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Can Cover Crops Control Weeds?

Two-Year Study Tests Efficacy in Vegetable Production Systems

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Mechanical cultivation is the most common non-chemical method of weed management in vegetable crops. However, cultivation is labor, time, and resource (fossil fuel) intensive. Growers need efficient and effective non-chemical alternatives for weed control.

A Role for Cover Crops?

Winter cover crops (e.g., hardy grasses, cereals, legumes sown during the late summer or early fall) offer certain benefits to the vegetable crop planted the subsequent spring. The introduction of winter cover crops into the production rotation has been shown to enhance nutrient capture, help control soil erosion, and improve water quality. They can also reduce weed growth.

Toward the eventual goal of finding an effective non-chemical weed control alternative, we conducted a study at Washington State University's Vancouver Research and Extension Unit on 1.3 acres of organically managed vegetables. The basic idea of the study was to overseed winter cover crops in demonstration plots of vegetables then to measure the efficacy of the cover crops in controlling weeds. We would plant vegetables in the spring, overseed cover

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crops in the late summer or early fall, then assess weed development later in the same fall and again the following spring. Efficacy of weed control would be measured by weed stand (diversity of weed species and number of individual weeds) and weed weight. We have conducted the study over two years so far, using the same field area in 2001 and 2002, but varying the vegetable crop, cover crops, and field design each year.

Vancouver Study, Year One

In May 2001, we planted edamame (vegetable soybeans) and dry beans in blocks measuring 50 and 90 feet wide, respectively, and 150 feet long. During the growing season, we mechanically cultivated weeds between the rows and controlled weeds by hand within the crop rows. Prior to the last mechanical cultivation, we overseeded five different cover crops onto observation plots measuring 25 feet long and 140 feet wide (Figure 1). The seed was incorporated with the last cultivation.

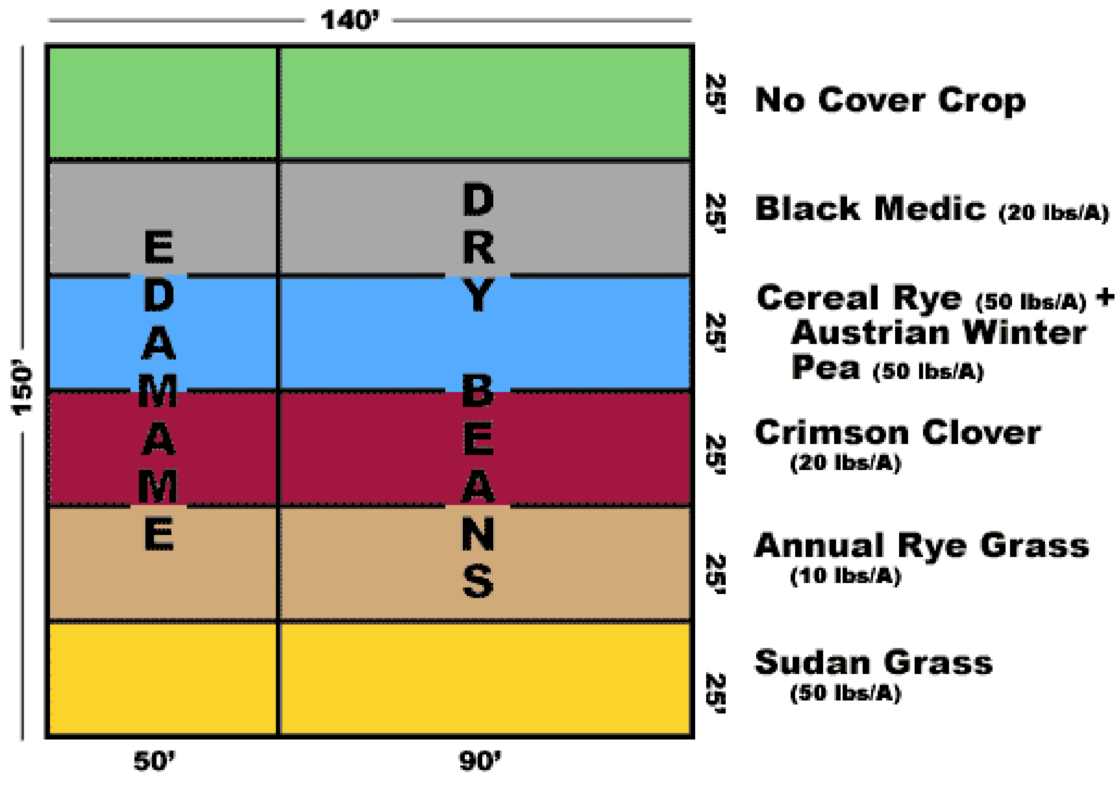

FIGURE 1. Vegetable and cover crop plot design at WSU Vancouver Research and Extension Unit in 2001. Cover crop plots were 140 feet wide by 25 feet long over a total crop area of 140 feet by 150 feet.

On October 17, 2001 and again on March 1, 2002 we collected and analyzed ten random samples of weeds and cover crops from each cover crop plot. Randomness was achieved by tossing a small (1.6 ft2 area) hoop into the plots then sampling the area inside the hoop. Stands and weights of weeds (Table 1) and cover crops (Table 3) are shown in the tables at the end of the article.

We found that all cover crops resulted in lower weed weight than the control plots, but the differences were not statistically significant (Table 1). In the fall, weed weight was lowest in the crimson clover treatment, but by late winter it was lowest in the annual rye treatment. Weed weight was highest in the Sudan grass in the fall, but by late winter was highest in the cereal rye plus winter pea mix. All cover crop treatments resulted in a decrease in the number of weeds compared to the control treatment (Table 2). The control and Sudan grass treatments had the greatest diversity of weed species while annual rye had the lowest weed species diversity. Annual rye also achieved the greatest biomass of the cover crops (data not shown).

From our work in the first year, we concluded that weed suppression due to cover crops is likely a function of both numbers of cover crop plants and cover crop biomass. In general, we found that Sudan grass and annual rye grew too vigorously for this overseeding system while medic was not vigorous enough. Annual rye was difficult to control in the following year, coming back as a weed. From our observations, the cereal rye and crimson clover performed well in the overseeding system.

Vancouver Study, Year Two

In the spring of 2002, the cover crops from the first year of the study were mowed and the field was disced and prepared for planting. Again, we planted dry beans and edamame (in May and June, respectively). Our dry bean plot measured 90 feet wide and 100 feet long, and edamame area was 90 feet wide and 50 feet long. Again, we managed weeds during the production season via mechanical cultivation between rows and manual weeding within the crop row. In the second year, we changed our cover crop treatments and plot design in response to vegetable crop disease and weed pressure. In 2001 (and, as it turned out, again in 2002) our dry bean crop suffered extensively from halo blight (*Pseudomonas syringae* pv. *phaseolicola*), a seed- and soilborne disease. We adjusted our cover crop treatments so that we could investigate potential control options of this disease as we studied the weed control benefits.

We harvested the bean crops in the fall of 2002, then on October 17 we disced the field, broadcast-seeded the cover crop treatments, and incorporated the seed by harrowing. This second year, we employed a randomized complete block design with four replications as shown in Figure 2; each block was 18 feet by 25 feet, for a total area of 90 feet by 100 feet (only a portion of the full 100-foot length of the dry bean plot was used). Compared to the first year, we added brown mustard and Caliente mustard, and removed the winter pea addition to cereal rye. We also increased the seeding density of cereal rye threefold. The resulting cover crops and seeding rates for fall of 2002 were: brown mustard (20 lbs/A), Caliente mustard (20 lbs/A), crimson clover (20 lbs/A), and cereal rye (150 lbs/A).

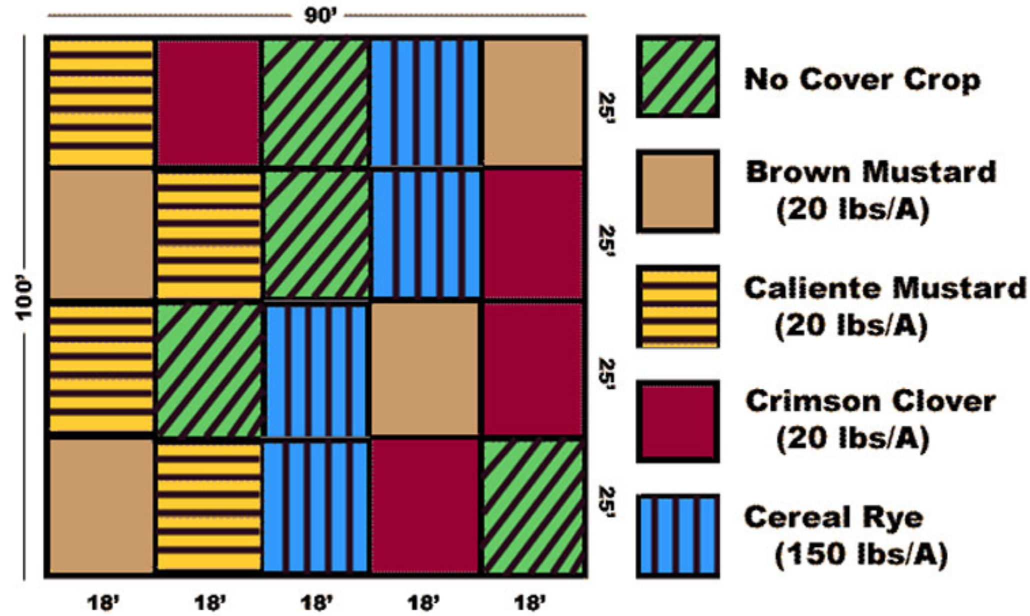

FIGURE 2. Cover crop plot design at WSU Vancouver Research and Extension Unit in October 2002. Cover crop plots were 18 feet wide 25 feet long and total area was 90 feet by 100 feet.

Conclusions and Continued Research

Winter cover crops have the potential to reduce weed growth in a subsequent vegetable crop. Some cover crops will work better than others; seeding rates and crop selection will influence the efficacy, as will the introduction of complicating factors such as disease pressure. There are indications that weed control can be optimized if the cover crops are sown in the summer into a standing vegetable crop. Timing of cover crop overseeding is critical; it should be late enough that there is no or little competition between the cover crop and the vegetable crop, yet early enough that the cover crop becomes established before winter.

We are continuing our research in 2003, expanding from our original focus of weed suppression to a dual focus of weed and disease suppression. This spring (2003), the plots are being planted with a single variety of halo blight-susceptible dry beans. We plan to evaluate weed and disease pressure in each plot.

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TABLE 1						
Mean weight (kg)* and number of weeds in cover crop plots at WSU Vancouver REU on October 17 2001 and March 1 2002. (*Average of the ten 1.6 ft^2 areas Sampled within each plot.)						
Treatment	Weeds					
	17-Oct-01			01-Mar-02		
	Fresh Wt. (kg)	Number		Fresh Wt. (kg)	Dry Wt. (kg)	Number
Control	0.23 a	18.2 a		0.24 ab	0.13 ab	7.4 a
Crimson Clover	0.03 a	4.5 b		0.09 b	0.05 b	4.7 ab
Black Medic	0.11 a	4.9 b		0.08 b	0.04 b	4.7 ab
Cereal Rye + Winter Pea	0.15 a	6.0 b		0.44 a	0.25 a	5.1 ab
Annual Rye	0.15 a	6.3 b		0.02 b	0.01 b	0.8 b
Sudan Grass	0.17 a	7.0 b		0.18 ab	0.11 ab	4.9 ab
P Value	0.2254	0.0053		0.0001	0.0002	0.0223
Treatments with different letters are significant at p=0.05 level by Tukey's multiple range test. "P Value" is a way of stating probability that data represents a true difference as opposed to an artifact of random sampling. P Values range from zero to one; the smaller the P Value (closer it is to zero), the more likely the difference is caused by the treatments.						

Table 2 appears on the next page.

TABLE 3						
Mean weight (kg)* and number of cover crops in plots at WSU Vancouver REU on October 17 2001 and March 1 2002. (*Average of the ten 1.6 ft^2 areas sampled within each plot.)						
Treatment	Cover Crops					
	17-Oct-01			01-Mar-02		
	Fresh Wt. (kg)	Number		Fresh Wt. (kg)	Dry Wt. (kg)	Number
Control	--	--		--	--	--
Crimson Clover	0.08 ab	25.0 a		0.31 a	0.11 ab	11.7 ab
Black Medic	0.04 b	14.9 ab		0.12 a	0.06 b	21.7 a
Cereal Rye + Winter Pea	0.08 ab	2.5 ab		0.12 a	0.06 b	2.3 b
Annual Rye	0.19 a	8.8 b		0.36 a	0.20 a	15.6 a
Sudan Grass	0.01 b	1.7 b		0.29 a	0.19 a	12.8 ab
P Value	0.0007	0.0097		0.7985	0.0010	0.0000
Treatments with different letters are significant at p=0.05 level by Tukey's multiple range test. "P Value" is a way of stating probability that data represents a true difference as opposed to an artifact of random sampling. P Values range from zero to one; the smaller the P Value (closer it is to zero), the more likely the difference is caused by the treatments.						

TABLE 2												
Total number and different types of weeds in 10 samples from each cover crop plot at WSU Vancouver REU on October 17 2001 and March 1 2002.												
Weed Type	**Control**		**Crimson Clover**		**Black Medic**		**Cereal Rye + Winter Pea**		**Annual Rye**		**Sudan Grass**	
	10/17	**3/1**	**10/17**	**3/1**	**10/17**	**3/1**	**10/17**	**3/1**	**10/17**	**3/1**	**10/17**	**3/1**
Annual Sawthistle	5	2	5	1	2	1	2	3	7	1	5	2
Barnyard Grass	47	1	10		16	12	20		2		1	
Canada Thistle	16	1	13		3		4				4	5
Chickweed		6						4				
Corn Spurrey		1		1		1		5				1
Dandelion	1	1			4	1			3		3	3
Field Horsetail											1	
Fireweed		3			1	4	1			1		1
Fringed Sagebrush	15				3		6		5			
Hairy Nightshade	8	1	4		3		5				1	2
Henbit		7		3					1		3	9
Johnson Grass	6	1			5				9		3	
Lesser Snapdragon			2	1			3				6	
Mayweed Chamomile		2		4	3	10	1	12	6	2	3	2
Pale Smartweed								1				
Perennial Sawthistle		3		5		4		4	7			7
Plantain	2	1	1			1	2				2	1
Prostrate Knotweed				1							2	2
Radish	1	2	1				1		1		2	1
Redroot Pigweed		2		1	1		1	2			1	
Ripgut brome											3	
Shepherds Purse		1										
Western Crabgrass		42		32		13		19				7
Western Salsify		1										
Wild Oat	11	2	1		1		2		19		18	
Witch Grass	2		3		5		3				1	

The work described in this article is just one of many integrated pest management (IPM) efforts underway in Washington State. Several other Washington IPM projects are detailed in the March and April issues of *Agrichemical and Environmental News,* available on the Internet at http://aenews.wsu.edu . For additional information on IPM in Washington State, please consult the following resources:

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