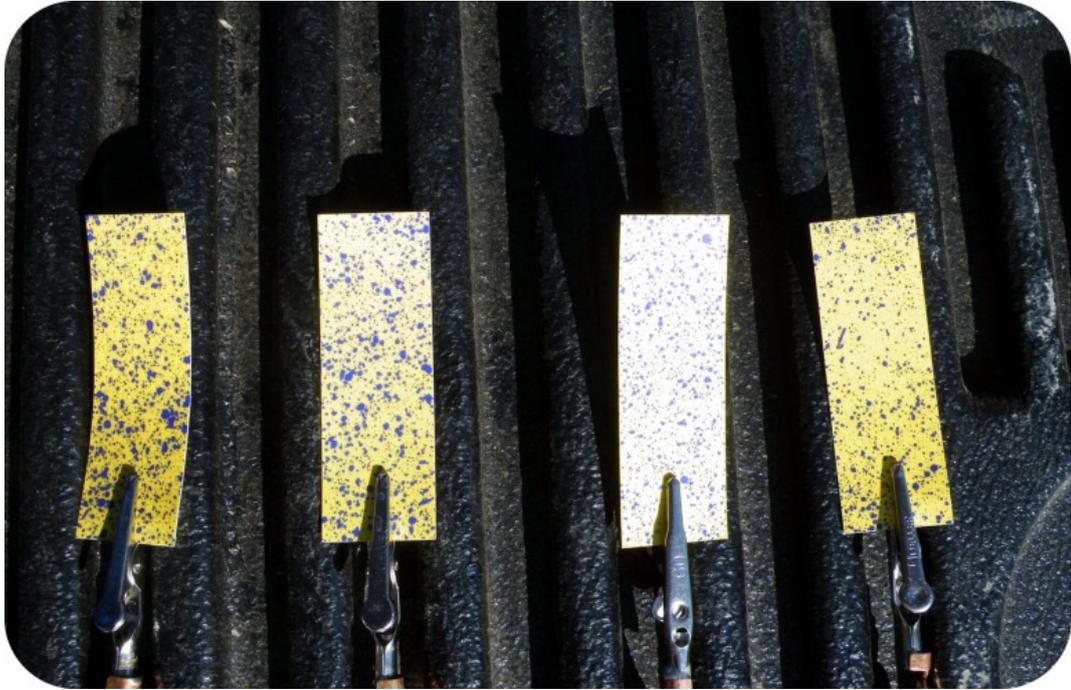

Fig. 3. Excellent coverage from Intelligent Sprayer.

   Minimally-acceptable coverage on water-sensitive paper is 85 discreet drops per square centimetre and at least 10% of the paper covered with spray. If you are getting more than that, you should consider keeping your tank mix the same, but spraying less per hectare. If you are not achieving that coverage, spray more per hectare, but never exceed the label rate. The Intelligent Sprayer clearly showed that a sprayer calibrated to achieve the "right" amount of coverage reduces spray waste and improves coverage. Until it is commercially available, spray operators will have to make changes to their existing sprayers, and how they use them, to get similar results.

   We are developing an app for operators to try it themselves. That information, a description of the steps for making any sprayer more effective, and so much more can be found at: www.sprayers101.com.