Effect of Rye Straw Mulch, Leguminous and Non- Leguminous Cover crops on Productivity and Weed Suppression in Organically Managed Asparagus Beds (Continuation of FNE01-382)

Farmer/Grower Grant Final Report

SARE Grant # FNE02-424

Goals: This project had two goals:

1. To identify the influence of a variety of cover crops and other management techniques on the **suppression of weeds** in two year old asparagus beds.
2. To identify the influence of a variety of cover crops and other management techniques on the **productivity** of two year old asparagus beds.

Farm Update: Our quantity of organically managed land has expanded an additional 3 acres of land in transition to organic certification in addition to the approximate three acres currently under organic management. The major accomplishment for 2002 was that we continued organic certification from the state of Maryland and addition of Consumer Supported Agriculture (CSA) by the sale of subscriptions for our produce as part of our marketing strategy. We have also expanded poultry by adding turkeys to free range chicken and eggs all grown in movable pens, to our farms diversification.

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Abstract

In April 2001, an experimental 1 acre planting of jersey hybrid (variety *Jersey Giant*) asparagus was established to determine the influence of four different cover crops and two management strategies on the growth of newly planted asparagus. This work was continued into the 2002 growing season. Three growth parameters; height, crown circumference and shoot number were monitored as well as productivity during a six week harvest period between April and May 2002. The four cover crops used in 2001 were: crimson clover, dutch white clover, rape and buckwheat. The cover crops were applied at standard application rates. Two management strategies used were "Control" limited cultivation and a straw mulch. Each treatment was replicated four times for a total of 24 randomly distributed treatment plots. Due to difficult environmental conditions an early wet spring and drought during the summer, the cover crops requiring re-seeding could not be applied. However, the perennial white clover and straw mulch carried over to the 2002 growing season. By the end of the growing season, there was no significant differences between any treatment with regards to any of the growth parameters. However, significant differences were observed between the productivity of the straw mulched plots and the other treatments. Over all no treatment had a significant effect based upon the mean and standard deviation of any monitored growth parameters for the 2002 season.

Project Performance

Planting

At the End of April 2001, approximately one acre of asparagus was planted. The planted area consisted of 12 rows spaced approximately 7 feet apart over a 500 foot long bed. This planting arrangement yielded a total of 6000 row feet (~6000 plants per acre) One year old asparagus crowns were purchased from a commercial supplier and planted at one foot intervals. Prior to planting the soil was plowed, roto-tilled and amended with lime at a rate of 2 tons per acre. Trenches were prepared with a middle buster with a depth of 8-12 inches and spaced at seven feet. Drip irrigation (15 mil. X 12 inch emitters) was installed at the bottom of the trench. The asparagus crowns were placed under the drip tape directly below the emitter. Water was pumped from a pond with no additives. The crowns were covered with a homemade back-filling device similar to a potato hiller. Cover crops were broadcast two weeks after after the trenches were covered and incorporated with a shallow roto-tilling. An two strand electric fence was installed around the perimeter of the planting to deter deer feeding on the plants.

Harvesting

Over the harvest period, (April through May) all the spears with a diameter greater than ¼ inch and 9" in height were harvested daily. Each plot was harvested into individually labeled baskets. Each basket was weighed and the number of spears counted.

Planting Time budget

Plowing (14" single bottom plow)~ 4 hours
Rototilling (50" rototiller) ~ 3 hours
Irrigation Installation (plumbing and design) ~ 16 hours
Planting (two - three participants) ~40 hours
Cover Cropping and Mulching (one person) ~8 hours
Harveasting ~ 2 hours per day

Mowing Time Budget

Approximately 4 Hours each time

Planting Budget (major costs)

Asparagus	~$1,600.00
Irrigation	~$ 500.00
Fencing	~$ 250.00

Experiment Setup

The one acre experimental area was subdivided into twenty four plots(identified A - X) allowing 4 replicates of each six treatments. The replicates were assigned by randomly by preparing a set of 24 paper slips with each replicate listed four times. The slips were mixed together and drawn in succession then assigned alphabetically. The final layout is represented in the table below. Each replicate plot was approximately 25 ft X 85 ft for a

total area of 2125 ft^2. Within each plot were three rows of asparagus. Six treatments were selected for this project : control (open cultivation), straw mulch and four cover crops (buckwheat, dutch white clover, crimson clover, and rape) applied at a rate suggested by the supplier. The control treatment consisted of infrequent rototilling during the growing season. The straw was applied over the entire planting area at a depth of approximated 6- 8 inches or 1 bale / 100 square feet. Buckwheat was applied at a rate of 2.5 pounds / 1000 ft^2. Rape was applied at a rate of 0.25 pounds/ 1000 ft^2. Dutch white clover was applied at a rate of 0.25 pounds/ 1000 ft^2. Crimson clover was applied at a rate of 0.5 pounds / 1000 ft^2. Over the duration of the project, all treatments were mowed twice. The mowing was performed such that the material discharged from the mower was directed onto the row of asparagus assigned to each treatment.

This is a diagram of the experimental area.

	Plot Length 510 feet , six sections 85 feet each, total row length per plot = 255 ft					
Plot Width 100' 4 Divisions 25 feet wide Three Rows Each	A- White Clover	B- Crimson Clover	C- Rape	D- White Clover	E- Rape	F- Buckwheat
	G- Crimson Clover	H- Control	I- Rye Straw	J- Crimson Clover	K- Crimson Clover	L- Buckwheat
	M- Rye Straw	N- Control	O- Control	P- White Clover	Q- White Clover	R- Rape
	S- Buckwheat	T- Rye Straw	U- Rye Straw	V- Buckwheat	W- Control	X- Rape

Cover Crop Budget

Treatment	Units / Plot	Cost /Unit	Total Units	Total Cost
Buckwheat	5.0 lbs	~$1.0/lb	20.0 lbs	$ 20.00
Rape	0.5 lbs	~$4.0/lb	2.0 lbs	$ 8.00
Dutch White Clover	0.5 lbs	~$4.0/lb	2.0 lbs	$ 8.00
Crimson Clover	1.0 lbs	~$4.0/lb	4.0 lbs	$ 16.00
Rye Grass Straw	30 bales	$1.5/bale	120 bales	$ 180.00
			Total	$ 242.00

Project Monitoring and Performance

Two parameters were monitored throughout the duration of this project: asparagus crown growth and spear production. Quantitative parameters for the asparagus plants were for, height of tallest shoot, clump circumference and number of shoots. Rainfall was monitored with a commercial rain gauge over the duration of the monitoring period. Irrigation was applied when rainfall totaled less than one inch per week. Growth monitoring was performed twice over the growing season (June and October). Individual plants for measurements were selected by walking along the rows and stopping at random intervals. The nearest crown was measured for circumference and height with a seamstress's measuring tape in inches and the total number of shouts were counted. Mowing of the cover crops was done twice in the growing season following weed and cover crop monitoring. Mowing was performed with a craftsman 42 inch riding mower or a King Kutter 60 inch finish mower. The trimmings were directed to the rows of asparagus through the side shoot of the mower. A final mowing the entire plot was performed in the winter of 2001 to remove dead asparagus ferns..

Asparagus and Cover Crop Observations

Over this growing season, all plantings showed positive growth in height and number of shoots, however crown circumference remained relatively constant. Main weeds were fox tail, plantain, assorted grasses, and rag weed. Weed growth was worst in the rows of asparagus due to the water provided by irrigation. Since the annual cover crops were not planted their impact could only be assessed from the previous year. Although not quantitatively measured, my observations were that different cover crops lead to different weed population the following season. For example Those plots originally cover cropped with buckwheat tended to have a high population (almost a mono-crop) of plantain between rows. Those plots originally planted with crimson clover tended to have a high proportion of grasses. Rape was followed by a mix of broadleaf weeds and grasses. The white clover over wintered and established a thick mat of weed reducing cover crop. No major insect damage was observed during the growing season.

Buckwheat : Asparagus data in October: maximum shoot height 53.7 ± 12.2 inches, shoot number 2.7 ± 1.5 inches and crown circumference 4.2 ± 2.8 inches. Over the harvest period, 499 spears were harvested for a total weight of 388 ounces and an average spear weight of 0.506 ounces.

Crimson Clover : Asparagus data in October: maximum shoot height 51.44 ± 10.1 inches, shoot number 2.5 ± 1.3 inches and crown circumference 3.3 ± 2.4 inches. Over the harvest period, 408 spears were harvested for a total weight of 136 ounces and an average spear weight of 0.333 ounces.

Dutch White Clover : In the fall, white clover was still growing after the second mowing establishing a thick lawn provided weed suppression the following year. Asparagus data in October: maximum shoot height 53.5 ± 11.1 inches, shoot number 3.5 ± 1.2 inches and crown circumference 5.7 ± 3.3 inches. Over the harvest period, 548 spears were harvested for a total weight of 263 ounces and an average spear weight of 0.480 ounces.

Control -Open Cultivation : Weed growth was reduced in the rows however, within the asparagus rows there was high amounts of weed growth. Even with the weeds growing amongst the asparagus the asparagus still grew well. Average data in October: maximum shoot height 59.5 ± 10.5 inches, shoot number 2.8 ± 1.8 inches and crown circumference 4.9 ± 3.5 inches. Over the harvest period, 672 spears were harvested for a total weight of 361 ounces and an average spear weight of 0.538 ounces.

Organic Mulch: A 6 inch layer of rye straw mulch was applied over the entire planting area. This thick mat suppressed weeds well until it started to decompose. Since it was applied within the rows, it also reduced some growth in weeds within rows. The mulch in the rows made it difficult to mow or cultivate when required. Average data in October: maximum shoot height 54.0 ± 12.5 inches, shoot number 2.8 ± 1.8 inches and crown circumference 4.6 ± 2.6 inches. Over the harvest period, 766 spears were harvested for a total weight of 388 ounces and an average spear weight of 0.506 ounces.

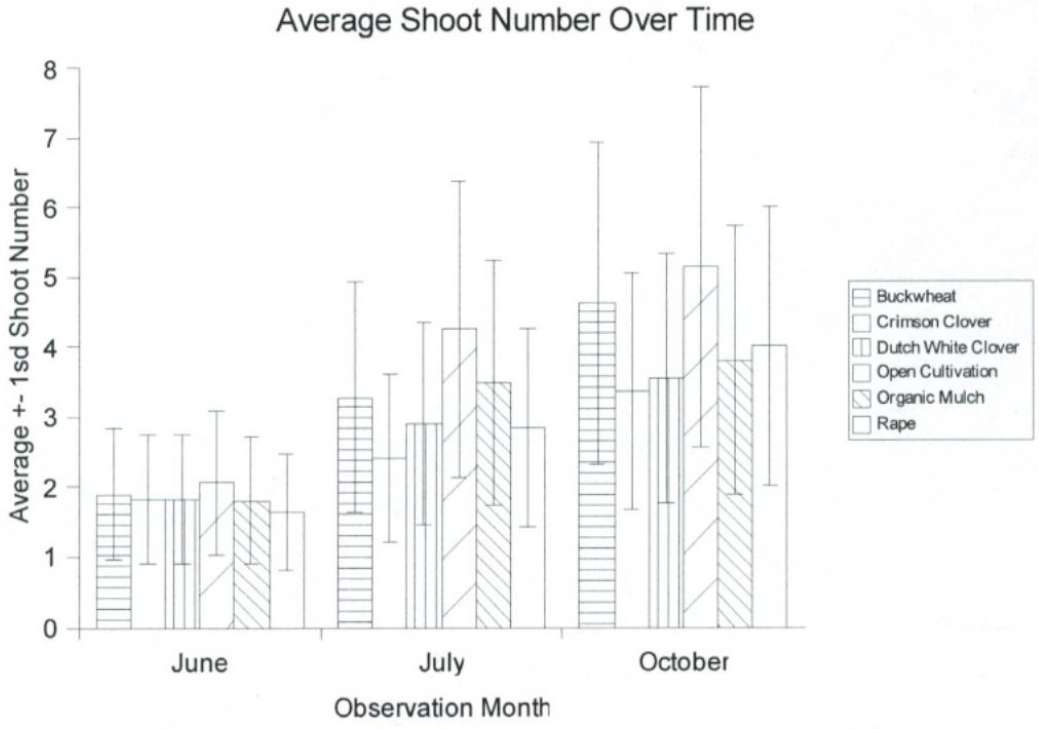
Rape : Average data in October: maximum shoot height 52.0 ± 7.4 inches, shoot number 3.8 ± 1.8 inches and crown circumference 5.4 ± 2.9 inches. Over the harvest period, 543 spears were harvested for a total weight of 233 ounces and an average spear weight of 0.429 ounces.

The following graphs represent the three growth parameters monitored during the 2001 and 2002 growing season. The mean and one standard deviation of the results are represented. From each treatment replicate, eight crowns were measured. With four replicates per treatment a total of 32 data points were collected for each monitored parameter for each monitoring period.

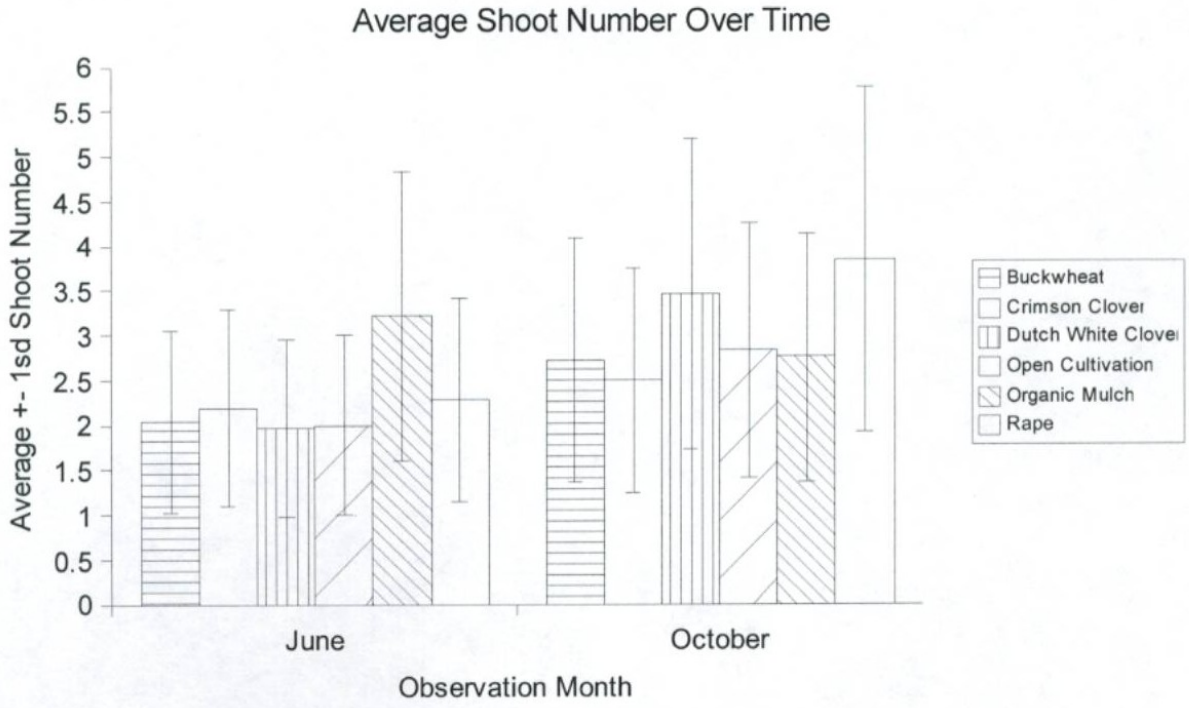
Maximum Average Shoot Height 2001

Maximum Average Shoot Height 2002

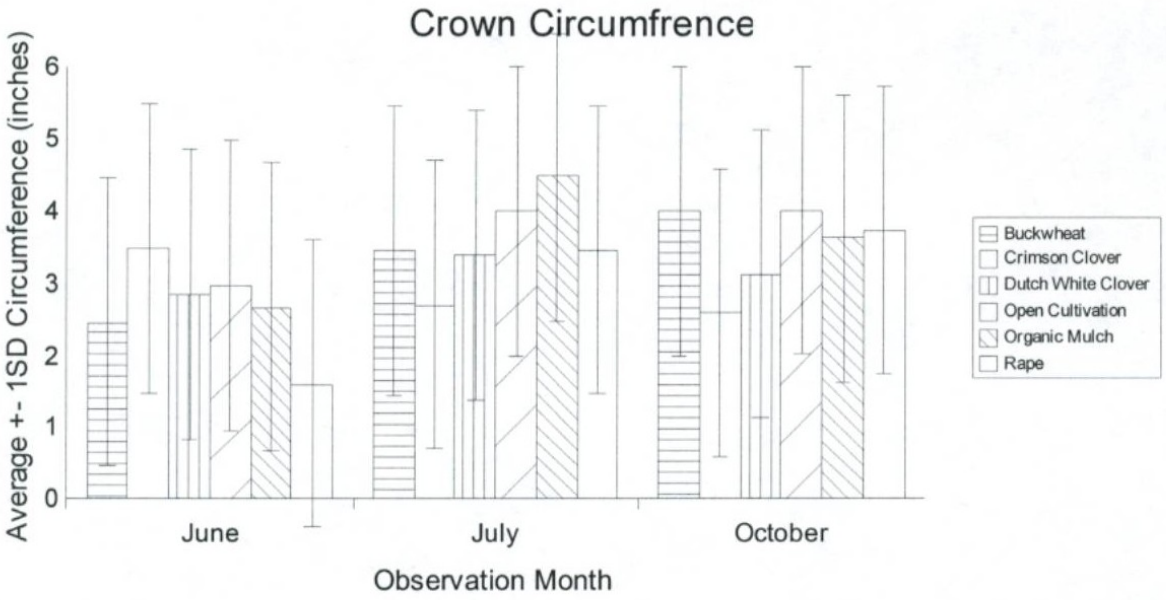
Average Shoot Number 2001



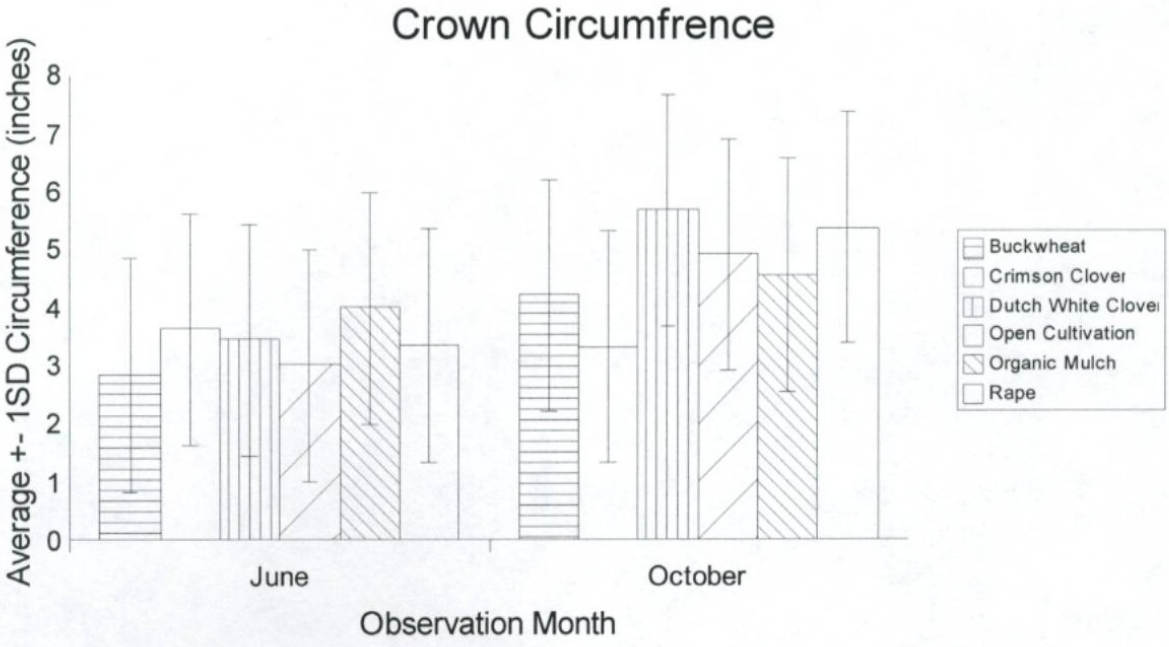
Average Shoot Number 2002



Crown Circumference 2001



Crown Circumference 2002



Site specific conditions

This season was hampered by several weather conditions. The early spring was relatively wet then dry followed by a sever drought (<1 inch between June and August) which did not subside until September. These conditions made it difficult to coordinate cultivation and cover crop planting.

Economic Findings

The first year planting of asparagus (2001) no harvesting was done and no direct economic findings were generated. The second year a total of approximately 100 pounds of marketable spears were harvested. This represents a market value of $300.00. Estimated production once fully established is 0.25 to 0.5 pounds / linear foot. At a whole sale price of $3.00/lb this plot could potentially generate (0.25lb/ft X 6000ft) =1500lbs or $4500 to (0.50lb/ft X 6000ft) =3000lbs = $9000.

Discussion

Based upon the results from the monitored growth parameters, there is no significant difference between treatments for the 2002 growing season. All treatments exceeded the growth parameters from the preceding year with the exception of spear number. This could be expected since many spears were harvested and would not be counted during this later months. Mulched rows produce 17% more spears and 7 % higher total weight in comparison to the cultivation control. For a more passive management system it appears that white clover may offer the best perennial weed suppression although production was reduced ,(18% fewer spears and 27% lower total weight). The growth of white clover in the rows of asparagus providing effective weed suppression amongst the asparagus which was a major problem in the previous year and stabilize the ground during the wet fall and winter. These productivity parameters were reduced for buckwheat, rape and crimson clover, in comparison to the control plots.

Total spears per treatment ranged between 408 and 766 with an average of 573. Straw mulch yielded the highest number of spears at 766 in comparison to crimson clover only producing 408. Straw mulch also produced the highest total weight of spears however, the largest average spears were produced by the open cultivated plots. White clover produce the third highest quantity for all three criteria. Although the straw mulch cover produced the highest number of spears, to apply this strategy to cover the entire acre may prove to be cost prohibitive. Alternatively, just the rows could be covered and the inter rows planted with white clover. One bale can cover approximately 40 row feet. At this rate, it would require approximately 150 bales at $2.00 each or $ 300, a nominal cost for a production increase of 14% for spears or 7% for weigh in comparison to cultivation.

	Spears	% Cult	Ounces	% Cult	Oz / Spear	% of Cult
Straw Mulch	766	114%	388	107%	0.506	94%
Cultivation	672	100%	361	100%	0.538	100%
White Clover	548	82%	263	73%	0.480	89%
Rape	543	81%	233	64%	0.429	80%
Buckwheat	499	74%	233	64%	0.466	87%
Crimson Clover	408	61%	136	38%	0.333	62%
Total	3436		1613		0.459	
Average	573		269		0.459	
St Dev	127		93		0.072	
Variability	22%		34%		16%	

Table presenting harvest data for the 2002 growing season.

If white clover is used there is a overall loss of productivity of 18% for spears and 27% for weight. These data suggest that a combination of straw mulching over the asparagus to increase productivity and white clover to reduce inter row weed may be an optimal strategy for organic production of asparagus.

Further investigation of the economic impact of these strategies could also be investigated. One initial goal of the project was to monitor shoot quality in relationship to cover crop type. Different cover crops may reduce insect damage or increase blanching of the stalks that may produce a better appearing thus more valuable product. These effects were not observed during the 2002 harvest season. The long term effects of cover crops could also be monitored. The observations that different cover crops were followed by different weed types may offer opportunities to evaluate control of different weeds by alternative cove crops. A perennial cover crop such as dutch white clover appears to be an appropriate cover crop since it establishes a permanent "lawn" of mowable leguminous material that can be distributed to the asparagus rows.

Continued use of this information

I plan on applying this information in the future in an attempt to develop a less labor intensive way of managing weeds for asparagus and other perennial crops.

Outreach

On February 15, 2003 these findings were presented at the MOFFA (Maryland Organic Food and Farming Association) annual winter meeting at the Maryland Department of Agriculture. Is was attended by farmers, representatives from Maryland's state department of agriculture and county extension agents. I have also invited representatives of county extension to the project site.

Michael Klein February 11, 2003