

SPRAY PATTERN AND DROPLET SPECTRA CHARACTERISTICS FROM AN ACTIVELY CONTROLLED VARIABLE-ORIFICE NOZZLE

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ABSTRACT

As variable-rate pesticide application technologies are further developed, maintaining proper nozzle flow rate, spray pattern, and droplet size distribution is critical for ensuring proper pesticide application rates. The VariTarget (VT) nozzle reacts to changes in system pressure via a metering assembly attached to a diaphragm and spring to control spray pattern and droplet size distribution. The goal of this study was to look at the impact of alternative orifice size control scenarios. The proposed system would be able to control carrier flow rate (at a constant pressure) by adjusting the position of the metering assembly within the variable-orifice nozzle tip. Nozzle discharge was collected to determine the resulting spray pattern distribution. Droplet spectra tests were also conducted to determine the effects of different metering stem settings on droplet sizes. Preliminary results indicated that spray patterns were acceptable for different orifice sizes and droplet spectra were preserved as well.

Keywords: precision agriculture, pesticides, variable rate application, spraying equipment, nozzle

INTRODUCTION

The VariTarget (VT) nozzle reacts to changes in system pressure via a metering assembly attached to a diaphragm and spring to control spray pattern and droplet size distribution. This study was conducted to determine the impact of alternative orifice size control scenarios. The proposed system controlled carrier flow rate (at a constant pressure) by adjusting the position of the metering assembly within the variable-orifice nozzle tip. Nozzle discharge was collected on a spray pattern test stand in conformance with ASTM E641-01 (ASTM, 2006) to determine the resulting spray pattern distribution for nozzles at a 51 cm spacing. Droplet spectra tests were also conducted to determine the effects of different metering stem settings on droplet sizes. These tests were conducted using a laser diffraction particle analyzer (2600, Malvern, Worcestershire, U.K.) with a 600 mm lens. All droplet spectra tests were performed in accordance with ASABE S572.1 (ASABE, 2009).

RESULTS AND DISCUSSION

An example of the data collected during spray pattern testing is shown for three test trials, results were consistent between tests (Fig. 1).

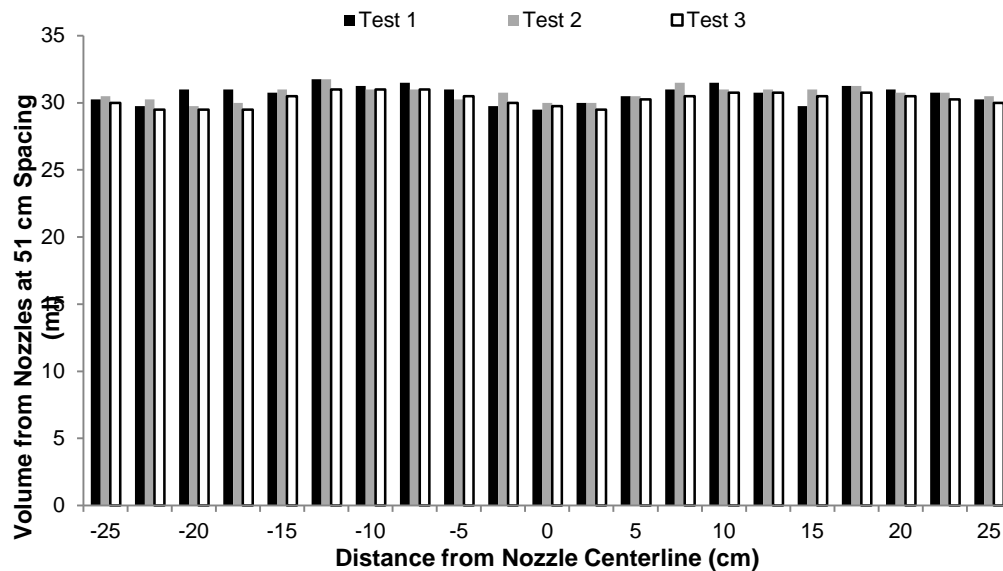


Fig. 1. Spray pattern distribution at 207 kPa; metering stem position of 1.83 mm.

Spray pattern CVs were plotted versus metering stem position and carrier pressure (Fig. 2). CV values were shown to be acceptable ($< 10\%$) for all metering stem positions at carrier pressures ranging from 138 to 414 kPa.

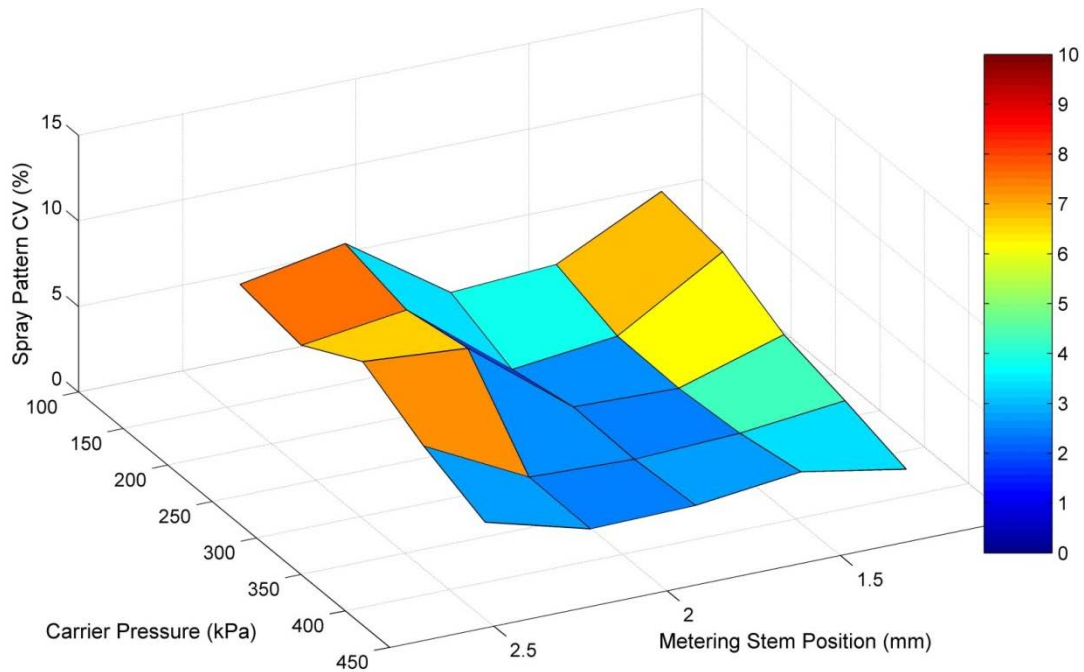


Fig. 2. Average spray pattern CV values versus metering stem position and carrier pressure at 51 cm spacing.

Droplet spectra classification values for the metering stem positions and carrier pressures are shown in Table 1. These data show that droplet spectra were slightly affected by changes in carrier pressure and metering stem position. As expected, smaller particle sizes were produced from the nozzle as carrier pressure increased. The original VT nozzle configuration was developed to ensure constant droplet spectra (very coarse) for the green cap used in this study (Delavan AgSpray Products, 2011). While the measured droplet spectra indicated slightly larger droplets, values were generally classified as extra to ultra-coarse for a set carrier pressure. This result indicated that the potential for spray drift would be very low across these operating pressures.

Table 1. Droplet spectra classification at test carrier pressures and metering stem positions.

Carrier Pressure (kPa)	Droplet Spectra Classification Category [†]				
	Metering Stem Position (mm)				
	1.22	1.52	1.83	2.13	2.43
138	UC	UC	UC	UC	UC
207	UC	UC	UC	UC	XC
276	UC	UC	XC	XC	XC
345	UC	XC	XC	XC	XC
414	XC	XC	XC	XC	XC

CONCLUSIONS

The results from this indicated that modified metering stem position control could result in acceptable spray patterns for carrier pressures ranging from 138 to 414 kPa (51 cm nozzle spacing). Droplet spectra were generally consistent for a set carrier pressure (ranging from 138 to 414 kPa) but were slightly higher than the advertised very-coarse classification for the green VT nozzle cap.

REFERENCES

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