ORGANIC FARMING RESEARCH FOUNDATION

Organic farming research project report submitted to the Organic Farming Research Foundation:

Project Title:

Cover Crops for Weed Management in Organic Vegetables

FINAL PROJECT REPORT

OFRF project number: 00-06, awarded spring 2000

Submitted: September 2001

Principal investigator:
Carol Miles and Chuhe Chen,
Washington State University Cooperative Extension
Vancouver Research and Extension Unit
1919 NE 78th Street, Vancouver, WA 98665
Tel. 360-576-6030,
Email: milesc@wsu.edu,
Web: agsyst.wsu.edu

Project budget: $10,000

Funding provided by OFRF: $7,500

Project period: 2000-2001

Organic Farming Research Foundation
P.O. Box 440
Santa Cruz, CA 95061
tel. 831-426-6606
email research@ofrf.org
web www.ofrf.org

Introduction

In the summer of 2000, we received a research grant from the ***Organic Farming Research Foundation*** to study over-seeded cover crops in summer vegetables to control weeds. We conducted this study at the WSU Vancouver Research and Extension Unit (WSU VREU), and intended to study the influence of summer over-seeded cover crops on vegetable crop production and weed populations in an organic farming system over a three-year period. We planted our vegetable crops in May 2000, but by mid-summer the weeds in our research field site had overwhelmed our vegetable crop. At that time we had no means to mechanically cultivate our plots (over an acre in size), and we hand weeded plots in an attempt to bring the weeds under control. Due to the extreme weed pressure, our vegetable crops were not harvestable, and we mowed and disked the plots to prepare for our cover crops. In September 2000 we seeded our cover crop, however within a few weeks the weeds once again dominated the field and we abandoned the study.

In this report we will provide background information about the study, an outline of our materials and methods, and results of our weed survey. Although our study failed to accomplish its original research objectives, the study was successful in impacting the WSU VREU and the overall WSU research agenda:

- This study has served as the foundation for the establishment of the first certified organic agricultural land at Washington State University.

- Due to our plight with weed control, WSU provided us with funds to purchase a small vegetable tractor, cultivator, and flay mower for future vegetable and cover crop research.

- This study provided the basis for a new grant project to establish a cover crop demonstration site for small and organic farmers in our region.

- In conjunction with the WSU Center for Sustaining Agriculture and Natural Resources (WSU CSANR), we have become a major contributor to the WSU Organic Research and Extension initiative and are seeking state and federal funding for this program.

- Also in conjunction with WSU CSANR, we conducted a survey of organic research and extension programs and will be coordinating a meeting of interested WSU faculty and staff to discuss organic activities.

Background

Weeds are major pests in organic production systems and cultivation is the most common method used for control. However cultivation is labor, time and resource (fossil fuel) intensive, and farmers need other options to manage weeds. Winter cover cropping is a practice commonly used in organic vegetable production systems in the Pacific Northwest to control weeds and to increase soil quality and nutrient availability. Cover cropping systems contribute significant benefits to organic production systems because they aid in the prevention of soil erosion, increase soil organic matter, assist in the recycling of soil nutrients, and help reduce the amount of nitrate runoff and leaching from the soil. Legume cover crops have been recognized for their capacity to fix nitrogen and effectively utilize rock phosphate, thereby increasing the availability of both nitrogen and phosphorous to successive crops.

Typical organic vegetable cropping systems consist of summer-harvested crops followed by fall-planted cover crops. However, fall planted cover crops leave the soil exposed during the early fall, a vulnerable

time for soil erosion and nutrient leaching. It takes 4-6 weeks for the cover crop to become established and meanwhile rainfall has already begun and new weed growth has started.

In our study we intended to over-seed our cover crops into our vegetable crop as the vegetable crop neared maturity. By planting the cover crop near the time of vegetable maturity, we greatly reduced the potential for competition between the cover crop and the vegetable crop. We also eliminated the lag time between vegetable crop harvest and cover crop establishment, thereby optimizing soil coverage and conservation. We included two vegetable crops in our trial, transplanted broccoli and direct-seeded onions. The transplanted broccoli crop was relatively fast growing while onions were slow growing and took almost two months to gain any size in the field. Weeds are a greater management challenge in onions than in broccoli as the onion canopy does not contribute to weed control (through shading) and more mechanical cultivation is necessary. We used these two vegetable crops with differing growth habits as models of fast- and slow-growing vegetable crops. We planted four different cover crops in the study in hopes of determining which type of cover crop might be best suited to over-seeding in each of the two vegetable crops.

Materials and Methods

The research design was a split plot design with four replications. Main plot treatments were the vegetable crops:

1. transplanted broccoli
2. direct-seeded onions

Split plot treatments were over-seed cover crops:

1. annual ryegrass (*Lolium multiforum)*
2. sudangrass (*Sorghum bicolor* var. *sudanense*)
3. Chinese milkvetch (*Astragulus sinicus)*
4. medic (*Medicago spp.*)
5. control - no cover crop

Split plots measured 30 feet by 30 feet. Broccoli (var. Green Sprouting Calabrese) was seeded in the greenhouse in April and transplanted to the field in early June. Onions (var. New York Early) were direct seeded in the field in late May. Plots were maintained organically. Bloodmeal fertilizer was applied based on soil test results. Irrigation was applied on a weekly schedule based on precipitation.

Plots were hand weeded for weed control, however our field crew was unable to keep up with weed control. By late July, plots were overgrown with weeds and the vegetable crops were essentially smothered. Two plots of broccoli were harvested, but plants were extremely small due to weed competition and yield data was discarded. Onions did not develop at all in the plots due to weed competition.

In early August, ten weed samples were taken at random in the field. Samples were collected by randomly tossing a small hoop measuring 17" in diameter into the plot. The hoop was pushed to the ground, and we removed the weeds found within the hoop. These weeds were sorted, counted and photographed. We posted the photos to my web site and asked our WSU Weed Specialist, Dr. Tim Miller, WSU Mt. Vernon REU, to identify the weeds. We thankfully acknowledge Dr. Miller for providing 'remote expertise' to this project and this experience has laid the groundwork for future remote expertise on similar projects. In early September, plots were mowed and disked to control weeds and cover crops were seeded. Plots were monitored for cover crop emergence and establishment. Cover crops emerged but weed pressure remained high in all plots and no data was collected.

Plots were mowed in March and May 2001 for weed control. A portion of the plots was tilled and edamame and dry beans were planted from May 21 to June 7. Plots will be maintained with mechanical cultivation (equipment was purchased the winter of 2000 with support from WSU) and five cover crops will be over-seeded in strip plots in the late summer. We will monitor cover crop establishment and vegetable crop yield in August-September 2001. In 2002, we will incorporate the cover crops and plant several vegetable crops throughout the plots. We will again over-seed cover crops in the late summer.

Extension Outreach

We have prepared a web page of our study and will post this on our web site, http://agsyst.wsu.edu/covercrop.html. The page will highlight the purpose of the study and will focus on our continuing work. We will also create links to cover crop information and will post a page highlighting our weed photographs with identifications. We will submit this report to the PNW Sustainable Agriculture Newsletter and the Washington State Tilth Journal. We will also include our revised cover crop study in our 2001 Vancouver Station field day August 22 to present our study to farmers in the region.

Weed Evaluation and Identification

A hoop measuring 17" in diameter was thrown at random into the vegetable plots ten times (Figure 1). Weeds that were within the hoop were collected, sorted, identified, and counted each time. The area within the hoop is 1.58 ft^2, and the total area of 10 hoops (the total sample area) was 15.8ft^2. A total of 259 weeds were found in the sample area (Table 1).

Figure 1. A hoop measuring 17" in diameter or 1.58 ft^2 in area was thrown at random into vegetable plots. Weeds within the hoop were collected, sorted, identified, and counted.

Table 1. Species and numbers of weeds collected at random in vegetable cover crop plots from sample areas measuring 1.58 ft^2 in size in early August 2000.

Weed Species	Number of Weeds										Species Totals
	Hoop1	Hoop2	Hoop3	Hoop4	Hoop5	Hoop6	Hoop7	Hoop8	Hoop9	Hoop10	
Annual sowthistle *Sonchus oleraceus*								1			1
Barnyardgrass *Echinochloa crus-galli*			2								2
Black medic *Medicago lupulina*						1				1	2
Canada thistle *Cirsium arvense*					2	2	3		3		10
Corn spurry *Spergula arvensis*	1										1
Field horsetail *Equisetum sarrachoides*					16	3	6	3		15	43
Fringed sagebrush *Artemisia frigida*	1										1
Hairy nightshade *Solanum sarrachoides*	1					2		2	2	1	8
Henbit *Lanium aplexicaule*						1		1			2
Lesser snapdragon *Antirrhinum orontium*		2	2				1		1	12	18
Mayweed chamomile *Anthemis cotula*			1								1
Pale smartweed *Polygonum lapathifolium*					1	1				1	3
Prostrate knotweed *Polygonum aviculare*			1								1
Radish *Raphanus sativus*	2			2		3	3	3	7	15	35
Redroot pigweed *Amaranthus retroflexus*		2				1					3
Wild oat *Avena fatua*		3	2	2	10	15	9	3	10	23	77
Witchgrass *Panicum capillare*	1	1	1			1		1			5
Unidentified- a		2	1	5	2	7	2	7	2	10	38
Unidentified- b				1							1
Unidentified- c						4					4
Unidentified- d								3			3
Hoop totals	6	10	10	10	31	41	24	24	25	78	
									Total (10 hoops)		259

WEED PHOTO IDENTIFICATION

Radish (*Raphanus sativus*)

Corn spurry (*Spergula arvensis*)

Fringed sagebrush (*Artemisia frigida*)

Hairy nightshade (*Solanum sarrachoides*)

Witchgrass (*Panicum capillare*)

Prickly lettuce (*Lactuca serriola*)

Wild oat (*Avena fatua*)

Lesser snapdragonm (*Antirrhinum orontium*)

Redroot pigweed (*Amaranthus retroflexus*)

Mayweed chamomile (*Anthemis cotula*)

Barnyardgrass (*Echinochloa crus-galli*)

Prostrate knotweed (*Polygonum aviculare*)

Broadleaf plantainm (*Plantago major*)

Pale smartweed (*Polygonum lapathifolium*)

Canada thistle (*Cirsium arvense*)

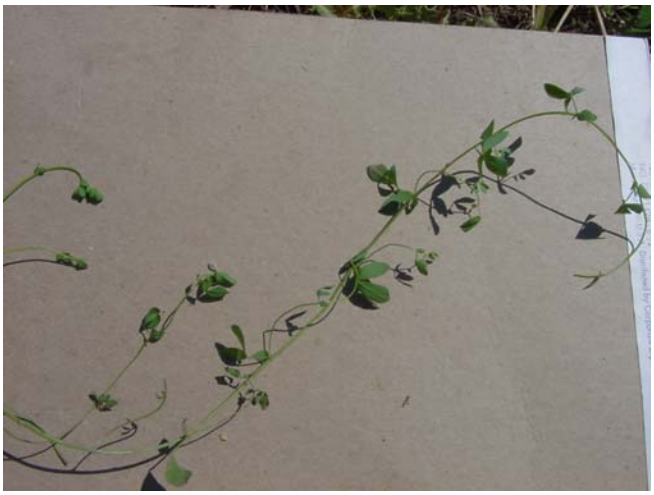
Field horsetail (*Equisetum arvense*)

White clover (*Trifolium repens*)

Henbit (*Lamium amplexicaule*)

Smooth hawksbeard (*Crepis capillaries*) (possible)

Annual sowthistle (*Sonchus oleraceus*)



Black medic (*Medicago lupulina*)

Unidentified (a)

Unidentified (b)

Unidentified (c)

Unidentified (d)