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

Farmer/Grower Grant Final Report

SARE Grant # FNE01-382

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 newly established asparagus beds.
2. To identify the influence of a variety of cover crops and other management techniques on the **productivity** of newly established asparagus beds.

Farm Update: Our current quantity of organically managed land remains the same. The major accomplishment for 2001 was that we received organic certification from the state of Maryland. We have also added poultry in the form of chicken in movable pens to our farms diversification.

Cooperators : Michelle Klein - Planting and monitoring
Okarsama Brooks-White - Agriculture Extension Representative,
Greg and Felice Nass - Planting assistance
Bret Grohsgal - Planting assistance

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. In addition, weed growth intensity was monitored between treatments. Three growth parameters height, crown circumference and shoot number were monitored as well as relative weed growth between April and September 2001. The four cover crops used 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. Subjective weed growth monitoring indicated that open cultivation followed by buckwheat provided the best weed suppression over time. Organic mulch yielded the highest maximum shoot height followed by buckwheat and control. The control treatment yielded the highest average number of shoots followed by buckwheat. Clump circumference remained constant over time and between all treatments. Over all no treatment had a significant effect based upon the mean and standard deviation of any monitored growth parameters however comparing grow trends may provide some insight to the impact of each treatment.

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.

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

Mowing Time Budget

Approximately 4 Hours each Time

Planting Budget

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 2125ft^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 rototillings during the

growing season. Organic Mulch, initially a wood chip mulch was proposed however due to handling difficulties a lighter and more portable mulch was selected, rye grass straw. 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 discrharged from 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 bale	$ 180.00
			Total	$ 242.00

Project Monitoring and Performance

Three parameters were monitored throughout the duration of this project: cover crop growth, asparagus shoot growth and weed growth. Cover crop growth was qualitatively monitored for emergence, effect of coverage and height. Quantitative parameters for the asparagus plants were for, height of tallest shoot, clump circumference and number of shoots. Weed intensity was ranked on a scale of one to ten, one = no weeds 10 = complete weeds. In addition, 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 three times over the growing season Early June, Late July and Early October. Individual plants were randomly 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. Weed and cover crop growth was observed

twice (July and September) during the growing season. Cover crop growth were only descriptive observations and weed intensity was given a relative score of 1 to 10 (1 no weeds and 10 complete weeds). 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. The trimmings were directed to the rows of asparagus through the side shoot of the mower.

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 all the cover crops were broad cast, there were also planted within the asparagus rows versus the control plantings which had nothing planted over the asparagus. Initially the cover crops provided some suppression of weeds until the weeds overgrew some cover crops. No major insect damage was observed during the growing season. Cover crops were planted two weeks after bed establishment. This time (mid may) may not have been the optimal time for planting of some cover crops however, all germinated and grew through the growing season. Based upon simple comparisons of average and the standard deviations calculated from treatment growth parameters there were no truly different effects of any treatment on growth of asparagus. However since this is a biological system with high variation, high standard deviations could be expected. If only the average parameters are compared, some trends can be observed which may be useful for future applications.

Buckwheat : Buckwheat emerged within one week and established a dense canopy that suppressed weed growth throughout the growing season. Since it was broad cast, it also grew within the asparagus row reducing weeds with the asparagus. It reached a height of approximately 48 inches prior to the first mowing. At this height it tended to fall over and form a thick mat. At this growth stage, seeds had formed and a second cycle of buckwheat started after the first mowing. Asparagus grew well compared to other treatments. Asparagus data in October: maximum shoot height 35.9 ± 9.2 inches, shoot number 4.6 ± 2.5 inches and crown circumference 3.98 ± 1.84 inches.

Crimson Clover : Crimson clover emerged within one week and was slow to form a growth dense enough to suppressed weeds. Maximum height prior to the first mowing was 12 inches. Through the growing season faster growing weeds grew through the clover forming a double layered canopy of weeds and clover. Asparagus did not grow as well in comparison to other treatments. Asparagus data in October: maximum shoot height 30.8 ± 8.0 inches, shoot number 3.4 ± 1.4 inches and crown circumference 2.6 ± 1.5 inches.

Dutch White Clover : Dutch white clover grew in a similar fashion to the crimson clover. Maximum height prior to the first mowing was about 8 inches inches. Through the growing season faster growing weeds grew through the clover forming a double layered canopy of weeds and clover. Asparagus did not grow as well in comparison to other treatments. In the fall, white clover was still growing after the second mowing establishing a tick mat which may provide improved suppression the following year. Asparagus data in October: maximum shoot height 31.4 ± 10.2 inches, shoot number 3.6 ± 1.5 inches and crown circumference 3.1 ± 1.7 inches.

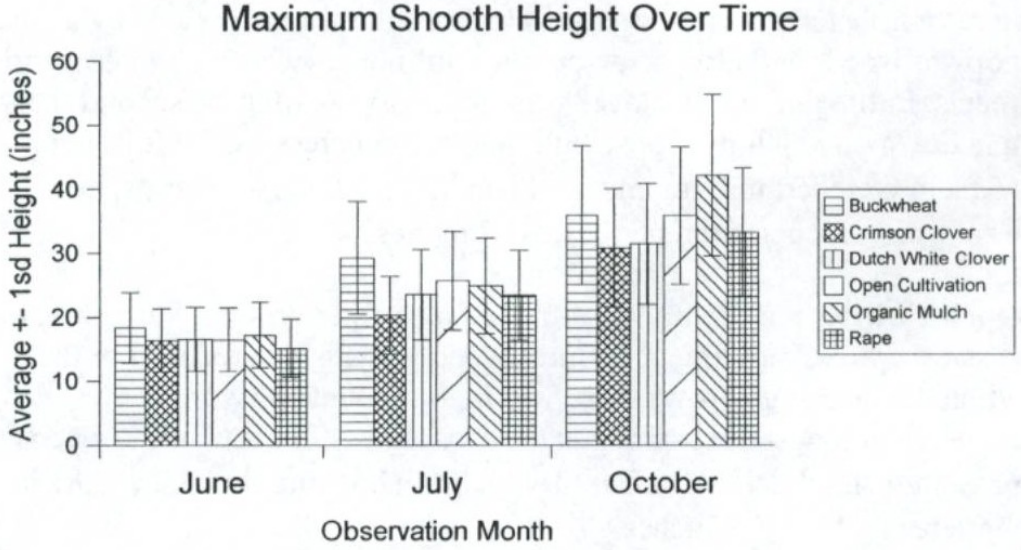
Control -Open Cultivation : A tractor mounted roto-tiller was used to cultivate between rows at the same time as mowing occurred. Weed growth was reduced in the rows however, within the asparagus rows there was high amounts of weed growth. Even with the weeds growing amongst the asparagus the asparagus still grew well. Average data in October: maximum shoot height 35.8 ± 11.4 inches, shoot number 5.2 ± 2.81 inches and crown circumference 4.0 ± 2.2 inches.

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. This treatment yielded the highest average height. Average data in October: maximum shoot height 42.2 ± 12.1 inches, shoot number 3.8 ± 1.5 inches and crown circumference 3.6 ± 1.5 inches.

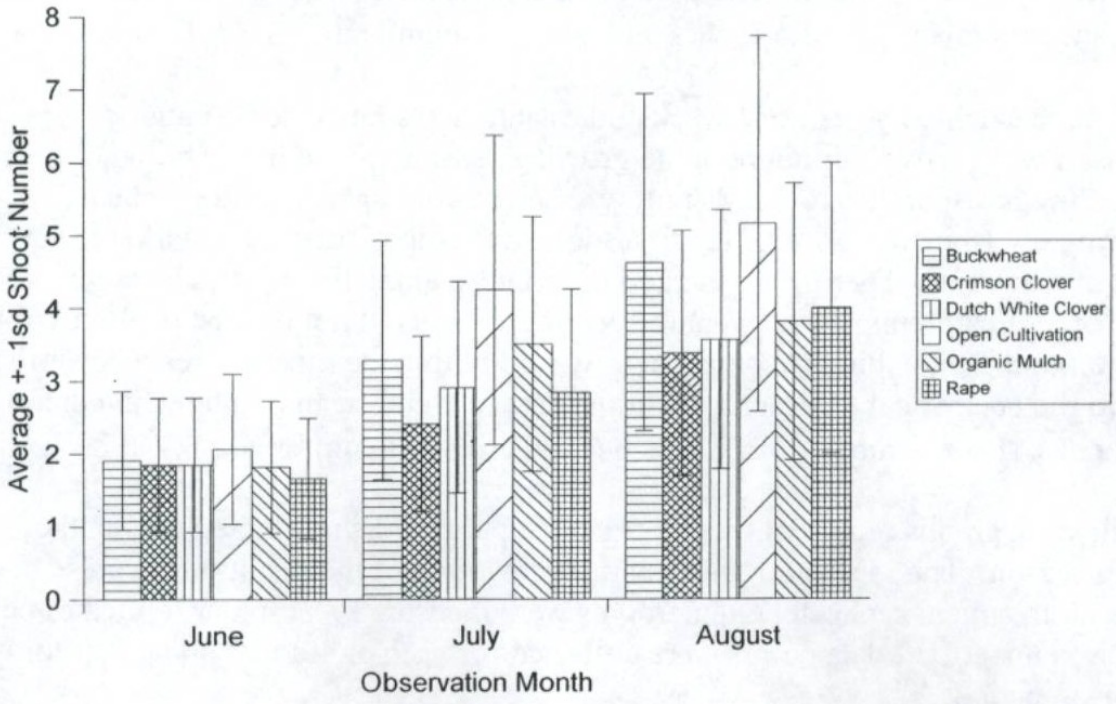
Rape : Rape emerged within one week and established a fairly dense canopy that suppressed weed growth throughout the growing season. Since it was broad cast, it also grew within the asparagus row reducing weeds with the asparagus. It reached a height of approximately 16 inches prior to the first mowing. Rape formed a remarkable barrier to grasses in particular. There were marked differences along the borders between the rape and the other treatments. Rape went to seed in July but did not re-seed itself possibly due to temperature or moisture. Asparagus grew well within the rape and reached similar height to the buckwheat treatment. Average data in October: maximum shoot height 33.3 ± 8.0 inches, shoot number 4.0 ± 1.9 inches and crown circumference 3.7 ± 2.3 inches.

The following graphs represent the three growth parameters monitored during the 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.

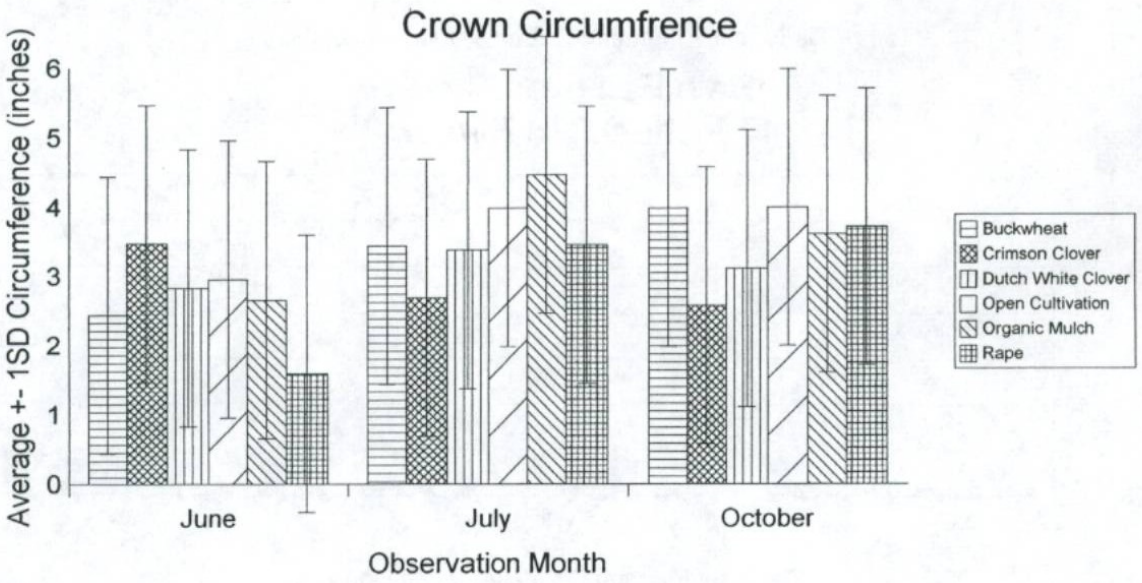
Tallest shoot Height



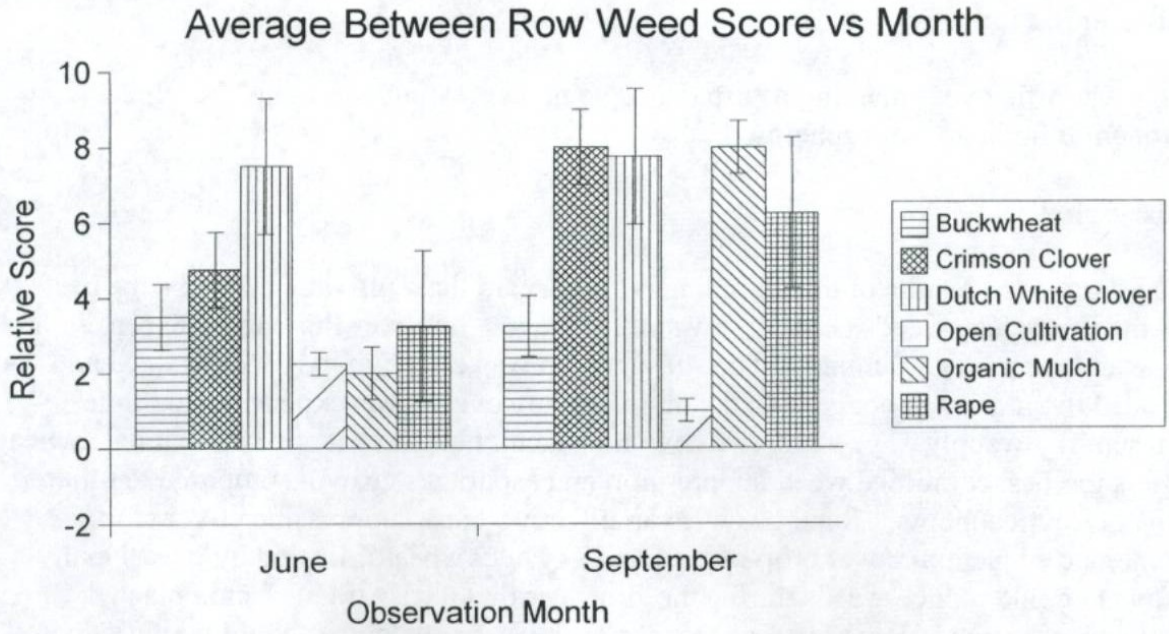
Total Shoot Number



Crown Circumference

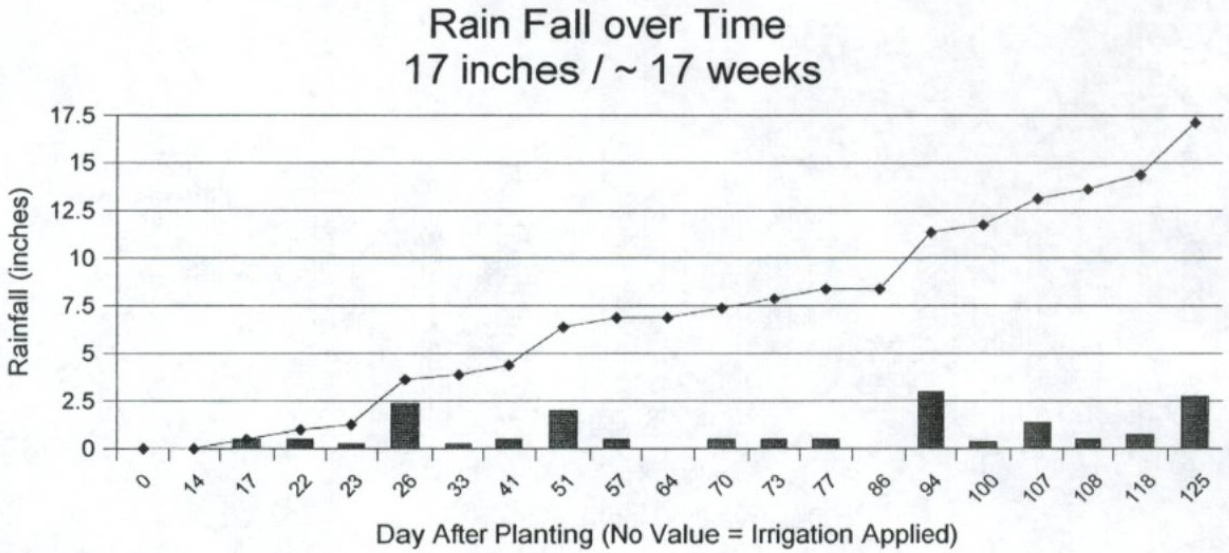


Relative Between Row score, 1 = Low number of weeds 10 = High number of weeds



Rain Fall Between May 17 2001 and August 30, 200. Irrigation was only required two times over this period. Irrigation was applied after planting to help establish the crowns.

Bars = Daily rain accumulation, Line = total accumulation



Site specific conditions

There were not particularly unusual conditions experienced during the growing season. Temperatures were some what cooler than the past few years and rainfall was average.

Economic Findings

This was a first year planting of asparagus so no harvesting was done. No direct economic findings were generated.

Discussion

Based upon the results of this experiment, it appears that cultivation may be the best method to reduce weeds between rows of asparagus, however this can be expensive in time and resources. Similarly, The straw mulch was effective in reducing weed and yielded the highest shoot growth and number, however it was expensive and time consuming to apply. For a more passive management system it appears that buckwheat offers the best combined weed suppression and asparagus growth compared to other cover crop treatments. Rape provides an effective grass suppressing cover crop. A combined sequential cover crop of rape and / or buckwheat followed by occasional mowing could reduce weeds during the first year that an asparagus bed is planted. For better management, some form of successive cover crop planting could be investigated. Rape followed by buckwheat followed by white clover way provide a year long weed suppression regiment.

One of the major problems I encountered was, the large quantity of weed that grew in the asparagus rows. It would be difficult to control these weeds mechanically with out damaging the asparagus. The use of buckwheat or rape planted directly on top of the asparagus was shown in this project to prevent this to some degree. Timely annual cultivation in late winter followed by an spring planting of rape that could smother out early emerging weeds without competing with the asparagus shoots. After harvest (April - May), This cover could be mowed and a buckwheat cover crop planted which would suppress weeds through the summer. In the fall a second mowing of the buckwheat followed by an appropriate winter hardy legume could finnish the annual cover crop cycle.

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 will need to determined during the up coming harvest season. The long term effects of cover crops could also be monitored. For example even though the two clover cover crops did not provide adequate weed suppression, added fixed nitrogen may result in long term benefits not yet observed. A perennial cover crop such as dutch white clover may turn out to be a more appropriate cover crop if and when 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. I am most interested in developing a successive cover cropping strategy.

Outreach

On January 5, 2001 I presented the findings of this project 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 January 18,2001