

PROGRESS REPORT: ORGANIC CROPPING RESEARCH FOR THE NORTHWEST

Title: Weed Management in Organic Dryland Spring Wheat

Personnel: Dr. Robert Gallagher (project director/contact), Ms. Suzanne Kopan (MS student), Mr. Dennis Pittman (Agriculture Research Technician III)

Contact Person Affiliation: Washington State University, Dept. of Crop and Soil Sciences

Phone: 509-335-2858

Email: gallagh@wsu.edu

Cooperators: Dr. Steve Jones and Mr. Kevin Murphy

Date: March 2004 to December 2004

Keywords: Mechanical weed control, conservation tillage, organic, transition, wheat, pea.

Abstract: Organic grain production in Washington State was limited to less than 2500 acres as of 2001, and has not been well represented in the university research system. This lack of attention by both growers and researchers has resulted in a serious knowledge gap, with no good guidelines available on how to manage weeds and other pests in these systems. Although weeds have been successfully managed in tillage-intensive organic wheat systems in the Palouse, such an approach leaves the soil prone to erosion by wind and water. Alternative approaches are needed that enable the organic management of weeds and conserve valuable soil resources. This research evaluated a rotary harrow prototype and a high residue rotary hoe for their potential to control weeds in high residue, conservation tillage systems. Crop variety tolerance to in-crop mechanical weed control was also evaluated.

Objectives

1. Optimize the timing and sequence of rotary harrow and rotary hoe operations to achieve adequate weed control in spring wheat and peas.
2. Evaluate the effects of the rotary harrow and rotary hoe operations on crop stand and yield parameters.
3. Compare the relative competitiveness and tolerance to mechanical weed control of select spring wheat varieties.

Procedures

All experiments were conducted at the Boyd Farm Organic Transition Study site, located just east of Pullman, WA.

Objectives 1 & 2

A factorial of 2 pre-plant rotary harrow regimes and 5 post-plant rotary hoe regimes were evaluated in spring wheat and peas. Rotary harrow regimes consisted of 1) 2x rotary harrow and 2) no-tillage. Rotary hoe regimes included no tillage, and 2x-5x operations. Measurements

included crop residue cover, crop stand counts, weed control ratings, late-season weed biomass, and crop yield.

Objective 3

Current and heirloom spring wheat varieties that vary in their coleoptile length and above ground biomass production will be compared for their ability to tolerate mechanical weed control measures and their ability to out-compete spring annual weeds. A split plot randomized complete block experimental design (4 replicates) will be employed with wheat variety as the main plot factor, and mechanical weed control (with and without) as the split plot factor. Measurements will include crop stand counts, crop canopy development, weed control ratings, late-season weed biomass, and crop yield. This study will also be conducted at our Organic Transition Study site, located just east of Pullman, WA.

Progress Toward Objectives

Objectives 1 & 2

There was no evidence that even 5 rotary hoe operations reduced the pea or spring wheat stands. Weed biomass at the time of grain harvest was reduced by an average of 60% in the spring pea plots that were rotary hoed compared to the untreated plots. There was no evidence the 2 operations was more effective than 3 or 4 operations. In spring wheat, weed biomass was reduced by 54% in the spring wheat plots that were rotary hoed 5 times compared with the untreated plots. Fewer than 5 rotary hoe operations had fewer weeds than the untreated plots, but more weeds than the 5x treatment.

Although there were measurable differences in weed pressure among the rotary hoe treatments, yields were statistically equivalent among these treatments in the spring wheat and spring pea crops. Across all treatments, spring wheat averaged 37 bu A⁻¹, whereas spring peas averaged 1140 lb A⁻¹. It is unclear precisely why even substantial weed pressure had little effect on crop yields, but perhaps the relatively high spring and summer rainfall and the supplemental fertility in our experiment buffered potential yield losses due to weed competition.

Objective 3

This objective was implemented by Mr. Kevin Murphy of Dr. Jones program with the assistance of members of the Gallagher program. Seventy spring wheat cultivars, a vast majority of which were heirloom cultivars, were planted in 2 m x 4 m nursery plots that were replicated 4 times. Plots were configured so that half of each plot could be subjected to rotary hoeing, whereas the other half of each plot remained undisturbed. There was no evidence that the 3 rotary hoe operations impacted crop stands in any of the cultivars. There were clear differences in the yield potential of the cultivars, with the modern cultivars tending to yield more than the heirloom cultivars. Preliminary analysis suggests that yield in the heirloom cultivars may actually have been reduced by the rotary hoe operation when compared to the modern cultivars; however not all historic cultivars followed this trend. This study will be repeated to evaluate if cultivar response to mechanical weed control is consistent between years. Weed control data has not yet been analyzed.

Related Experiments

Data from our 2004 organic transition plots (funded by the USDA Organic Transitions Program) illustrates that mechanical/cultural management of wild oat and prickly lettuce may be quite feasible in wheat sown under conservation tillage (Table 1). For example, we found that wild oat control in winter and spring wheat was 70-90% with 5 rotary hoe operations when the crop followed a faba bean green manure crop in the previous year, where wild oat seed set was prevented. Weed control decreased significantly in both crops when these crops followed spring peas in the previous year, where wild oat control was poor. These data suggest that the poor wild oat control in our 2003 spring peas resulted in an increase in the soil seed bank and enhanced recruitment in the subsequent wheat crops. Our data are consistent with conventional wisdom that winter wheat is more competitive than spring wheat. These results suggest that successful annual weed management in organic direct seed systems will rely on the integration of weed seed-set prevention, the enhancement of soil fertility and crop competitiveness, and mechanical weed suppression. Management of perennial weeds, such as field bindweed and Canada thistle remains far more problematic.

Table 1. Weed control and crop as influenced by previous crop. All plots received 5 spring rotary hoe operations and zero rotary harrow operations.

Year 2 Transition Crop (2004)	Wild oat	Prickly lettuce	Crop yield
	% control		bu/A
Winter wheat (following faba green manure)	90	98	60
Winter wheat (following spring pea)	60	98	50
Spring wheat (following faba green manure)	75	95	34
Spring wheat (following spring pea grain crop)	45	95	27

In addition to our organic transition research, we have initiated an experiment that will evaluate how the rotary harrow and hoe operation influence soil weed seed bank dynamics and soil-borne diseases. Seed bank and pathogen plots were established in 2004 and the experimental treatments will commence in the spring, 2005. This work is being done in collaboration with Dr. Tim Paulitz (USDA – ARS) with funding from The Washington State Commission on Pesticide Registration and Small Planet Foods.

Outputs: Our primary output has been our Organic Transitions Field Day, held July 15, 2004. This field day was attended by over 50 people, including 10 production grain farmers. In addition, all our experiments at the Boyd Farm were featured as part of my Crop Science 305 Ecology and Management of Weeds) course.

Impact: We believe that it is premature to extend these research results after only one year of data. However, we expect to have a more comprehensive understanding of our experimental

system after our 2005 season, and will then begin to showcase our results at local and regional Tilth Producer meeting, and other extension forums.

Institution: Washington State University

State: Washington

Funding Sources and Amounts: In addition to the funding being received by the CSANR Organic Cropping Research in the Northwest (\$24,639, 1 year), our organic research program is supported by the USDA Organic Transitions program (\$164,000, 4 years), The Washington State Commission on Pesticide Registration (\$14,000, 1 year), Small Planet Foods (\$14,000, 1 year), and the Washington Wheat Foundation (\$3,500, 1 year).

Organic Research Land: Our primary site is the Boyd Farm, which consists of 16 acres under organic transition, with the remaining 80 acres under CRP.

Farmer Cooperator: Mr. Lester Boyd