GROUND-BASED SPECTRAL REFLECTANCE MEASUREMENTS FOR EVALUATING THE EFFICACY OF AERIALLY- APPLIED GLYPHOSATE TREATMENTS

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ABSTRACT

A weedy field was set up in a randomized complete block experimental design using three replicates. Four aerial spray technology treatments, electrostatic nozzles with charging off, electrostatic nozzles with charging on, conventional flat-fan hydraulic nozzles and rotary atomizers, were tested. To evaluate the glyphosate efficacy and performance of aerial spray technologies, spectral reflectance measurements were acquired using a ground-based sensing system for all treatment plots. Three measurements were taken at 1, 8, and 17 days after treatment (DAT). Statistical analyses indicated that glyphosate applied with different methods killed the weeds effectively compared to untreated areas at 17 DAT. Conventional flat-fan nozzles and rotary atomizers performed better than the electrostatic nozzles with charging off. There was no evidence to show that the electrostatic nozzle performed better with charging on or charging off. The results could provide applicators with guidance equipment configurations that can result in herbicide savings and optimized applications in other crops.

Keyword: Aerial spray technology, glyphosate efficacy, remote sensing

INTRODUCTION

Aerial applications of glyphosate have increased with the requirement for more effective weed management prior to planting spring-seeded crops. Ground-based remote sensing data were collected to evaluate the glyphosate efficacy applied with conventional and emerging aerial spray nozzles.

MATERIALS AND METHODS

The field used for this study was located in Burleson County, Texas (30.524588°N, 96.407181°W) and was treated with glyphosate on March 2, 2009. Treatments were applied in randomized complete blocks with 3 replications. Each replicate block was subdivided into 5 unique randomized treatments. Each treatment plot was 3 swaths wide (195 ft) and 600 ft long and was delineated with a disked strip of soil. A turbine-powered Air Tractor AT-402B agricultural aircraft (Air Tractor, Inc., Olney, Texas) was used to make all applications. The following table shows aircraft and nozzle settings for each treatment.

TRT	Nozzle	# Nozzles	Rate (GPA)	Orifice	Deflection (˚)	Pressure (psi)	Airspeed (MPH)
1	Electrostatic Off	100	1	TXVK-8	0	70	130
2	Electrostatic On	100	1	TXVK-8	0	70	130
3	CP-11TT	39	3	15	0 (8)	35	131
4	AU-5000	8	3	VRU=Max	65	40	110
5	Untreated Check						

Remote sensing data was collected using a ground-based sensing system (Lan et al., 2009), which was assembled using Greenseeker® Data Collecting and Mapping unit (NTech Industries, Inc., Ukiah, Cal.) and a FieldSpec® (Analytical Spectral Devices, Inc., Boulder, CO) spectroradiometer. All the field tests were conducted between 12:00 a.m. and 2:00 p.m. at DAT 1, 8, and 17.

RESULTS

ANOVA test results on NDVI from DAT 1 and DAT 8 did not show any difference among treatment means. The ANOVA test on DAT 17 shows that nozzle type had a significant effect on glyphosate efficacy ($p=0.0315$ at $\alpha = 0.05$). TRT 2, 3, and 4 were significantly different from TRT5. Therefore, electrostatically charged nozzles powered on, CP-11TT flat fan nozzles and AU-5000 rotary atomizers were more efficacious than the electrostatically charged nozzles powered off or the untreated check in controlling weed populations.

The overall changes in spectral reflectance within each treatment plot were observed from the shapes of the reflectance curves. Overall decreases of spectral reflectance in healthy weed area due to herbicidal control resulted in an increase in the blue and red reflectance and a decrease in the NIR reflectance. Spectral reflectance responses from 5 treatment plots were similar at DAT 1. TRT3 had higher reflectance both in the visible and NIR wavelength regions at DAT 8 and TRT3 had the highest spectral reflectance in the visible wavelength bands at DAT 17. Glyphosate herbicidal efficacy under different aerial spray treatments could be differentiated from spectral responses over the visible and NIR spectrum regions.

REFERENCE

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