HERBICIDE APPLICATIONS: FINDING A BALANCE BETWEEN DRIFT CONTROL AND EFFICACY

Thomas R. Butts[1]

The effectiveness of a herbicide application relies on two factors, (i) maximizing the biological effect, and (ii) minimizing environmental contamination through off-target spray movement. These two factors are often in competition with one another, like being on opposite sides of a seesaw. As a result, herbicide applications have become more challenging and reductions in weed control have been observed due to the current emphasis on reducing spray drift through more restrictive herbicide labels and increasing spray droplet size.

The identification of optimum droplet sizes (i.e., maintain a high level of weed control while simultaneously mitigating spray particle drift) would assist applicators with more effectively applying herbicides. To accomplish this goal, field research using pulse-width modulation (PWM) sprayers was conducted across six site-years in Mississippi, Nebraska, and North Dakota. The objective was to evaluate the influence of droplet size (150 µm to 900 µm) and carrier volume [47 L ha^{-1} (5 GPA), 94 L ha^{-1} (10 GPA), 140 L ha^{-1} (15 GPA), and 187 L ha^{-1} (20 GPA)] on the efficacy of several commonly used herbicides. Herbicides evaluated included glufosinate (Liberty®), dicamba (Clarity®), 2,4-D choline plus glyphosate pre-mixture (Enlist Duo®), dicamba plus glyphosate tank-mixture (Clarity® plus Roundup WeatherMax®), lactofen (Cobra®), and acifluorfen (Ultra Blazer®). Applications were made when weeds were ≥15 cm (≥6 in) and weed species evaluated included common lambsquarters (*Chenopodium album*), horseweed (*Erigeron canadensis*), kochia (*Bassia scoparia*), and Palmer amaranth (*Amaranthus palmeri*). Models were established to predict a droplet size which maximized weed control, and a droplet size which maintained 90% of the maximum weed control, but would also reduce particle drift.

Liberty®:

Liberty® was applied at 0.45 kg a.i. ha^{-1} (22 fl. oz. per acre) in 5 and 20 GPA. From this research, a 310 µm (Medium) droplet size across carrier volumes is recommended for Liberty® applications across pooled site-years; however, if particle drift concerns exist, Liberty® droplet size can be increased to 605 µm (Extremely Coarse) and 90% of the maximum weed control can still be achieved. Generally, across droplet sizes, 5 GPA out-performed 20 GPA to maximize weed control. This is likely due to the fact that no water-conditioning adjuvants such as AMS were used, and more concentrated droplets overcame hard water antagonism better than less concentrated droplets. If no water-conditioning adjuvants are used in conjunction with Liberty® herbicide, a lower carrier volume should be used, but applicators should keep in mind that greater weed control is often observed with the combination of water-conditioning adjuvants and increased carrier volume.

[1] Assistant Professor, Extension Weed Scientist, Univ. of Arkansas System Division of Agriculture, 2001 Hwy 70 E, Lonoke, AR, 72086. tbutts@uaex.edu, @weedsARwild

Clarity®:

Clarity® was applied at 0.28 kg a.e. ha^{-1} (8 fl. oz. per acre) in 5 and 20 GPA. A 900 µm (Ultra Coarse) droplet size with a 20 GPA carrier volume is recommended for dicamba applications because this combination provided at least 90% of the maximum weed control with the least particle drift potential across pooled site-years.

Enlist Duo®:

Enlist Duo® was applied at 0.79 kg ae ha^{-1} 2,4-D choline plus 0.84 kg ae ha^{-1} glyphosate (3.5 pints per acre formulated product) with a carrier volume of 10 GPA. Across Mississippi and North Dakota sites, a 900 µm (Ultra Coarse) droplet size was recommended, while across Nebraska sites, a droplet size of 565 to 690 µm (Extremely Coarse) was typically needed to maintain 90% of the maximum weed control. These differences in optimum droplet sizes were likely due to differences in weed species, specifically their leaf structure. In Mississippi and North Dakota, the weed species evaluated were Palmer amaranth and common lambsquarters, respectively, which have rather flat, horizontal leaf surfaces. Conversely, in Nebraska, the primary weed species' evaluated were kochia and horseweed which have a much smaller, narrower leaf structure. Numerous other factors such as application weather conditions, geographic location, time of day, and herbicide resistance evolution, may have also played a significant role in final herbicidal efficacy.

Clarity® plus Roundup WeatherMax®:

Clarity® and Roundup WeatherMax® were applied at 0.28 kg ae ha^{-1} dicamba (8 fl. oz. per acre) plus 0.87 kg ae ha^{-1} glyphosate (22 fl. oz. per acre), respectively, with a carrier volume of 10 GPA. Across a broad geographic setting and diverse weed spectrum, tank-mixture applications of Clarity® and Roundup WeatherMax® should use a 620 µm (Extremely Coarse) droplet size when applying with a carrier volume of 10 GPA. Similar to Enlist Duo®, the tank-mixture of Roundup WeatherMax® plus Clarity® required a smaller than expected droplet size to maximize weed control; therefore, greater carrier volumes (above 10 GPA) should be considered to increase coverage and maintain weed control with larger droplet sizes.

Ultra Blazer®:

Ultra Blazer® was applied at 0.42 kg ai ha^{-1} (24 fl. oz. per acre) plus 1% v/v crop oil concentrate (COC) with a carrier volume of 15 GPA. Ultra Blazer® maximized weed control with a 300 µm (Medium) droplet. In fact, the 300 µm droplet size was the only treatment different from the nontreated control. This indicates Ultra Blazer® is very droplet size sensitive and requires a smaller droplet size to maximize weed control even with a carrier volume of 15 GPA.

Cobra®:

Cobra® was applied at 0.22 kg ai ha^{-1} (12.5 fl. oz. per acre) plus 1% v/v crop oil concentrate (COC) with a carrier volume of 15 GPA. Droplet size did not impact weed control from Cobra®, and across a range of droplet sizes, weeds were controlled better than with Ultra Blazer®. This research highlights that even within herbicide sites-of-action (PPO-Inhibitors), optimum droplet sizes can vary. For Cobra®, carrier volume affects weed

control to a greater extent than droplet size; therefore, it is recommended to use at least 15 GPA with greater droplet sizes to maintain high levels of weed control while reducing drift potential.

Overall, droplet size impacts weed control differently across herbicides and carrier volumes. This data illustrates even with systemic herbicides, such as growth regulators, there is a critical droplet size and if the spray droplet size increases, weed control is reduced. Alternative drift reduction practices other than increasing spray droplet size must be identified and implemented to avoid reductions in weed control in the future. To optimize spray applications using droplet size, applications should be tailored for site-specific weed management approaches to more effectively account for variables such as herbicide, weed species, weather conditions, and geographic location. Additionally, it is always important to read and follow label instructions. In these studies, there were a few situations where the label restrictions were not followed for research purposes. It is recommended that applications ALWAYS meet label requirements.

For more information regarding optimum herbicide droplet sizes for weed control, please scan the QR codes below (Figures 1 and 2).

Figure 1. Spray droplet size and carrier volume effect on dicamba and glufosinate efficacy.

Pest Management Science article.

Figure 2. Precise spray droplet sizes for optimizing herbicide applications.

Univ. of Nebraska-Lincoln CropWatch article.