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—Scientific Note—

PAPS: A Portable and Adjustable Prototype Sprayer to Analyze Fungal Biopesticide Deposition In the Greenhouse

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When evaluating spray leaf coverage of fungal-based biopesticides for insects associated with Huanglongbing management in citrus, a significant amount of data is needed to: 1) analyze the efficiency of the sprayer in applying a uniform amount of biopesticide, and 2) evaluate the biopesticide efficacy for management of pest populations. To collect this data, it is necessary to have controlled environmental and field conditions. These parameters which include the absence of wind, availability of the spraying machine, field management strategies, etc. significantly increase the cost and time required to obtain meaningful research outcomes. In addition, cost-efficient sprayer devices that can simulate the spraying patterns of field machines in a lab setting are not available. The goal of this study was to develop a cost-efficient portable and adjustable prototype sprayer (PAPS), that can be used under controlled environmental conditions, including laboratory and greenhouse, for the evaluation of biopesticide leaf coverage.

To define the spraying simulation patterns in PAPS, two commonly used sprayer machines for citrus management applications were selected the air-blast (AB) sprayer and ultra-low volume (ULV) sprayer. AB is characterized in distributing the pesticide by creating a wind blast hitting the leaves under a specified pressure and, ULV by producing a mist of very fine droplets of pesticide directed through a set of ventilators.

To assess the feasibility of PAPS, we calibrated multiple variables including droplet size, air speed, and pesticide incidence angle. The initial calibration of the AB and ULV spray application machines was performed at the Florida Research Center for Agricultural Sustainability (FLARES) in Vero Beach, FL. The conditions used by crop managers in a commercial citrus field were reproduced. Calibration of PAPS was performed at the University of Florida, Indian River Research and Education Center (IRREC), in Fort Pierce, FL, under greenhouse conditions. Sensitive paper and a handheld anemometer were used for the collection of droplet size-distribution and air speed data, respectively. Measurements were collected at a wall with sensitive paper located 2.1 m from the prototype application device. The sensitive paper was placed following a quadrant across the PAPS nozzles wet pattern. Preliminary results using water showed that, based on droplet size estimations, this prototype can represent the conditions of the AB and ULV sprayer in the laboratory or greenhouse. A summary of the field and the prototype sprayer calibrations are presented in Table 1.

The observed spray droplet sizes were within the range of 131.6 to 390 μm and 31.6–139.3 μm for PAPS-AB and PAPS-ULV, respectively. This confirms that PAPS can accurately represent the conditions of the AB and ULV field application machines. It is important to understand that if the distance from PAPS to the target is modified, the pressure and droplet size would be modified as well. Results of air speed tests indicated that the average difference in speed between AB and ULV for both the field application machines and PAPS is nearly 30%. Values in PAPS are lower due to the reduction in scale from the field application machines. The implementation of PAPS in the greenhouse is a cost-effective and time saving solution to gather sprayer efficiency data, determine leaf coverage, and indirectly evaluate the effects of biopesticides for management of pest populations. A 360 visualization of PAPS can be found at: <https://www.youtube.com/watch?v=T0jMVDacXek>. Future work includes the evaluation of the relationship between changes in incidence angle and leaf coverage, and laboratory assessment of pest control comparing the field machines with PAPS.

Table 1. Sprayer calibration results of air blast (AB) and ultra-low volume (ULV) sprayers in the field vs. portable and adjustable prototype sprayer (PAPS) calibration results (PAPS–AB and PAPS–ULV) using water.

Parameter	AB	ULV	PAPS–AB	PAPS–ULV
Droplet size (μm)	131.6–390	31.6–139.3	200	110
Air speed (m/s)	53.65	41.12	4–15	6.71

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