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FACTORS AFFECTING DROPLET SIZE, COVERAGE, AND WEED CONTROL WITH SHARPEN HERBICIDE

Gary M. Fellows, Alvin Rhodes, Roy Vidrine, and Roberto Barbosa

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Research Objectives: Objectives of the research included 1) to compare expected droplet sizes using a theoretical USDA model, droplets measured using water-sensitive cards (WSC) produced from an application of water and from an application of herbicide and adjuvant solution; 2) to evaluate the effect of selected nozzle deflection angles, spray pressure, and total carrier volume combinations in weed control; 3) to determine weed control differences with the various combinations using saflufenacil herbicide.

Materials and Methods : A trial was conducted in June 2010 at Angelina Plantation near Monterey, LA, on stale wheat stubble. Numerous weed species were present including prickly sida (Sida spinosa), pitted morningglory (Ipomoea lacunosa), and red vine (Brunnichia ovata), to name a few. Most of the weeds were very large and well beyond the recommended size for good control.

Applications were made with an Air Tractor 602 traveling an average speed of 150 miles per hour, equipped with CP-09 nozzles with either 0.078 or 0.125 orifice size, and delivering either 3 or 5 gallons per acre (GPA) total volume. The pilot and aircraft in this study had participated in an Operation SAFE Fly-in, in which droplet size, coverage, and spray pattern had been evaluated with water. With information gleaned from the pattern testing, along with known factors of nozzle type and aircraft speed, the droplet size calculator available on the CP Nozzle website (www.cpproductisinc.com) was used to identify several droplet size scenarios with changes in pressure, nozzle angle, and nozzle size before choosing the treatments used in the actual field study.

The aircraft boom was equipped with 63 nozzles, with a swath width of 70 feet for 5 GPA and 75 feet for 3 GPA. Treatments consisted of Sharpen® herbicide (active ingredient saflufenacil) at either 0.5 or 1.0 ounces per acre (oz/A) in a total volume of 3 or 5 GPA, with nozzles at a deflection angle of either 30º or no angle (straight back). Spray pressure varied between 26 and 46 pounds per square inch (psi), depending on treatment (Table 1). All treatments included 32 oz/A of glyphosate, 1 pint /A of methylated seed oil, 12 lbs/100 gallons of spray grade ammonium sulfate, and 1 oz per load of Control® drift agent. This combination was used in order to replicate as closely as possible a burndown combination that is commonly used. Weed control ratings were taken at 7 and 16 days after treatment.

Table 1. Sprayer setup for field study

Treatment	Sharpen Rate (oz/acre)	Total Volume (GPA)	Pressure (PSI)	Nozzle Deflection Angle
1	0.5	3	46	Straight
2	1.0	3	46	Straight
3	0.5	3	26	30º deflection
4	1.0	3	26	30º deflection
5	0.5	5	31	30º deflection
6	1.0	5	31	30º deflection

Spray droplet assessments were made three times, one calculated (based on the USDA model available on the CP website) and during two flying applications (one with water, one with the herbicide treatments). During each of the two flying applications testing, water sensitive cards were placed above the wheat stubble in the field, collected and assayed using a droplet scanner.

Research Results: The greatest affect on droplet size was from deflection angle. Approximately 20 to 28% reduction in droplet size was predicted as deflection angle was changed from 0º deflection (straight back) to a 30º deflection. Only small differences in expected droplet size difference between 3 GPA and 5 GPA were observed (Figure 1).

Figure 1. Comparison of expected droplets sizes according to GPA and deflection angle from USDA model and collected spray using water, and herbicide.

The predicted water droplet distribution was significantly less than the actual herbicide solution spray pattern (Table 2). Predicted droplet spectrums were closer at the upper droplet range

(VD0.9), about 12% smaller than the actual herbicide solution, but at the lower droplet range, the difference was from 18% less for VMD's and nearly 41% reduction in the VD0.1 droplet range. Actual water application droplet patterns were close to that of the herbicide solution, only about 5-7% less averaged over the three spray setups. During this trial, spray droplet analysis using water-sensitive cards was a more accurate measurement of the droplet spectrum than the predicted USDA model, although the model did reasonably predict the overall trends for the three sprayer setups.

Table 2. Differences in spray droplet size when comparing different setups and analysis methods.

	USDA Model			Water		
	VD 0.1	VMD	VD 0.9	VD 0.1	VMD	VD 0.9
	Reduction (%) in size compared to Herbicide application					
3 GPA, 0º Deflection	42.0	23.7	13.3	3.7	0.2	1.1
3 GPA, 30º Deflection	39.3	15.2	11.1	8.3	8.3	6.7
5 GPA, 30º Deflection	41.4	15.7	11.4	8.8	9.7	8.7
Average Deviation	40.9	18.2	11.9	7.0	6.1	5.5

Deflection angle also had a significant impact on number of droplets with actual applications of the herbicide spray solution (Figure 2). With an application volume of 3 GPA, the number of droplets collected doubled, from 189 to 392 droplets per square inch when the deflection angle went from 0º to 30º. The number of droplets increased by nearly threefold, with only a 2 GPA increase in spray volume. By increasing both GPA (3 to 5 GPA) and deflection (0º to 30º) overall droplet numbers increased fivefold.

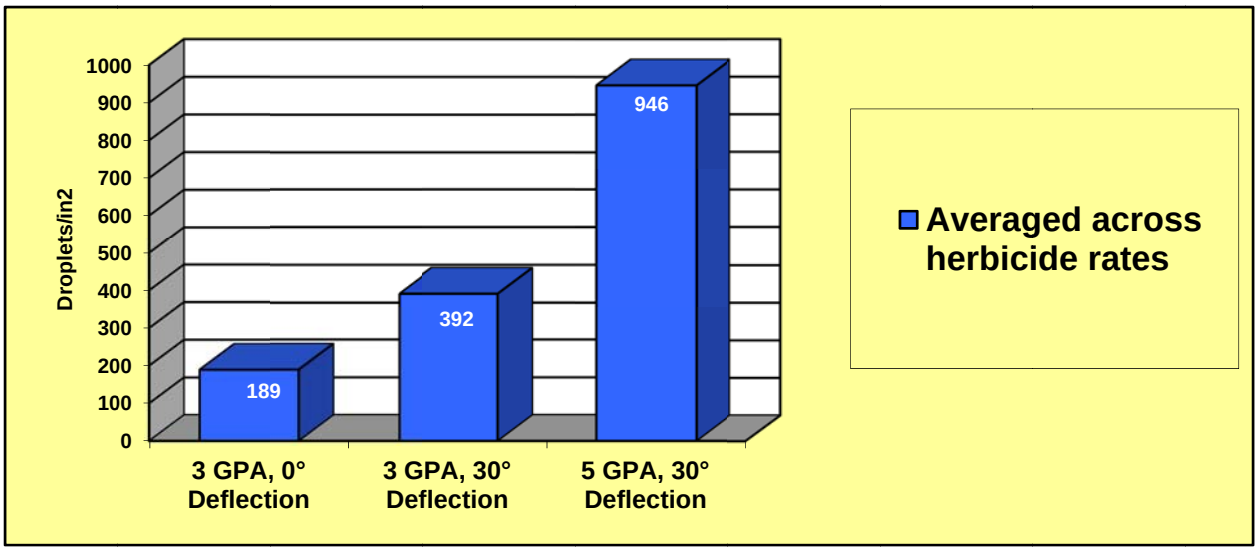

Figure 2. Number of droplets per square inch according to application volume and deflection angle.

Increased deflection at 3 GPA produced an increase in spray droplets, however this was offset by the decrease in droplet size and resulting in a 37% decrease in spray coverage (Figure 3). With a similar size droplet spectrum and deflection of 30º, increasing water from 3 to 5 GPA (a 40% increase) resulted in maximized droplet numbers, the greatest overall coverage, and the lowest reduced overall variation (CV) tested. With a contact herbicide mode of action like saflufenacil, increased coverage of target weeds would be expected to show a significant increase in overall weed control efficacy.

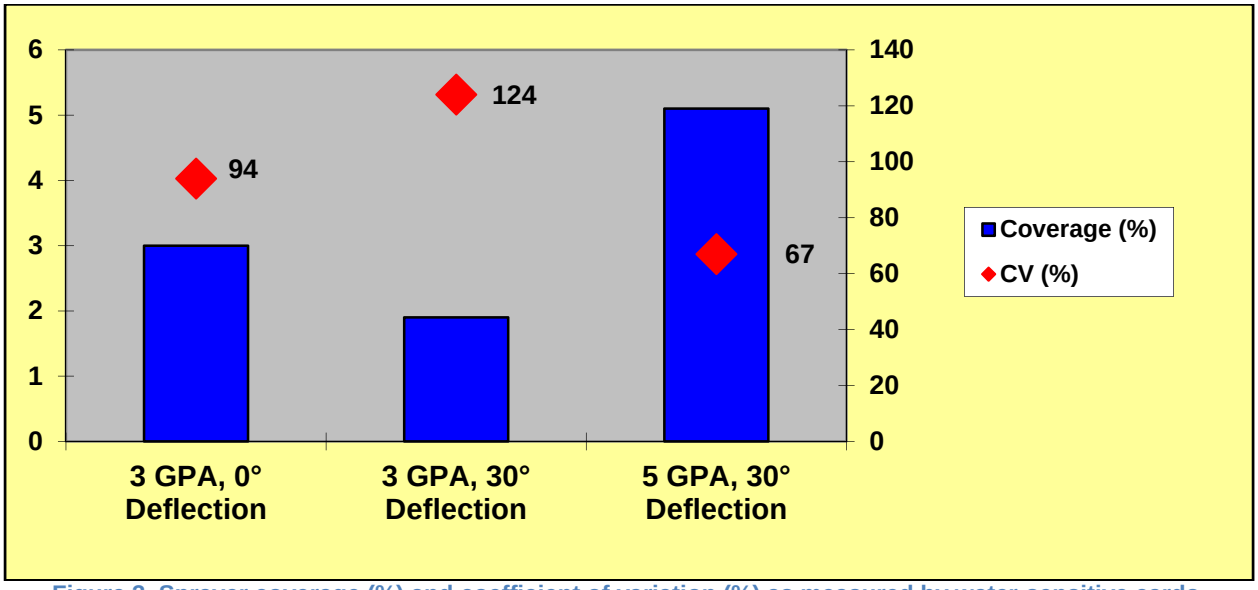

Figure 3. Sprayer coverage (%) and coefficient of variation (%) as measured by water-sensitive cards, according to sprayer setup.

Weed control data was taken in this trial for all weeds present (data not shown). To gain separation of the aerial sprayer setup treatments a reduced rate of saflufenacil (0.5 oz/a) was included along with the normal use rate of 1.0 oz/a. However, since glyphosate was included in all the treatments, the separation of weed control data based on spray coverage was not shown in this trial. Air temperature during this trial was also very high (+95 º F) and resulted in weed control being maximized as the weeds were not stressed. Future plans are to repeat this study under more stressed weather conditions and on glyphosate resistant weed populations to allow for potential for separation of treatments.

Conclusions: Aerial applicators have the ability to improve crop protection product coverage and performance by incorporating deflection angle and GPA changes to their systems while at the same time minimizing droplet size in the “very fine” size category, thereby limiting drift potential. An important consideration when selecting the spray setting for an aerial application is the type of pesticide being applied. Sharpen (saflufenacil) herbicide requires good coverage for best weed control due to the inherent mode of action on weeds. Selecting a setup that maximizes coverage, increases spray consistency, while not creating conditions that increase droplets smaller than 150μm droplets is an important decision.

Although the USDA model is a good predictor of actual overall trends in nozzle selection and output, the best indication of droplet characteristics without spraying actual herbicide mixtures, was the use a water-only system. Results in this trial showed a very good correlation with the water and herbicide spray droplets. The model tended to underestimate the VMD and VD0.1 droplet spectrums by 18-41%. Based on this data, applicators can remain confident that pattern testing with water and dye is a sound practice.

Sharpen at 0.5 oz/A worked as well as Sharpen at 1.0 oz/A in this study, 3 GPA worked as well as 5 GPA, and weed control differences among treatments were not observed. Glyphosate was included in the tank-mix with Sharpen, may have masked potential differences in efficacy amongst the treatments. A similar evaluation should be conducted under more typical burn-down conditions, which including early spring timing, cooler temperatures, smaller weeds, and more winter annual weeds.