Effects of Spray Droplet Size on Pronamide Control of *Poa annua*

Martin Ignes, Connor Ferguson, Edicarlos B. de Castro, Te-Ming P. Tseng, and James D. McCurdy
Department of Plant and Soil Sciences, Mississippi State University, Starkville, Mississippi

Introduction

Annual bluegrass (*Poa annua* L.) is a problematic turfgrass weed, ranking third among resistant weeds by number of sites of action (Heap 2021). It competes with desirable turfgrass species, and its seed heads disrupt the uniformity of turfgrass color, creating an unsightly and irregular surface.

Pronamide, a mitotic inhibiting herbicide, controls annual bluegrass both pre- and post-emergence (Burt and Gerhold 1970) but may have limited efficacy when applied postemergence due to lack of root uptake (Carlson et al. 1975). For this reason, rain or irrigation is essential following application to move pronamide from the leaves into the root zone (Carlson et al. 1975). Pronamide-resistant annual bluegrass was first reported on a golf course in Georgia (McCullough et al. 2017) where the biotype survived post-emergence applications but was susceptible to pre-emergence applications. Pronamide applications are sometimes combined with other herbicides, including acetolactate synthase (ALS)-inhibiting herbicides such as flazasulfuron, in order to decrease selection pressure for resistance to a single site of action. Flazasulfuron controls susceptible annual bluegrass populations post-emergence in warm-season turfgrasses (Shaner 2014).

Objective

Quantify how spray droplet size affects the deposition of pronamide on annual bluegrass and whether tank-mixture with flazasulfuron affects deposition.

Hypothesis

Deposition of pronamide on leaf surfaces will vary with spray droplet size. In prior studies, droplet sizes around 100 µm have been used to increase foliar deposition (McKinlay et al. 1972).

Materials and Methods

A controlled growth experiment was conducted as a 4 (herbicide treatments) × 5 (droplet sizes) factorial treatment arrangement in a completely randomized design. The study was conducted twice in time. Fluorescent dye was added to a distilled water spray solution (0.454 g dye L^{-1}), from which three herbicide treatments were prepared: 1160 g pronamide ha^{-1}, 44 g flazasulfuron ha^{-1}, and pronamide + flazasulfuron at the same rates. Spray droplet size was measured by a VisiSize P15 (Oxford Lasers Ltd.). Treatments were applied using an enclosed spray chamber delivering 374 L ha^{-1} to two-to-three leaf stage annual bluegrass plants in cone-tainers containing potting mix. Immediately after application, the plant foliage was collected, and the dye solution was washed off using distilled water. The concentration of dye in the composite sample was quantified using a spectrofluorometer (RF-6000, Shimadzu Scientific Instruments). Foliar surface area was determined using a leaf area meter (LI–3000, LI-COR Environmental). Data were analyzed using simple linear regression within GraphPad Prism (v. 9.0) and were pooled across the two runs of the study. The slopes of the three herbicide treatments were tested to determine if spray droplet size affected foliar deposition of the herbicide. Regression models were compared using pairwise F-tests at α=0.05, and the slopes of pronamide-containing treatments were compared to determine how the addition of flazasulfuron to pronamide in the tank mixture affected herbicide deposition.

Table 1. Nozzles selected for the study.

Droplet size (µm)	Nozzle	Pressure (PSI)[a]	Speed (MPH)[a]	Photo
200	TCP 11004	30	2.74	
400	AIXR 11003	35	2.19	
600	TDXL-D 11003	55	2.77	
800	TTI 11004	45	3.32	
1000	TTI 11004	30	2.77	

[a] Pressure and speed used to deliver the desired droplet size

Table 2. Calibration curve created for pronamide.

Pronamide concentration (g ai/L)	Dye concentration (µg/L)
0.030849	4540
0.0030849	454
0.00030849	45.4
0.000030849	4.54
0.0000030849	0.454
0.00000030849	0.0454
0.000000030849	0.00454

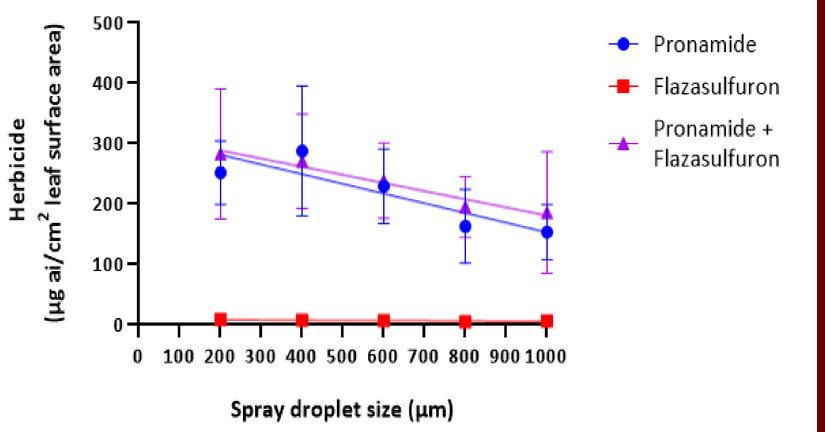

Figure 1. Herbicide deposition as affected by droplet size. Data were pooled across the two runs of the study.

Table 3. Pairwise F-test comparisons of herbicide deposition (α=0.05). Green boxes represent statistical difference between slopes. Data were pooled across the two runs of the study.

Treatments	pronamide	flazasulfuron	pronamide + flazasulfuron
pronamide	–	< 0.0001	0.3947
flazasulfuron	–	–	<0.0001
pronamide + flazasulfuron	–	–	–

This project was partially funded by the USDA-NIFA Specialty Crops Research Initiative (SCRI) program (award #: 2018-51181-28436).

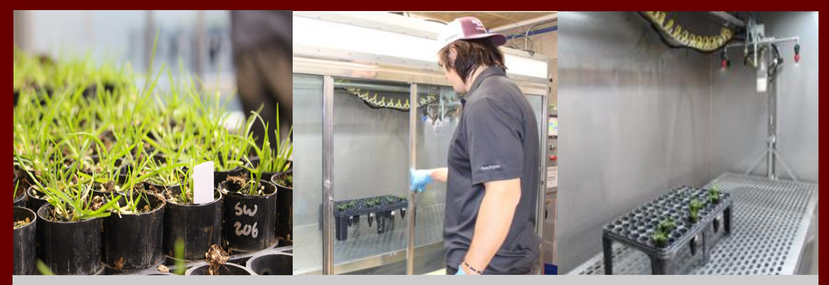

Figure 2. Application of pronamide.

Results

- Spray droplet size significantly affected foliar deposition of pronamide and flazasulfuron, applied alone and in combination, to annual bluegrass foliage.
- Pronamide foliar deposition decreased as the spray droplet size increased above 400 µm. Foliar deposition of flazasulfuron and pronamide + flazasulfuron deposition decreased as droplet size increased above 200 µm.
- In general, larger droplet sizes improve soil deposition and decrease foliar deposition.
- Slope analysis suggests that the addition of flazasulfuron does not affect pronamide foliar deposition.

Conclusions and Discussion

Four nozzle types are most commonly used for turf applications: extended-range flat-fan, air-induction, pre-orifice flat-fan, and flooding wide-angle flat-spray (Shepard et al. 2006). Results of this study suggest that the 400 to 200 µm spray droplet size may be optimal for foliar deposition of pronamide. Air-induction nozzles, which produce droplets in the 250–450 µm range and provide control similar to flat-fan nozzles while reducing the potential for drift, could be used to deliver those droplet sizes. Alternatively, larger droplet sizes may facilitate better soil deposition of pronamide where root uptake is optimal. Pre-orifice flat-fan and flooding wide-angle flat-spray nozzles produce larger droplets than the nozzle types mentioned before, and thus could be used when pronamide soil deposition is required.

Future Research

- Future research will evaluate pronamide efficacy on annual bluegrass populations as affected by spray droplet size.
- Little is known regarding surfactants and deposition aids, which may impact foliar and root uptake, but also are known to affect droplet size. This, too, is an area of future research.

References

- Burt EO, Gerhold NR (1970) *Poa annua* control in bermuda turf with Kerb. *In* Proceedings of the 23rd Annual Meeting. Atlanta, GA: Southern Weed Science Society: 122–126
- Carlson WC, Lignowski EM, Hopen HJ (1975) Uptake, translocation, and adsorption of pronamide. Weed Sci. 23:148–154
- Heap (2021) The International Survey of Herbicide-Resistant Weeds. http://www. weedscience.com. Accessed: September 30, 2021
- McCullough PE, Yu J, Czarnota MA (2017) First report of pronamide-resistant annual bluegrass (*Poa annua*). Weed Sci. 65:9–18
- McKinlay KS, Brandt SA, Morse P, Ashford R (1972) Droplet size and phytotoxicity of herbicides. Weed Sci. 20:450–452
- Shaner DL (2014) Herbicide Handbook. 10th ed. Lawrence, KS: Weed Science Society of America. Pp 195, 196, 368
- Shepard D, Agnew M, Fidanza M, Kaminski J, Dant L (2006) Selecting nozzles for fungicide spray applications. Golf Course Mgt. 74:83–88

@ResistPoa
resistpoa.org

Resist Poa
USDA-SCRI ANNUAL BLUEGRASS COLLECTIVE