Light-activated Sensor Sprayer for Reduced Herbicide Use in No-till Fallow

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Abstract

An on-going study is being conducted at the Columbia Basin Agricultural Research Center near Pendleton, Oregon to evaluate the efficacy of various herbicide treatments in no-till fallow using a light-activated sensor-controlled (LASC) sprayer (trade name WeedSeeker®). The typical, commercial method for weed control in no-till fallow (also known as chemical fallow) is with repeated applications of glyphosate herbicide. As many as four or more glyphosate treatments can be required to maintain an acceptable level of weed control during the 14-month fallow period that alternates between crops of winter wheat. This study was designed to minimize the quantity of herbicide necessary to maintain a high level of weed control during the no-till fallow period through the use of a LASC sprayer. During 2007, the dominant broadleaf weed species in the plot area were tumble pigweed, Russian thistle, and prickly lettuce. Glyphosate applied alone as a broadcast application provided acceptable control of these weeds in no-till fallow. Several treatments made with the LASC sprayer were similar to broadcast application of glyphosate for weed control. Effective LASC-applied treatments included a high application rate of glyphosate, glyphosate plus pyrasulfotole, or paraquat. These treatments provided acceptable total weed control with a calculated 60 percent savings in spray volume compared to the conventional broadcast spray application. LASC-applied treatments containing bromoxynil or 2, 4-D applied alone, or carfentrazone plus dicamba, proved to be the least effective herbicides with the LASC sprayer, mainly due to a lack of prickly lettuce control.

Key words: chemical fallow, WeedSeeker, spot treatment, herbicides, weed control, Russian thistle, prickly lettuce.

Introduction

Growers in intermediate rainfall zones are increasingly interested in developing no-till fallow (chemical fallow) systems to replace the more erosive dust-mulch fallow. A primary motivation for this interest includes the rising cost of diesel fuel necessary for mechanized tillage operations. Two primary problems associated with no-till fallow are evaporative losses of soil moisture in the shallow seed zone in undisturbed soil, and problems with weed control associated with the elimination of tillage and the subsequent reliance on herbicides. Currently, most growers rely on repeated broadcast applications of glyphosate for season-long weed control in no-till fallow. Often, control of weeds with glyphosate alone has not been acceptable, and/or greater glyphosate application rates are necessary to effectively control weeds. Dusty conditions sometimes contribute to reduced herbicide activity. Moreover, moisture-stressed weeds that grow later during the fallow period often require higher herbicide rates to provide the same level of control compared to plants grown under adequate soil moisture. Another concern with repeated herbicide applications in no-till fallow is the development of herbicide-resistant weed populations. One concept for reducing repeated broadcast applications of glyphosate uses light-activated sensor controlled (LASC) spot-treatment ("WeedSeeker®") technology. This technology has the potential to reduce herbicide use and associated costs through the directed spot-treatment of weeds. It also may reduce the concern about dust inhibition of herbicide activity because it is possible to greatly increase the concentration of herbicide in the spot-treatment operation.

Methods

Studies were conducted at the Columbia Basin Agricultural Research Center near Pendleton, Oregon to evaluate the efficacy of various herbicides in chemical fallow systems using a LASC spot sprayer (WeedSeeker®). A 10-ft, tractor-mounted, spray boom was fitted with 10 LASC spray units on 1-ft spacing. LASC units were fitted with TeeJet 6502 flat-fan nozzles operating at 35 psi. The spray unit was calibrated to apply 24 gal/acre of a herbicide/water mixture when all nozzles were operating. This boom configuration was compared with herbicide treatments applied with a conventional 10-ft broadcast spray boom fitted with TeeJet XR 8002 flat fan nozzles operating at 30 psi, and calibrated to apply 16 gal/acre of herbicide spray mixture. Tractor operating speed for all treatments was 3.5 mph. Broadcast and LASC herbicide applications were made to a no-till fallow field on June 26, 2007. The study was arranged as a randomized complete block with four replications per treatment. Individual plots were 10 by 70 ft in size. At time of herbicide applications, the dominant broadleaf weed species present were prickly lettuce (*Lactuca serriola*), tumble pigweed (*Amaranthus albus*), and Russian thistle (*Salsola iberica*). Weed height at time of application for prickly lettuce was 4-12 inches, tumble pigweed was 6-15 inches, and Russian thistle was 4-10 inches. Weather conditions at time of applications were 57°F air temperature, wind at 0-1 mph, clear skies, and a dry, no-till-fallow soil surface with approximately 100percent wheat straw residue cover. Percent visible weed control of each weed species was evaluated at 14 days after treatment (DAT). Total weed density and weed dry weight in each plot were obtained at 21 DAT by counting and clipping all above-ground weed biomass in two 0.5-m^2 quadrats per plot, and oven drying for 48 hours.

Results and Discussion

Visible weed control 14 days after treatment ranged from 86 to 100 percent for Russian thistle, 13 to 88 percent for prickly lettuce, and 19 to 100 percent for tumble pigweed (Table 1). In general, control of prickly lettuce was less acceptable than that of other weeds. In dryland Pacific Northwest cropping systems, prickly lettuce has been reported to be increasingly difficult to control, particularly as a late-season weed in no-till fallow and post-harvest fields. Glyphosate applied as a broadcast treatment at 1.5 lb acid equivalent (ae)/acre (64 oz/acre of a 3-lb/gal isopropylamine salt formulation) provided the greatest overall control of weeds present in the plot area. Several spot treatments using the LASC sprayer also provided a high degree of visible weed control, including a high spot-treatment rate of glyphosate (3.0 lb ae/acre) applied alone and at a lower rate (0.75 lb ae/acre) used in combination with pyrasulfotole plus bromoxynil (Huskie®). Paraquat (Gramoxone®) applied with the LASC sprayer also provided a high level of visible weed control (Table 1). A treatment containing carfentrazone (Aim EW®) plus dicamba (Clarity®) provided an intermediate level of weed control. Treatments containing either bromoxynil (Buctril®) or a solvent-free, acid formulation of 2,4-D (Unison®) were the least effective herbicides for control of the weed species present in this study (Table 1). Measurements of total weed dry weight and weed density evaluated at 21 DAT also illustrated the slightly greater overall weed control from broadcast herbicide application than from the LASC applications (Table 2). However, weed control was very good with glyphosate, or glyphosate plus Huskie applied through the LASC sprayer, as compared to the broadcast application. We calculated that the LASC sprayer used 60 percent less spray volume compared to broadcast spraying, a significant savings. The slightly greater weed dry weight was not significantly different between the best LASC and broadcast applications, so the savings in herbicide use makes this sprayer technology an attractive option for reducing herbicide inputs, thereby reducing herbicide application expenses.

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Disclaimer

Treatments in this study were selected for experimental purposes. Mention of product names should not be considered to be a product endorsement, or recommendation for commercial use. Read and follow herbicide label directions for appropriate product uses and application rates.

Table 1. Comparison of visible weed control 14 days after treatment with a broadcast or light-activated sensor sprayer, Pendleton, OR, 2007.

	Treatment [1]	Rate	Application method [2]	LACSE [3] control	SASKR control	AMAAL control
		-- amount/acre --		----------------- %	-----------------	
1	glyphosate	1.5 lb ae	A	86	100	100
2	glyphosate	3.0 lb ae	B	85	100	99
3	glyphosate	0.75 lb ae	B	73	95	95
4	glyphosate + Unison	0.75 lb ae + 4 pt	B	69	100	97
5	Unison (2,4-D)	4 pt prod.	B	44 *	85 *	76 *
6	glyphosate + Huskie	0.75 lb ae +15 fl oz	B	88	100	97
7	Huskie	15 fl oz prod.	B	86	98	91
8	glyphosate + Buctril	0.75 lb ae + 0.5 lb ai	B	78	100	84 *
9	Buctril	0.5 lb ai	B	13 *	86 *	19 *
10	glyphosate + Aim EW + Clarity	0.75 lb ae + 0.031 lb ai + 0.25 lb ai	B	81	98	90
11	Aim EW + Clarity	0.031 lb ai + 0.25 lb ai	B	81	98	84 *
12	Gramoxone Inteon	3 pt prod.	B	86	100	99
13	Untreated control	--	--	0 *	0 *	0 *
	LSD (0.05)			13.8	9.7	10.4

[1] All treatments except untreated control received Bronc Max at 1 percent v/v and a non-ionic surfactant at 0.5 percent v/v.

[2] A = broadcast sprayer; B = light-activated, sensor-controlled (LASC)(WeedSeeker) sprayer.

[3] LACSE = prickly lettuce; SASKR = Russian thistle; AMAAL = tumble pigweed.

* LASC treatment ratings followed by '*' are significantly different from the broadcast spray treatment at a 95 percent confidence level.

Table 2. Comparison of total weed biomass and density in chemical fallow with a broadcast or light-activated sensor spot sprayer, Pendleton, OR, 2007.

	Treatment [1]	Rate	Application method [2]	Total weed dry weight [3]	Total weed density [3]
		-- amount/acre --		g/m^2	no/m^2
1	glyphosate	1.5 lb ae	A	1 *	1 *
2	glyphosate	3.0 lb ae	B	3 *	1 *
3	glyphosate	0.75 lb ae	B	19 *	3
4	glyphosate + Unison	0.75 lb ae + 4 pt	B	42 *	3
5	Unison (2,4-D)	4 pt prod.	B	53 *	5
6	glyphosate + Huskie	0.75 lb ae +15 fl oz	B	22 *	2 *
7	Huskie	15 fl oz prod.	B	46 *	5
8	glyphosate + Buctril	0.75 lb ae + 0.5 lb ai	B	61 *	5
9	Buctril	0.5 lb ai	B	155	8
10	glyphosate + Aim EW + Clarity	0.75 lb ae + 0.031 lb ai + 0.25 lb ai	B	83 *	4
11	Aim EW + Clarity	0.031 lb ai + 0.25 lb ai	B	84 *	6
12	Gramoxone Inteon	3 pt prod.	B	34 *	3
13	Untreated control	--	--	194	5
	LSD (0.05)			52.8	2.6

[1] All treatments except the untreated control received Bronc Max at 1 percent v/v and a non-ionic surfactant at 0.5 percent v/v.

[2] A = broadcast sprayer; B = light-activated, sensor-controlled (WeedSeeker) sprayer.

[3] Weed dry weight obtained 21 days after treatment (DAT). Total weed density was obtained 30 DAT.

* Treatments followed by '*' are significantly different from the untreated control at a 95 percent confidence level.