Weed control using a Precision Application System with Image-vision

Juan C. Brevis[1], Thomas Lanini[1], Ken Giles[2], David C. Slaughter[2], Daniel Downey[2] and Chris Gliever[2]. [1]Department of Vegetable Crops, [2]Department of Biological and Agricultural Engineering, University of California, Davis, California.*

ABSTRACT

Researchers at UC Davis are developing an image processing based system for early weed control. The precision application system consists in a camera that captures images of the crop row, a computer that analyzes and distinguishes targets and a micro-sprayer that precisely applies the herbicide to the weeds.

The objectives of this research were: 1) Measure the ability of the precision application system to treat the target plants under field conditions. 2) Assess the weed control from treatments applied with the application system compared to a broadcast herbicide application.

In two field experiments conducted at UC Davis, weed seed was spread in the beds before cotton planting. Common purslane (*Portulaca oleracea* L.) was used in the first experiment and barnyardgrass (*Echinochloa crus-galli* (L.) Beauv.), in the second. In the first experiment the precision application system was set up to spray weed and crop plants, while in the second experiment only the weeds were targeted. Treatments and application methods are shown in Table 1. A randomized complete block design was used with four replications. Poly-ethylene oxide (PEO) was included to evaluate its ability to reduce micro-splash. The sprayer accuracy was assessed by counting the number of missed plants after each plot was applied. Weed control was assessed visually at 3, 7, 14 and 21 days after treatment (DAT). At the same time, cotton and weed mortality was determined by counting live plants in each plot.

The weed control and crop injury for both experiments is shown in Table 2. Mortality values for weeds are only for those that were treated, considering the inaccuracy of the application system. In the first experiment, the overall accuracy of the precision application system was 86.6%, varying from 78.9% to 92.8% among the treatments. Plant size and leaf position are among the factors that affect the applicator accuracy. In the second experiment, the system averaged 70.8% of proper plant recognition. Dense weed patches can be misclassified as "crop" by the system and remain untreated. Cotton mortality was very low with the micro-applied treatments, indicating that the precision application system performed well in discriminating the crop. Glyphosate was more effective than the essential oil treatments for controlling purslane and barnyardgrass. Weed recognition remains the most difficulty task in the refinement of the precision application system.

Table 1. Herbicide treatments and application methods used in the experiments.

N	Herbicide treatment	Application method
1	0.25% Glyphosate + 0.03% PEO[a]	Precision application system
2	0.50% Glyphosate	Precision application system
3	0.50% Glyphosate + 0.03% PEO	Precision application system
4	3.0% Cinammon oil	Precision application system
5	3.0% Clove oil	Precision application system
6	3.0% Eugenol oil	Precision application system
7a	Pyrithiobac 36 g ha-1	Precision application system
7b	Sethoxydim 360 g ha-1	Backpack sprayer (First experiment)
8	Control (Untreated)	Backpack sprayer (Second experiment)

[a] Polyethylene-oxide, anti-splash polymer.

Table 2. Weed control and crop injury at 21 days after treatment.

	1st Experiment			2nd Experiment		
Herbicide	Control %	Mortality %		Control %	Mortality %	
treatments	POROL	POROL[a]	Cotton[b]	ECHCG	ECHCG[a]	Cotton[b]
0.25% Gly[c] + PEO	50.0 a	95.8 a	90.2 a	12.5 b	81.8 a	7.8 a
0.5% Gly	55.0 a	97.7 a	100.0 a	12.5 b	93.0 a	0.0 b
0.5% Gly + PEO	35.0 ab	94.5 a	76.4 a	27.5 b	70.8 a	0.0 b
3% Cinnamon oil	2.5 c	19.8 bc	6.3 c	7.5 b	27.5 bc	3.6 ab
3% Clove oil	10.0 c	23.7 b	17.4 bc	5.0 b	19.2 bc	0.0 b
3% Eugenol oil	7.5 c	24.1 b	39.9 ab	5.0 b	36.6 b	10.7 b
Pyrithiobac 36 g ha^{-1}	20.0 bc	4.0 cd	0.0 c			
Sethoxydim 360 g ha^{-1}				99.5 a	98.8 a	0.0 b
Control (Untreated)	0.0 c	1.7 d	4.2 c	0.0 b	5.3 c	0.0 b

[a]Consider only treated plants. [b]Consider total number of plants (treated and untreated). [c]Glyphosate.