Effect of Image Binarization  
on Drop Diameters Measurement

Salvatore Privitera, Emanuele Cerruto\*, Domenico Longo, Giuseppe Manetto

Department of Agriculture, Food and Environment (Di3A), Section of Mechanics and Mechanization, University of Catania, Via Santa Soﬁa, 100, 95123 Catania, Italy.

Corresponding author: [emanuele.cerruto@unict.it](mailto:emanuele.cerruto@unict.it), Tel. +390957147514, Fax. +390957147605

**Keywords.** Image analysis, Threshold, Droplet spectrum, Pesticide application.

**Abstract.** The measurement of droplet size spectrum of nozzles is a very complex task that has been addressed in multiple ways over the years. Referring to agricultural nozzles for pesticide applications, the drop size affects both biological efficacy of a phytosanitary treatment, environmental pollution, and operator safety. According to the International Standard ISO 25358, the droplet size spectrum can be measured with any non-intrusive measuring system, appropriate for the range of droplet size and velocity. Examples of non-intrusive systems are Phase Doppler Particle Analyzers (PDPA), laser diffraction, and imaging principles (also known as shadowgraphy methods). Intrusive methods are also quite common in the literature, which include the liquid immersion technique and the use of Water Sensitive Papers (WSP).

Both intrusive and non-intrusive techniques allow measurements with different degrees of uncertainty and each measurement method produces results significantly different, depending on measuring protocol, settings and type of measuring equipment. Measurement methods based upon image analysis, such as high-speed imaging, WSP and liquid immersion, have to solve the problem of recognizing the drops and separating them from the background. This is known as “binarization” or “segmentation” of the image, and usually it is accomplished by setting one or two (upper and lower) cut-off value(s), referred as threshold, separating specific pixel intensities from each other. The choice of the threshold value is a key aspect and it may be manual or automatic, by applying different algorithms.

In this research the drop size spectrum of an air induction hollow cone nozzle TVI 8002 at the pressure of 1.0 MPa was studied. Measurement of the drop size was based on the liquid immersion method. A starting threshold value was selected based on the average gray level of the image. Variations of ±5% with steps of 1% were considered and their effects on the measured volumetric diameters were analyzed. The first results showed that the corresponding variations of volumetric diameters ranged from -0.20% to 0.16% for Dv01, from -0.03% to 0.85% for Dv05 and from -0.52% to 1.03 % for Dv09. This means that, once the image acquisition system is established, the binarization process may be made automatic and operator independent.