Comparing Greenhouse Sprayers: The Dose-Transfer Process

Pest-control application equipment should be evaluated based on our understanding of the dose-transfer process. Optimal efficacy has been tied to spray droplet size, and, in some cases, application equipment that produces small droplets can improve efficacy. A sprayer can influence efficacy by changing droplet size, density, velocity, and in some cases trajectory. Changing application volume also affects these factors and changes the physio-chemical characteristics of the liquid, altering the retention and diffusion rates.

Three sprayers were evaluated for their influence on retention and efficacy: a carbon-dioxide-powered high-volume sprayer, a DRAMM coldfogger, and an Electrostatic Spraying System (ESS) with air-assistance. The active ingredients used were spinosad and azadirachtin. The plant canopy was constructed in the greenhouse using potted soybeans. Application efficacy with spinosad was assessed using thrips and mite abundance on shoots and leaves while azadirachtin was assessed using thrips and aphid abundance on shoots and leaves. The atomization characteristics of each sprayer were measured using an Aerometrics phase/Doppler particle analyzer (PDPA) 100-1D. The results of four tests are presented. Two tests used each sprayer according to manufacturer recommendations. These are 'recommended volume' tests that confound differences in toxicant distribution caused by the sprayer with differences caused by changes in application volume. The other two tests were 'constant volume' tests in which all three sprayers were used to deliver the same application volume. Both types of test gave differences between sprayers in retention of toxicant, but only the 'recommended volume' tests showed significant effects of the sprayers on pest abundance. We attribute this difference to the role plated by changing application volumes in the dose transfer process. The 'constant volume' test showed that application equipment influenced efficacy.

Figure 1. Sprayer characteristics and settings.

	DRAMM	ESS	Hydraulic
Recommended volume tests			
Nozzle	Factory default	Max-Charge®	TXVS-18
Pressure (KPa)	17 000	70	280
Flow rate (ml s^{-1})	12	3	21
ml applied	80	28	1738
Application Time (s)	7	10	80
Constant volume tests			
Nozzle	Factory default	Max-Charge®	TXVS-6
Flow rate (ml s^{-1})	12	3	6
ml applied	60	60	60
Application Time (s)	5	20	9

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Figure 2. Analysis of co-variance models predicting micrograms of dye recovered

	Shoots				Leaves		
	Recommended volume		Constant volume		Recommended volume		Constant volume
	Test 1	Test 2	Test 3	Test 4	Test 1	Test 2	Test 4
Model $P > F_2$	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Adjusted R^2	0.44	0.40	0.61	0.62	0.72	0.58	0.58
Source	$P > F^a$	$P > F$	$P > F$	$P > F$	$P > F$	$P > F$	$P > F$
Dry weight			<0.001	<0.001	0.028		
Block							
Sprayer	<0.001	0.003		0.001	<0.001	0.014	<0.001
Row	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Row * Sprayer	<0.001		0.012	<0.001	<0.001	<0.001	<0.001
Location	<0.001				<0.001	<0.001	
Sprayer * Location			0.027		0.016	0.033	
Row * Location			<0.001	0.041			
Row * Location * Sprayer					0.031		