Greenbook 2008

Program Vision Statement

Agriculture in Minnesota will be based on dynamic, flexible farming systems that are profitable, efficient, productive, and founded on ethics of land stewardship and responsibility for the continuing vitality of local rural communities. Minnesotans will strive to understand and respect the complex interconnectivity of living systems, from soil to people, so as to protect and enhance all natural resources for future generations. Minnesota agriculture will sustain an abundance of food and other products as well as meaningful, self directed employment that supports the quality of life desired by farmers and rural communities. Agriculture will foster diversity in all its forms of production, products, markets, and cultures.

Program Mission Statement

To work toward the goal of sustainability for Minnesota agriculture by designing and implementing programs that meet the identified needs and support the creativity of Minnesota farmers.

MINNESOTA DEPARTMENT OF AGRICULTURE

July 2008

Thank you to the MDA's Agricultural Development and Financial Asssistance Staff who helped to make *Greenbook 2008* a reality. They include: Linda Bougie, Jean Ciborowski, Alison Fish, Mary Hanks, Wayne Monsen, Meg Moynihan, and Mark Zumwinkle. A special thanks to Stacy Gulden, Information Technology Division, for the layout and design of *Greenbook 2008*.

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Introduction to the Greenbook 2008

I am pleased to introduce the 19th edition of the *Greenbook*, a publication of the Minnesota Department of Agriculture's Agricultural Development and Financial Assistance (ADFA) Division. We highlight the project results of creative and innovative farmers and researchers involved with the Sustainable Agriculture On-farm Demonstration Grant Program.

Sustainable agriculture focuses on environmentally friendly farming practices with a special emphasis on reducing inputs. It also includes diversification of crops and alternative livestock systems, and it gives farmers increased access to alternative markets.

Greenbook 2008 contains articles highlighting the results of the grantees' projects and provides practical and technical information. Each article includes personal observations and management tips from the participants. Additionally, these grantees are willing to share their knowledge and experiences with you. They are all dedicated to making Minnesota agriculture more profitable and environmentally friendly. Feel free to give them a call about their projects.

This year's *Greenbook* also includes articles on sustainable agriculture provided by the Minnesota Institute for Sustainable Agriculture (MISA), a partnership between the College of Food, Agricultural and Natural Resource Sciences at the University of Minnesota and the Sustainers' Coalition, a group of individuals and nonprofit organizations. MISA received funding from the Sustainable Agriculture Research and Education (SARE), program of USDA's Cooperative State Research, Education, and Extension Service (CSREES) to help farmers implement sustainable agriculture practices. The articles in *Greenbook 2008* present the work done on these projects.

Greenbook 2008 also includes updates on other ADFA Division projects such as Organics in Minnesota and the Integrated Pest Management program.

I hope you find *Greenbook 2008* interesting and full of new and useful ideas.

Gene Hugoson, Commissioner
Minnesota Department of Agriculture

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Sustainable Agriculture Grant Program

Program Purpose

The Grant Program provides a unique opportunity for farmers, nonprofit groups, agricultural researchers, and educators across the state to work together to explore ways of enhancing the sustainability of a wide range of farming systems.

Program Description

The Department has received over 1,060 grant applications and has approved over $2.8 million in funding for 263 projects since the program began in 1989. Project categories include: Alternative Markets and Specialty Crops, Cropping Systems and Soil Fertility, Energy, Fruits and Vegetables, and Livestock. The grant projects, located throughout the state of Minnesota, are described in *Greenbook 2008*.

Grants provide a maximum of $25,000 for on-farm demonstrations that last up to 3 years. The projects demonstrate farming methods or systems that increase energy efficiency, reduce agricultural chemical usage, and show environmental and economic benefits. A Technical Review Panel evaluates the applications on a competitive basis and makes recommendations to the Commissioner of Agriculture for approval. The Technical Review Panel is made up of farmers, university agricultural researchers, extension agents, and educators and works with assistance from the Sustainable Agriculture and Integrated Pest Management Program staff.

Grant Summaries

The project summaries that follow are descriptions of objectives, methods, and findings of individual grant projects funded in the past 2 years. To find out more details about these projects, contact the principal investigators directly through the listed telephone numbers, addresses, and email addresses.

Summary of Grant Funding (1989-2008)

Year	Number of Grants Funded	Total Funding	Average Grant Size	Ranges
1989	17	$280,000	$16,500	$3,000-25,000
1990	14	189,000	13,500	4,000-25,000
1991	4	46,000	11,500	4,000-23,000
1992	16	177,000	11,000	2,000-25,000
1993	13	85,000	6,000	2,000-11,000
1994	14	60,825	4,000	2,000-10,000
1995	19	205,600	11,000	2,000-25,000
1996	16	205,500	12,900	4,000-25,000
1997	20	221,591	11,700	1,000-25,000
1998	19	210,000	11,100	1,000-24,560
1999	23	234,500	10,200	3,000-21,000
2000	17	150,000	8,800	4,600-15,000
2001	16	190,000	11,875	5,000-25,000
2002	18	200,000	11,000	4,300-20,000
2003*	---	---	---	---
2004*	---	---	---	---
2005	10	70,000	7,000	2,000-11,600
2006	8	70,000	8,750	4,600-12,000
2007	9	70,000	7,777	2,700-12,000
2008	10	148,400	14,800	4,500-25,000
Total Funded	**263**	**$2,813,416**		

**No grants were awarded in 2003 and 2004.*

Developing a Saskatoon Berry Market in the Upper Midwest

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Project Duration

2005 to 2007

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Keywords

berries, fruit, Juneberries, pick-your-own, Saskatoon berries, U-pick

Project Summary

The goals of this project were to: determine whether Saskatoon berries can be profitably grown in Minnesota; identify which varieties are best suited to Minnesota markets and growing conditions; assess the sustainability of Saskatoons, a crop that reportedly requires low fertilizer, chemical, and labor inputs; and develop a Minnesota market for fresh and/or processed Saskatoon berries. This project also received funding from the USDA Sustainable Agriculture Research and Education (SARE) Program.

Project Description

Saskatoons (*Amelanchier alnifolia*) are an old berry gaining a lot of new interest. The wild variety, called Juneberries around here, has been a treasured fruit for years. Saskatoons are now being grown in Canada on U-pick and commercial operations, and the demand far exceeds the supply. The berries have a unique flavor kind of like blueberries, but richer. They are naturally sweet and healthy, being high in antioxidants and vitamins. With the popularity of U-picks and farm markets in our area, my sister and I decided we wanted to try growing Saskatoons, possibly for a U-pick. We anticipated this project would be popular and profitable. Saskatoons are very hardy, adaptable to many soil types and climates, and have minimal disease and insect problems. We wanted to test their potential to increase our farm income, reduce labor costs, reduce soil erosion, work as a shelter belt for our building site, reduce chemical use, and provide a healthy new product for our community.

My husband Ron (who is disabled) and I own 226 acres in central Minnesota. We have 90 beef brood cows. Our land is a sandy loam with sloping hills and lots of rocks. We do have some trouble with erosion too so we want to reduce our tillage as much as possible.

My sister, Judy Heiling, has been my partner in this project. She owns and operates a 4 acre nursery. She grows and markets all of her plants through local farm and flea markets. The Saskatoons just seemed to fit into everything we wanted.

In spring 2004, we selected a number of varieties to try (Table 1) and began establishing Saskatoons on our farm with funds from a North Central Region Sustainable Agriculture Research and Education Program Farmer/Rancher Grant. We planted 648 2- and 3-year old bushes 4' apart in 18' rows for about 800 plants/A. These did well, despite a dry June and an August frost. There were no apparent insect or disease problems. By fall 2004, we had lost about 10% of that first planting, mostly

It's beginning to look like an orchard!

Photo by Bill Wilcke

Table 1. Saskatoon Berry Varieties Planted

Forestburg
Honeywood
Lee 3
Lee 8
Martin
Northline
Pembina
Smoky
Thiessen

to deer. We began installing 8' woven wire fencing to keep deer out of the berries and we planted another 1,200 trees, this time seedlings, from Canada. To prevent washouts, we seeded grass between the rows and mulched around the bushes within the rows with sawdust from a nearby sawmill or wood chips from a tree service, using about one yard of mulch per 10'of row.

We are interested in doing a U-pick berry operation. These are popular in central Minnesota and many older people in the area have fond memories of collecting wild Juneberries. We have asked other fruit operations about their management methods, weed control, fencing, labor, storage, and strategies for dealing with leftover fruit. Some farms find high school students are a good labor force. Others get help from residents of retirement communities and nursing homes who are spry and enjoy the work. Still other operations "pick on shares." The customer may pick two pails full, for example, and take home one bucket for free or at a reduced price, while leaving the other bucket behind as "payment" for the operation to package and sell.

We have talked to several local processors of specialty foods who are interested in buying this unique fruit for jams and jellies. We expect that as others learn about Saskatoons, there will be a market for started plants as well. Our own plants started really bearing in 2007 and we can look forward to many more years of growing and marketing Saskatoons.

Our MDA demonstration grant lasted through 2007. We have been really happy with the way the project worked out. Along the way, we learned important things about establishing the plants, protecting them from deer, mulching effectively, and public speaking.

2005

In the fall of 2005, we used some funds from our MDA Sustainable Agriculture Grant to plant and mulch another 420 3- and 4-year old Saskatoons that had been in Judy's nursery. Planting the bushes took about 10 hr/A, with two of us working together. Mulching took us about 16 hr/A. The domestic bushes cost $3.50 to $4.00 each, for an investment of $2,800 to $3,200 in plants/A. The seedlings imported from Canada were more expensive due to the added costs of shipping and import permits. The cost of mulch was highly variable and depended on the source and the cost of hauling. After establishment and before picking begins, labor is required for mowing the grass planted between the rows. The bushes require occasional light trimming to remove dead or damaged branches. Heavy mulching did a good job of controlling weeds, and only a little spot spraying was needed. By July, 2005, many of the little bushes planted the previous spring had flowered, and even a few of the seedlings we planted in fall 2004 flowered.

We found the main disadvantages to the project were initial preparation and planting labor and costs of planting stock. We anticipated that the berries will take about 5 years to mature and produce a return on investment. We (Pat and Ron) participate in a farm business management program offered by our local community college; it has been an excellent tool to evaluate our farming management decisions and it was natural for us to consult the farm business management instructor for help with financial projections on this enterprise.

2006

In 2006, we learned how much damage deer can do to these plants and really concentrated on fencing. We cut tamarack trees in a nearby swamp and trimmed them into 12' fence posts. Tamarack is naturally rot resistant and the posts worked well. Our fence was not entirely foolproof, however; we actually found one deer inside the fence! When we startled her, she ripped a big hole in the fence to escape.

This year, we noticed some other pest trouble as well. During the winter, mice nested in the sawdust mulch and chewed on the Saskatoon bark. Rabbits also like to munch on the trunks. We put out traps to catch the mice and after the fall freeze, we sprayed an Irish Spring®[1] soap solution

[1] *Inclusion of a trade name does not imply endorsement of that product by the Minnesota Department of Agriculture, nor does exclusion imply non-approval.*

on the bushes and trunks to deter both mice and rabbits. We found this solution worked extremely well to protect the plants against pest chewing.

We did quite a bit of spot spraying to control weeds during the summer of 2006. We also ran short on mulch in some areas; these were noticeably weedier. During this very dry summer, we noticed that the mulch helped hold what little moisture there was. Our other fruit trees really seemed to suffer from the drought and we watered them, but the Saskatoons looked good all summer. Some of the plants put on quite a few berries and started to show some nice suckering.

And then, disaster! As the hot summer progressed, grasshoppers hatched out like crazy. They were so thick they ate most of the leaves off many of our fruit trees. They even ate the bark off some of the smaller stems. When a turkey producer neighbor asked us if we wanted some leftover birds he couldn't ship, we got the idea to put them in the orchard for grasshopper control. It really helped, and the turkeys grew like crazy!

2007 and Final Project Conclusions

Our recommendations from previous years seem to be working. We had no further deer damage. But, with the drought in the summers of 2006 and 2007, the grasshoppers multiplied like crazy again. They were stripping the leaves and even eating some of the bark off some of the bushes. The fence came in handy to pen in some turkeys we acquired for grasshopper control. Since the turkeys worked so well at controlling grasshoppers in 2006, this year we got more turkeys a lot earlier. It really made a difference! There were grasshoppers all over the farm except in the berry patch. The turkeys did a great job and you could see them foraging almost constantly. An added benefit was that we ended up with a lot of almost free meat.

Our weed control methods worked very well also. There wasn't much mowing to do because of the drought. We did some spot spraying of Roundup®[2] within the rows. The mulch really helped, giving us good to very good weed control and helping conserve what little moisture there was. We did not water our Saskatoons at all and they remained healthy looking. They also did some more suckering. At a Saskatoon workshop we attended in Michigan, speakers recommended using woodchips or coarse sawdust for mulch. They said if the sawdust is too fine it will pack and shed water.

Seeding grass between the rows has prevented washouts. This fall, when we finally did start getting rain, we had some pretty good downpours. I know that without the grass cover we would have had a lot of washouts, so the Saskatoon/grass system is proving itself in terms of preventing soil erosion.

We are both still very optimistic about this crop's potential for us and for others in Minnesota. We're told that the Saskatoon market in Canada is exploding. At the Michigan workshop we attended, Troy Isaac from Direct Grocer, Inc. (Sault Ste. Marie, Ontario) said they cannot find enough berries for processing to keep up with the demand, that exports are expanding, and that even the Queen of England eats Saskatoon jam!

With multiple years under our belts, we can draw some conclusions about the varieties we planted and our preferences. We decided we liked 'Smoky' the best. Our full rankings are provided in Table 2.

We also visited Graham's Groves at Carman, Manitoba again this year. They market a lot of their berries as pies and tarts at a local farmers' market. They gave us a tour of their facilities with the large ovens and mixers. It was interesting to see how pies are made in large quantities. The owner also told us he has more and more customers requesting pre-picked berries. They have a commercial picker, sorter, and other equipment, so providing this kind of supply is not such a problem for them and enables them to have a year round supply of frozen berries.

Table 2. Saskatoon Ratings and Qualities - ranked from our most favorite to least favorite

#1	Smoky	Good growth. Best flavor.
#2	Northline	Good growth.
#3	Lee 8	Aggressive. Suckered a lot, even in dry summer.
#4	Honeywood	
#5	Forestburg	
#6	Lee 3	Planted as seedlings - still pretty small.
#7	Pembina	Planted at 2 yrs. old in fall, 2005. Small berries, prolific.
#8	Martin	Huge berries, but not a lot of them. Mild flavor.
#9	Thiessen	Huge berries, but not a lot of them. Mild flavor.

[2] *Inclusion of a trade name does not imply endorsement of that product by the Minnesota Department of Agriculture, nor does exclusion imply non-approval.*

Interest in Saskatoons here in the U.S. is expanding, too. Stephen Fouch (Michigan State University Extension County Extension Director, Benzie County) is generating interest in Saskatoons by giving people plants and trying to get more people involved; he thinks it's a great idea for sustainable farming. Nick Lawyer from Lawyer Nursery in Montana (a wholesaler) was also at the Michigan workshops and said his nursery has different varieties of Saskatoon plants in large quantities. They feel that this market will really take off.

We ourselves have had so much response to this project that we continue to distribute the informational brochures we made in 2006. We also had a field day this summer with a good turnout of about 60 people. We had planned to let people pick and taste ripe berries but with the drought they had dried up by the time we had our field day. We served jam sandwiches instead, so people could at least get an idea of how the berries taste. We also had a few visitors stop before and after the field day. When the berries first started ripening there were enough to let a few friends come and pick. Including what we picked for ourselves, we harvested about 100 lb before they dried up.

Saskatoon bushes have an average life of 60 to 80 years once established so this will be a long lasting investment. With the popularity of U-picks and the trend towards healthy eating, I think something new like this will be very profitable. The disadvantages are the initial labor and costs of getting a patch started. It will take about 5 to 8 years to mature and so a return on investment will take a long time.

We would recommend Saskatoons to anyone who is willing to put a lot of time and effort into getting them started. They would be great for small acreages or marginal areas where other farming practices won't work, for example, rocky or highly erodible ground. They'd make a great windbreak, but do not like low ground.

Turkeys on grasshopper patrol. *Photo by Bill Wilcke*

We haven't heard of anybody else in Minnesota who has planted Saskatoons as a result of our project, but we do know some farmers in Michigan are planting Saskatoon bushes. They heard about our project and asked us lots of questions at the Michigan workshop that we attended.

We definitely plan on continuing with this project and even expanding it as we can afford it. We need to keep track of expenses, income, and production on the berries to assure that it is a profitable venture. We wonder if maybe investing in older plants would be more practical – the plants would produce sooner and provide a quicker return on investment. Our neighbors are all for our project. They can hardly wait until there are enough berries to pick. We haven't heard one single negative thing yet about our project. Everyone seems to be very interested in it.

Management Tips

1. To keep deer away from tender young plants, install fences before you plant Saskatoon berries.

2. Pile on mulch – the thicker the better.

3. Establish ground cover between the rows as soon as possible – especially if you have light or sloping soil.

4. Use a soap solution to prevent pests from chewing on trees during the winter months. Irish Spring® worked great for us. Shave a couple of bars of soap into a kettle of 1 to 2 qt hot water until you have a slurry. Dilute 2 c of slurry with 4 gal of water. Spray plants. Repeat as needed after rain events. This method seems to work particularly well when applied to tree trunks in late fall; it really cut down on the mouse and rabbit chewing.

Cooperators

Dave Stish, Farm Business Management Instructor, Central Lakes College, Staples, MN

Project Location

Go 3 miles west of Randall on Cty. Rd. 14. We are on the north side of the road just before the intersection of Cty. Rd. 11. The patch is next to the road and we plan on having a large sign.

Other Resources

These people would both be more than happy to try and answer any questions and advise you.

Nick Lawyer, Lawyer Nursery, 6625 Montana Hwy. 200, West Plains, MT 59859, 406-826-3881, www.lawyernursery.com

Troy Isaac, Sales and Marketing Director, Direct Grocer, Inc., 177 Elgin St., Sault St. Marie, Ontario P6A 2Y9, 705-759-1375, Troyissaac@shaw.ca

Since Saskatoons are very new in this area, resources are not easily available. There is a lot of information on the Internet and in Canada. Some really helpful web sites are:

Chaudhary, G. Nabi. N.D. Economics of Saskatoon berry production. Alberta Agriculture, Food and Rural Development. Available at: www.agric.gov.ab.ca (Type "economics of Saskatoon" into the search box.)

Government of Alberta. 2002. Beginning berry production. Available at: www.agric.`gov.ab.ca (Type "beginning berry" into the search box.)

Laughlin, Kevin M., Ronald C. Smith, Robert G. Askew. 1996. Juneberry for commercial and home use on the northern great plains. North Dakota Extension Service. Available at: www.ext.nodak.edu/extpubs/plantsci/hortcrop/h938w.htm

Manitoba Agriculture, Food and Rural Initiatives. Web site: www.gov.mb.ca/agriculture/index.shtml

Mazza, G. and C.G. Davidson. 1993. Saskatoon berry: a fruit crop for the prairies. In J. Janick and J.E. Simon (eds.), New crops. pp. 516-519. Wiley, NY.

Ontario Ministry of Agriculture and Food. Web site: www.gov.on.ca/omafra

Saskatchewan Agriculture and Food. 2002. Costs and returns for a Saskatoon berry orchard. Available at: www.agr.gov.sk.ca (Type "Saskatoon berry" into the search box.)

University of Manitoba. Web site: http://umanitoba.ca

Improved Productivity in a Winter Greenhouse

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Project Duration

2007 to 2008

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Keywords

greenhouse greens, passive solar greenhouse, winter CSA, winter greenhouse,

This sustainable agriculture demonstration project was a USDA North Central Region Sustainable Agriculture Research and Education Program producer grant.

Project Summary

If you've ever shopped for produce in a small northern rural town in the depths of winter, you know the meaning of the word pitiful. We do not have to eat like this and we CAN produce our own high quality vegetables in a way that is sustainable. Currently, my passive solar greenhouse solves the fresh winter produce problem for 27 very grateful winter CSA members. I wanted to do research to optimize winter green production in the greenhouse and show that a small greenhouse can be a profitable enterprise. I tested growing cool season vegetables in heated raised beds; tested different planting schedules for growing greens in the short-day, low light greenhouse; and tested a variety of greens for their production potential, as well as their palatability to my winter CSA members.

I concluded that heating beds do not result in increased yields from the three crops tested: broccoli, pac choi, and Chinese cabbage. Their weight and size was either equal or slightly smaller compared with beds that had soil temps 15 to 20 degrees cooler. Conversely, when the heat was turned off in the raised bed, that broccoli eventually slightly outproduced the broccoli in the other beds. I plan to create more of these deeper raised beds for broccoli production. The system used was very cost effective and easy to construct and move. Also, new varieties of cold hearty greens were tested that produced well even during midwinter. These varieties included Yukon Savoy, Tokyo Bekana, and Giant Red Mustard.

Project Description

Our "farm" is actually a large double residential lot in Milan, MN (population 325). I converted most of the yard into garden plots where I grow storage crops and crops that can be harvested in late autumn. I have a large cold storage area in the basement of my home.

Our passive solar greenhouse is 22' long and 18' deep. It was built onto the south side of my double garage. The greenhouse is heavily insulated on its back wall and half of the side walls. There is a 2' deep rock bed below the soil that has drainage tile laid in it. The tile is connected to a pipe system that runs up to the peak of the structure. At a specified temperature, fans kick in to pump that hot air down into the rock bed below the soil. Last winter, the soil temperature 2" deep never went below 52°F. There is a small furnace that kicks in when the air temperature goes below 40°F. I estimate the structure used $50 of propane during the 2006 winter.

Ground level beds are used to grow crops such as broccoli, pac choi, Chinese cabbage, radishes, turnips, mache, and kohlrabi. Intercropping is used to maximize growing space throughout the season. Above those beds are hanging planters that produce a wide variety of cold-hearty greens. These 3.5' long planters are made of plastic gutter with end caps and holes drilled in the bottom.

Carol standing by her passive solar greenhouse.

Three-tiered harnesses run the length of the greenhouse, suspended from the rafters. There are two rows of planter harnesses above the ground beds, which add considerable growing space to the facility.

My CSA runs from mid-October to mid-April and serves 15 families (27 people). I have a full time job at the University of Minnesota in Morris and yet am able to participate in the local foods movement in a very important and rewarding way. Consumers in my area are hungry for locally raised winter produce well beyond my capacity to supply it. I would like my passive solar greenhouse/winter CSA to be a model that can be replicated by other farmers.

Midwinter is the most challenging time for vegetable production in an upper midwest greenhouse due to short days and cold temps. Solutions should address the need to keep costs low as well as keep it low tech to achieve the maximum benefit for the broadest range of producers. These challenges are the main reason northern vegetable producers believe that winter production is 1) too difficult or 2) not profitable. I am currently the only winter producer in my area and I would like to see that change. What I learn from this research will add more information to a viable model that other producers can replicate. The more winter growers we have, the stronger our local food system will be.

For this grant, I wanted to test different production methods to maximize production, and provide an example of a profitable way to participate in the local foods movement to the benefit of eager consumers. I proposed to monitor three different variables on productivity to determine the best method for growing greens in a passive solar greenhouse from mid-December to mid-February.

The first variable was soil temperature. My greenhouse has a heat storage system that uses existing heat generated in the peak of the structure. This heat is drawn through a pipe system into a drainage tile in a gravel bed below soil surface. The structure also has an insulated cement block foundation that extends below the frost line. The intent of these features is to keep soil temperatures as warm as possible, as this is a critical component for plant growth in cool air temperatures. Before promoting this design to other potential growers, I wanted to compare it to a system of raised beds with a heat coil in their base.

The second variable I monitored was days until harvest given different planting dates. Seed catalog predictions for "number of days until harvest" do not apply in short day situations. The environment in my cool greenhouse is warmer than that found in a season extension high tunnel and colder than a heated commercial greenhouse. Planting schedules for these structures are not helpful. I am currently in my second year of production and still

Greens being grown in heated raised beds.

experimenting with a planting schedule that will maximize my harvest during the short-day weeks in midwinter. I planned to test three common cold weather crops: arugula, tatsoi, and mixed lettuce. I planned to vary the planting schedules and monitor growth rates as the day length dwindled and use the gathered data to support a reasonable planting schedule that optimizes production during low light weeks in a cool greenhouse.

Finally, I wanted to test new varieties of cold hearty greens for productivity and taste. I selected three new varieties, planted them at the same time, and then monitored their growth. I asked my CSA members to evaluate the flavor of these new varieties. It is important to have variety in a winter CSA, but also to listen to the preferences of consumers.

The materials needed to do this project included a raised bed kit from FarmTek, a greenhouse supply company, which uses side walls made of heavy duty pond liner material with sewn-in sleeves to accommodate the metal posts that secure it to the ground along the perimeter of the beds. The kit was designed to construct one long raised bed but we adapted it to our bed layout in the greenhouse. It worked well. I would recommend this material to others who want to have a low cost way to create raised beds that can also be easily disassembled and relocated if needed. I will continue to monitor how this raised bed system holds up in the greenhouse environment. We purchased a considerable amount of soil amendments (top soil, peat, and compost) to match the composition of the soil in the regular beds of the greenhouse.

We purchased soil heating cables that were attached to metal cloth that was placed in the raised bed with an additional 6" of soil materials placed on top. A temperature regulator was purchased along with the heating cable to control the soil temperature more consistently. The cables were designed to keep soil temperature at a certain

Raised heated beds prior to planting.

degree above ambient temperature but we wanted the soil temperature at a consistent 70°F for our research. A soil thermometer was also purchased to record soil temperatures in both the raised and regular beds.

Results

Raised heated beds

When plants were harvested for CSA shares, an equal number were taken from regular and raised beds. Harvested plants were measured for length and the total harvest in each bed type were weighed and recorded.

The results were not at all what I expected. I assumed that added heat in the soil would result in increased production. I just wasn't sure if that added production would warrant the added cost, energy, and effort required. The first harvest of Chinese cabbage from the raised and regular beds was the same in size and weight. This was not surprising since the soil temperatures were similar, in the high 60s°F. The second harvest showed that the crop grown in the regular bed was, on average, 1.5" taller and weighed twice as much as the crop grown in the raised bed! During this time, the temperature in the regular bed was approximately 15°F cooler than in the raised beds.

Planting Schedule

Thus far, my changed planting schedule for the greens in the hanging planters shows useful results. I seeded eight rather than six planters each week at the beginning of my season (Sept.-Oct.) and included with them some of the varieties (mache, red Russian kale, and claytonia) that I know are slower growers. This gave me enough greens for the initial harvests and added the slower growing varieties into the harvest mix when the other varieties are on their second or third cutting (less harvest than the first cutting). This gives a more consistent harvest amount and quality for each planting.

New Varieties

The eight new greens varieties did well with several showing good production even in midwinter. The best new varieties - Tokyo Bekana, Giant Red Mustard, and Yukon Savoy - will be added into the planting schedule for that part of the growing season along with other known successful varieties such as Mizuna, Tatsoi, Arugula, and Vitamin Green. All of these varieties germinate within 3 to 4 days when placed on germination mats and are ready for first harvest within 3 weeks. They are good for at least 3 to 4 cuttings and the Yukon Savoy still produced good quality greens for five harvests. The survey I conducted with my shareholders indicated that those who noticed a difference in the varieties (half of those surveyed) preferred the greens mix that contained the new varieties due to their color, texture, and flavor.

Management Tips

1. Growers who want to address the strong consumer interest in fresh winter greens should consider experimenting with a wide variety of greens to find out what produces best for them. Discovering the greens that will still grow vigorously in midwinter is key to developing a successful planting schedule. This will vary according to the northern farmer's chosen structure whether it's a hoophouse or greenhouse and how warm the soil and air temperature is.

2. I do not recommend the added cost of heating the soil beyond what the passive solar design provided. Heated beds did not result in increased productivity for us. I do think raised beds are helpful though.

3. There are many Asian greens that are very cold tolerant and grow well even in the short days of winter. Mustards are also productive and do not have an overly strong flavor when grown in winter. In addition, I have found that chard, kale, and collards provide good quality baby greens that add weight to a salad mix although they do grow a bit slower than the other varieties of greens I've tried.

Cooperators

Chuck Waibel, Milan, MN

Other Resource

Coleman, Eliot. 1999. Four season harvest: Organic vegetables from your home garden all year long. 2nd Edition. Chelsea Green Publishing. Web site for Eliot Coleman's Four Season Farm: www.fourseasonfarm.com/index.html

Hardwood Reforestation in a Creek Valley Dominated by Reed Canarygrass

Principal Investigators

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Project Duration

2007 to 2009

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Keywords

hardwood reforestation, healthy understory, open areas, reed canarygrass removal

Project Summary

Thirty years ago the 20 acres of creek bottom land on our farm was dominated by a floodplain forest comprised mostly of American elm. As these trees were killed by Dutch elm disease, and the shade disappeared, reed canarygrass (RCG) (*Phalaris arundinacea*) began to move into the area. RCG is an aggressive perennial grass that threatens wetland and riparian areas where it forms a monoculture, eventually smothering the native grasses and forbs and preventing any regeneration of trees or shrubs. It now dominates most of the 20 acres except for pockets of natural stands of native hardwoods and trees that were planted before it moved in. RCG provides almost no wildlife benefits, makes poor pasture or forage if not intensely managed, and provides little economic gain.

Returning this area to forest will provide food and habitat for birds and wildlife and provide short-term economic returns from nut and acorn harvesting and hunting opportunities, and long-term economic benefits from the sale of timber. The trees will shade Lost Creek, a designated trout stream, providing better trout habitat. We have planted spruce, pine, and fir trees on our farm and have been selling Christmas trees for over ten years. We have also planted hardwood trees in appropriate areas of our farm and restored native grasses and wildflowers in other areas. These have increased the wildlife benefits as well as current and future income on our farm. This project is a continuation of that process.

Project Description

Due to RCG persistence and its resistance to control by non-chemical practices, we were faced with an environmental decision: whether it was better to leave the creek valley and RCG untreated and allow the RCG to dominate and spread but not expose the area to herbicides or to explore several alternatives including treating an area with chemical herbicides for several years in an attempt to reforest the area. After much research and deliberation, we believe the more sustainable and environmental decision would be using effective herbicides with low environmental impact at rates no higher than would be used in a field of soybeans for a period of only three or four years to reestablish a forest that should remain for over 100 years. We think of this as a transition period that will provide long-term environmental benefits to our farm and to the Lost Creek and Root River Watersheds. We plan to reach the goal of reforestation by testing four alternative plans using different techniques of suppressing the RCG and growing trees.

We realize that this is a long-term project and plan to complete the project over 7 to 10 years. This long-term plan exposes no more than 2 acres of tilled soil to erosion in any year. Over the past 20 years we have planted tree seedlings and tree seeds such as walnuts and acorns in the creek valley with fair survivability in the areas not yet overtaken by RCG, and near 100% failure in the RCG areas.

Prescribed burn in progress.

The four strategies that we are using to control the RCG and return the area to a mix of bottomland forest with a healthy understory and open areas of sedges, reeds, and native forbs are:

- **Plan A:** Control RCG with a combination of prescribed burning, herbicide application, mowing, and tillage followed by direct seeding a diverse mix of bottomland and shrubs.
- **Plan B:** Plant fence post sized poles of willow and cottonwood in areas that are not accessible by machinery to eventually shade out the RCG.
- **Plan C:** Plant a diverse direct tree seeding in areas where the shade of boxelders has already controlled the RCG followed by cutting down the boxelder trees.
- **Plan D:** Do one year of herbicide treatment and tillage adjacent to stands of boxelder to allow natural seeding by the boxelders and encourage new stands of boxelder to shade out the RCG.

All four methods utilize the fact that RCG does not reproduce or survive in heavy shade. We will repeat the four plans over the three years of the grant to test the procedures in different weather conditions.

2007 Results

Plan A: The area for this practice is about 1½ acres. To prepare the area, a prescribed burn was completed in April, 2006 to remove a layer of thatch. The site was then sprayed with sethoxydim herbicide in late May, 2006 to kill the grasses including RCG. Sethoxydim kills grasses without harming the forbs.

A second burn was planned for the spring of 2007, but a late winter flood deposited a layer of mud on the site preventing us from burning. In 2007, the area was treated with sethoxydim herbicide in early June, mowed in late June, and treated with glyphosate herbicide in late August to kill all plants in the areas to be direct seeded. The herbicide treatments appear to have killed most of the RCG.

The site was mowed and tilled in mid-September and direct seeded to a mixture of burr oak, white oak, swamp white oak, walnut, butternut, bitternut hickory, Kentucky coffee tree, Ohio buckeye, chokecherry, wild plum, dogwood, redbud, ninebark, and false indigo in late September and early October. The larger seeds were disked in followed by the smaller seeds with oats as a cover crop and finished with a cultipacker. Warm wet weather allowed the oats to grow well, hopefully minimizing the affects of creek flooding.

In April, 2008, willow, cottonwood, and tamarack seedlings will be planted. Silver maple seed will be sown in June 2008 when the seed is ripe.

New growth on cottonwood pole.

Plan B: Willow and cottonwood poles, 4" to 6" diameter and 6' to 8' long were gathered while still dormant in March, 2007 and stored in a root cellar to keep them cool and moist. As soon as the frost was out in April the pole cuttings were planted in holes made with a post hole digger into a stand of solid RCG in an area of about ⅛ acre.

Most of the poles of both species sprouted, but deer browsed on the shorter poles causing some trees to die. Some of the taller poles, above the browse level, put on new growth of up to 3'. We will reassess the survival rate of this area when trees leaf out next spring.

Plan C: The thick stand of young boxelder trees in this ¼ acre area was thinned so that trees are at least 4' apart. The lower branches on the remaining trees were removed to a height of 7' to allow the area to be worked up by a small tractor and tiller. The site was tilled in mid-September and direct seeded to a mixture of burr oak, white oak, swamp white oak, walnut, butternut, bitternut hickory, Kentucky coffee tree, horse chestnut, chokecherry, wild plum, dogwood, redbud, ninebark, and false indigo in late September and early October. The larger seeds were worked in with the tiller running at a slow speed with the smaller seeds sown on top of the ground.

This winter the boxelder trees will be cut, with the trees dropped onto the seeded area. The removal of the canopy will allow sunshine to reach the new tree seedlings and we hope that the tangle of branches will discourage the deer from browsing the new trees. In April, 2008, willow, cottonwood, and tamarack seedlings will be planted. Silver maple seed will be sown on the area when that seed is ripe in June.

Plan D: A prescribed burn was conducted in April, 2007 on about ½ acre. The area was treated with dethoxydim herbicide in early June, mowed in late June, and treated with glyphosate herbicide in late August. The herbicide treatments appear to have killed most of the RCG. The site was mowed and tilled in mid-September. The site will be left as is and should be a good area to germinate volunteer boxelder seeds.

Management Tips

1. Acorns should be kept moist and cool to maintain viability. Soak acorns in cold water prior to storing to chill and hydrate them.

2. Store early collected seed at 40°F.

3. A chest freezer can be used for seed storage by installing an override thermostat to convert it to a refrigerator. When you add the first seeds to an empty freezer, set the thermostat ten degrees colder than the current temperature of the seed and lower it ten degrees daily until you reach 40°F. This will allow the interior of the seed to get chilled without freezing the seed at the edges. Look for the freezer/refrigerator override thermostat where wine and beer making supplies are sold.

4. Oak, dogwood, chokecherry, plum, and other early collected seed may need to be stored for up to 6 weeks before other later maturing seeds, such as walnuts, are ready for planting.

5. The use of the Nut Wizard saves considerable time and effort compared to picking by hand or raking. It is available in several sizes for various sized nuts to collect acorns, hickory nuts, butternuts, and walnuts.

6. If your seed planting is near an existing forest, provide an easy food supply for squirrels by making several piles of walnuts around the edge of the planting. Hopefully, the squirrels will take these and leave your planted tree seeds in the ground.

7. Use cottonwood and willow poles that are at least 8½' tall. This will leave over 6½' of the pole above the ground, keeping the new growth that sprouts from the top above the RCG and protect the new growth from browsing by deer.

8. Cottonwood and willow poles will not grow if planted upside-down. Make sure they are oriented the way they were growing when planted. You may want to mark the tops when harvesting the poles.

9. Contact your local DNR forester and county Soil and Water Conservation District for information on direct seeding, tree planting, and weed control in your tree planting.

Cooperators

Fillmore Soil and Water Conservation District, Preston, MN
DNR Forestry, Preston, MN
Jon Alness, Zumbro Valley Forestry, Elgin, MN

Project Location

From the traffic lights in Chatfield, MN, go 5 miles west on Cty. Rd. 2 then 1.5 miles south on Cty. Rd. 101, also known as Ninebark Rd. Farm is on the east side of the road at #31924.

Other Resources

A detailed web site of this project can be found on the Fillmore Soil and Water Conservation District web site: www.mn.nrcs.usda.gov/partnerships/fillmore/index.htm click on "Creek Reforestation Project"

Cottonwood and willow pole planting web site: www.nm.nrcs.usda.gov/news/publications/pole-cutting-solution.pdf. This web site provides basic information about pole planting in riparian areas.

Direct seeding hardwood trees web sites: www.dnr.state.mn.us/treecare/maintenance/collectingseed.html and www.dnr.wi.gov/forestry/Publications/articles/HardwoodDirectSeeding-2004.pdf

Reed canary grass control web sites: www.phalaris.pbwiki.com/ and www.lrrb.org/pdf/200436.pdf where best management practices are summarized on pp. 92, 93, and 94.

Seed collecting web site: www.nutwizard.com

Reed canarygrass dominates creek valley.

Introducing Cold-hardy Kiwifruit to Minnesota

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Project Duration

2007 to 2010

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Keywords

cold-hardy, kiwi, kiwifruit, orchard, pergola, trellis

Project Summary

The goal of this project is to provide Minnesota farmers with information about the culture and management of growing tasty and nutritious cold-hardy kiwifruit using two trellising approaches, pergola and T-bar, that prevent soil erosion, conserve soil moisture, and integrate natural biological measures.

Project Description

Cold-hardy kiwifruit is a deciduous vine that contains small, delicious, smooth-skinned berries and that deserves greater attention in Minnesota. Kiwifruit are native to eastern Asia; there are about 70 different kiwifruit species. The most cold-hardy is *Actinidia kolomikta*, sometimes referred to as "Arctic Beauty" due to its colorful tri-color leaves. Native to Siberia, this particular species performs well throughout Minnesota when its cultural considerations are met. *A. arguta*, another species of merit, has a more vigorous growth habit, is sun-tolerant, and can be grown in southern Minnesota where winter temperatures are not expected to fall below -23°F. The University of Minnesota Horticultural Research Center (HRC) has been growing cold-hardy kiwifruit since the mid-1980s.

All kiwifruit prefer well-drained, silty soil that contains ample organic matter and retains moisture. The plants perform best in a partially shaded and sheltered location that provides protection from both late afternoon winter sun and strong summer winds. Generally the east side of a windbreak will satisfy the shade and wind protection conditions, but shallow tree roots may compete for soil moisture and nutrients during the growing season. The site should also have good air movement to avoid damaging frost pockets.

Horticultural Research Center Location – Pergola Training System

At the University of Minnesota - Horticultural Research Center (HRC) construction began on a pergola-type trellis structure in fall 2007. The pergola is an arbor-like structure where the vegetative canopy is grown in a single plane. This system protects the berries from wind-rub scarring. The site occupies a north facing slope and is bounded by woods to the west. Because of the shading from trees, this location is not suitable for most other fruit crops, but the kiwifruit actually benefit from the shading.

Prior to planting and trellis construction, a 4" layer of woodchip mulch was placed at the orchard site. The woodchips will retain soil moisture, prevent erosion, and smother most weeds until the canopy forms. Once established, the vegetative canopy will shade out much of the underlying vegetation (including weeds). The woodchips will also

A pergola structure in Roseville, MN that is similar to the one being built at the HRC.

The HRC pergola site is located on a north-facing slope bordered by trees to the west, which protects them from winter sun. Tubes protect young kiwifruit plants from marauding rabbits.

allow for the lateral extension of roots at the soil-woodchip interface, resulting in increased yields. Fallen kiwifruit leaves will encourage earthworm activity and increase both aeration and the distribution of organic carbon in the soil profile.

The kiwifruit demonstration site at the HRC traverses a hill, so posts for the pergola were spaced in columns 15' apart. The crossbeam spans of 21' making a total pergola canopy area of more than .25 acre. There is 7' between rows. *A. kolomikta* vines were planted 3' apart, while *A. arguta* vines were planted 6' apart.

The vines will be trained to high-tensile steel wires. The HRC's pergola uses rectangular steel tubes mounted on wooden posts with plastic clips to hold the wires in place. The galvanized steel tubing is structurally stronger than wood, lacks knots and other defects, and will not deteriorate the way wood will over time. At the ends of the pergola structure, the wires are fastened to a braided steel cable with one end receiving an in-line tightener to adjust wire tension. Generally, wires should be supported at distances of 20' or less, otherwise line sag will become problematic as the plants mature and vegetation and fruit loads increase.

Excellent drawings of pergola designs are contained in an Oregon State University publication called "*Growing Kiwifruit*" which is available for free on the Internet. See the "Other Resources" section at the end of this article.

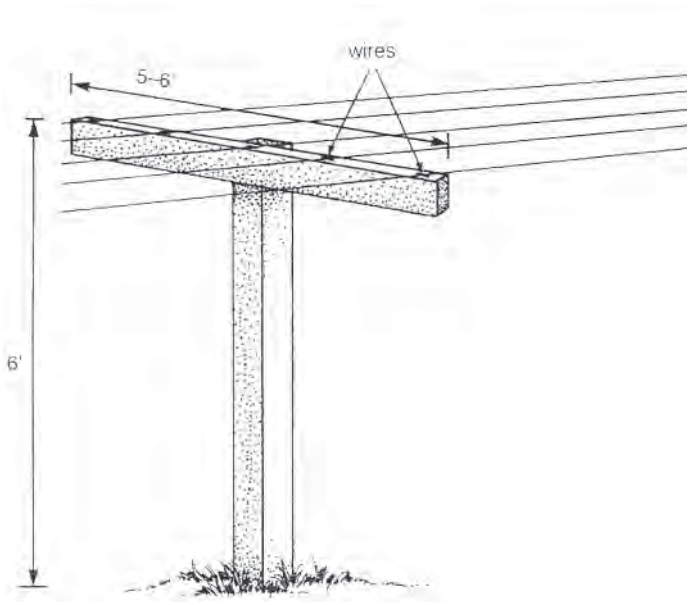
On-farm Location – *A. kolomikta* on a T-bar Training System

Five miles away from the HRC, cooperator and organic grower, Eric Theship-Rosales, will be planting *A. kolomikta* seedlings and rooted cuttings at his orchard site in Chanhassen, MN in 2008. For the past three years, Eric has been preparing his 1 acre orchard site to grow kiwifruit organically. He became interested in this crop after seeing and tasting the kiwifruit growing at the Horticultural Research Center located about five miles from his home. Most of the seeds Eric will be planting were derived from a large fruited (for species) Russian variety called "Krupnopladnaya."

Eric is starting this batch of seeds himself from berries that cooperator Bob Guthrie gave him last year. The seeds require a 90 day stratification period (moistened and stored in a cool place like a refrigerator). Typically they need to be grown one season in a container before being large enough to be transplanted to the field in the late summer or the following spring. (If you have a greenhouse or warm sunny porch that can act as a greenhouse, the seeds can be stratified in early winter, germinated in February and March, and may be large enough to plant in the field by June.)

If seed germination is successful, Eric hopes to have up to 1,000 kiwifruit plants to set out in 2008. Roughly half of the seedlings will be male plants and many of these will be culled out in subsequent years. Eric will be growing cold-hardy kiwifruit on a terraced and northeast facing hillside using a T-bar training system, which also trains vines to high tensile wires supported at distances of 20' or less. A northeast slope is ideal for this species and the T-bar system that Eric will use will allow for the growth of soil stabilizing vegetation between the rows.

Figure 1. Standard T-bar Trellis System for Kiwifruit[1]



Interested individuals will have the opportunity to see both T-bar and pergola structures and ask questions at an HRC field day in 2008.

Management Tips

1. Choose a partially shaded, sheltered location with rich, well drained but moisture retentive soil that is neutral or slightly acid in pH. North and east facing gentle slopes are preferred with shelter from strong winds provided by woodlots, windbreaks or shelter belts.

2. Use a thick layer of woodchip mulch to retain soil moisture, prevent erosion, and smother weeds until the vine canopy closes. Replenish every 3 years.

3. Protect the newly planted vines with plastic tubes to protect them from rabbit damage.

4. Support trellis wires at a distance of 20' or less to prevent sagging.

[1] *Trellis system illustration used with permission of the Oregon State University Extension Service from page 10 (figure 1-A) of publication PNW 507, Growing Kiwifruit (reprinted April, 2005, Corvallis).*

Project Location

The HRC site is located in Victoria, MN near the Minnesota Landscape Arboretum. Travel 0.3 miles northwest of the intersection of Minnesota State Hwy. 5 and Rolling Acres Rd.

The Theship-Rosales farm is located about 4 miles south and east of the University of Minnesota Landscape Arboretum on Audubon Rd., approximately 1 mile south of Minnesota State Hwy. 5.

Other Resources

Growing Kiwifruit. 1995. Oregon State University. Available at: extension.oregonstate.edu/catalog/pdf/pnw/pnw507.pdf

How to build fences with USS Max-10 200 high-tensile fence wire. 1980. United States Steel, Pittsburgh, PA, 75 pp. (out of print but some of the information it contains is also available at: www.kencove.com/Guide.php

Dream of Wild Health Farm Indigenous Corn Propagation Project

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Project Duration

2006 to 2008

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Keywords

corn, heirloom, indigenous, Native American Indian, propagation

Project Summary

Peta Wakan Tipi, a 21-year-old nonprofit organization, operates the Dream of Wild Health Farm in Hugo, Minnesota. The Dream of Wild Health (DWH) is an American Indian agricultural and education program. We have a rare collection of 400 indigenous heirloom seeds gifted to us by elders, reservations, and seed savers around the Upper Midwest. Our purpose for this project is to explore the process and cost of growing and protecting the integrity of indigenous heirloom food crops. Specifically, we will regenerate up to ten varieties of near-extinct indigenous corn in order to serve the rural American Indian communities in our area.

Project Description

After meeting with a variety of community members, we selected nine varieties of indigenous corn seed to propagate based on seed availability, viability, and community needs. Working with the University of Minnesota's Center for Urban and Regional Affairs (CURA), Dr. Craig Hassel and Dr. Albert (Bud) Markhart of the University of Minnesota Department of Food Science and Nutrition and Department of Horticulture, respectively, we entrusted our seeds to their laboratory environment as the DWH greenhouse was not yet ready when we began the project in 2006. In 2007, the DWH greenhouse was still not ready so we sowed the seeds directly in the field as detailed below.

2006

In May of 2006, the seeds were photographed and a portion of each variety was imbibed along with a control of organic sweet corn from Seed Savers Inc. Imbibed seeds were planted in five gallon pots containing Sunshine Professional Growing Mix. Pots were placed in an isolated greenhouse section in the Plant Growth Facilities at the University of Minnesota. Plants were grown at 30°C day and 25°C night temperatures with supplementary light provided by high intensity discharge (HID) lights for 16 hr per 24 hr period. Germination was variable, but we were able to establish at least two plants for each variety (Table 1).

On June 8, Dr. Markhart imbibed and planted most of the remaining seed in flats and allowed them to germinate under mist. When plants were 7 days old, they were planted at one of two field sites. Site one was the Student Organic Farm on the St Paul Campus. Site two was May Farm Community Supported Agriculture (CSA) at the Wilder Forest in May Township. These sites were selected because they both follow organic practices.

Greenhouse Grown Plants: Between July 17 and August 20, plants were hand pollinated. Individual cobs were trimmed and bagged; pollen was collected from several plants of the same variety, combined, and used to pollinate silks that had emerged overnight. Plants were watered and fertilized daily with high calcium

Table 1: Corn Seed Variety, Number of Seeds Provided, and Percent Germination of Each Lot, 2006

Variety	# of Seeds	Germination (%)
Chip Amber	34	44
Mandan Red Clay	8	50
Mandan Blue	18	22
Bear Island	55	50
Cherokee Flour	19	10
Lenape Blue	4	50
Quapaw Red	10	40
Red Lake Hominy	61	5
Cree Corn	62	2

Table 2: Peta Wakan Tipi Indigenous Corn Seed Increase, 2006

Variety	Seeds Supplied	Harvested Dry Weight (g)	Weight per 10 Seeds (g)	Approx. # Harvested Seeds	Seed Increase (%)
Chip Amber	34	503.8	2.15	2,343	6,892
Mandan Red Clay	8	92.15	2.2	419	5,238
Mandan Blue	18	43.2	2.8	154	856
Bear Island	55	237.3	2.1	1,130	2,054
Cherokee Flour	19	118.2	4.5	263	1,384
Lenape Blue	4	139.5	3	465	11,625
Quapaw Red	10	97.4	2.6	375	3,750
Red Lake Hominy	61	150	4.3	349	572
Cree Corn	62			10	---

fertilizer. Plants were taken to maturity and cobs harvested when plants turned brown and cobs drooped. Cobs were taken into the lab, allowed to dry until seed was easily removed from the cob.

Field Grown Plants: Transplanting the young seedlings into the field was very successful. Ninety-five percent of the transplanted plants survived. Unfortunately, about 5 weeks after transplanting, 8 days of very high temperatures significantly affected plant growth. The major problem was that the plants produced pollen before the silks were ready. It was therefore not possible to pollinate silks with pollen from the same variety. Only one small cob of Mandan Red was produced from the field experiment. Plants were planted later than was optimal. We do not anticipate a similar problem if seed is planted earlier next year.

Harvest: Cobs were photographed; seeds were removed from the cobs by hand and placed in paper bags. A sample of ten seeds from each variety was randomly selected and weighed from each variety. The total seed yield was then weighed and an approximate harvested seed number was calculated by dividing the total weight by the weight for ten seeds and then multiplying by ten. The percent seed increase was then calculated by dividing the approximate number of seed by the number of seeds supplied and multiplying by 100 (Table 2).

2006 Results

Significant seed increase was achieved for all varieties in 2006 except the Cree Corn. Although the Cree Corn was reported to have been grown in 2002, we had only 2% germination. This germination rate yielded only two plants in the greenhouse and the one harvested cob had only ten seeds. Despite our best efforts, the Mandan Blue had one ear that was contaminated with pollen from another plant. The blue seed was separated from the yellow, only the true blue seed is provided.

Overall, the seed from all varieties looks good and we anticipate it should grow well next year. Seed will be stored in a cool, (4-8°C) dry place over the winter and planted according to best practices in the spring/summer of 2007.

2007

Although, after last year's experience, we wanted to plant the corn earlier, we were unable to do so because of the threat of frost through the end of May. On June 5, nine corn varieties were sown directly into a sandy loam at the Dream of Wild Health Farm. We used seeds harvested by Dr. Bud Markhart during the 2006 growing season. Table 3 lists the varieties, number of seeds planted, and percent germination for each variety. The night before planting, the seeds were taken into a sweat lodge in accordance with cultural tradition. Pre-plant soil tests indicated low nitrogen so the soil was amended with a 9-0-0 organic fertilizer derived from corn gluten meal at 2 oz/ft^2 and then tilled before seeds were planted. All plants were grown using organic methods and materials.

The seed provided by Dr. Markhart germinated very well and was significantly better than the seed used in 2006 (Table 3).

We pollinated the plants by hand by bagging the tassels of each individual plant when pollen drop began and cutting back the silks before their emergence. After the silks were cut back, they were also bagged and stapled shut for one day. After one day, all available pollen from the variety being pollinated was combined and then used to pollinate the silks that had been cut back the previous day.

The silks were pollinated up to three times each. In order to maximize seed growth and production, the two most promising ears of each plant were selected and the rest were discarded after successful pollination.

2007 Results

All of the plants were hand harvested on September 14 because a killing frost was predicted for that night. Most of the varieties had not yet dried on the stalk; all were hung in the greenhouse to continue drying. Our seed stock was increased for all varieties except the Chip Amber. The Mandan Red Clay, Mandan Blue, Cherokee Flour, and Cree varieties saw a very large percent seed increase while the remaining varieties saw a more modest percent seed increase (Table 4).

In 2007, extreme drought conditions and high temperatures reduced plant growth and altered normal development patterns in many of the corn varieties (Table 5). For example, the Cherokee Flour and Mandan Red produced pollen before their silks were ready, resulting in pollination occurring at a late date in the growing season. This did not allow for the full maturation of all pollinated ears of corn. We noticed that plant height and growth varied greatly

Table 3: Corn Seed Variety, Number of Seeds Provided, and Percent Germination of Each Lot, 2007

Variety	# of Seeds	Germination (%)
Chip Amber	10	90
Mandan Red Clay	20	90
Mandan Blue	20	75
Bear Island	20	60
Cherokee Flour	10	100
Lenape Blue	10	100
Quapaw Red	10	90
Red Lake Hominy	20	90
Cree Corn	3	67

Table 5: 2007 Average Height of Each Plant Variety on Three Dates

Variety	Height, June 29 (in)	Height, Aug. 12 (in)	Height, Sept. 14 (in)
Chip Amber	18	33	34
Mandan Red Clay	23	29	31
Mandan Blue	17	25	26
Bear Island	19	25	26
Cherokee Flour	44	64	66
Lenape Blue	33	50	53
Quapaw Red	49	61	66
Red Lake Hominy	29	49	51
Cree Corn	35	45	49

Table 4: Peta Wakan Tipi Indigenous Corn Seed Increase, 2007

Variety	Seeds Supplied	Harvested Dry Weight (g)	Weight per 10 Seeds (g)	Approx. # Harvested Seeds	Seed Increase (%)
Chip Amber	2,343	413	2.0	2,046	-13
Mandan Red Clay	429	348	2.0	1,746	307
Mandan Blue	201	262	3.3	793	295
Bear Island	1,104	172	1.5	1,156	5
Cherokee Flour	550	286	1.7	1,633	197
Lenape Blue	649	185	1.9	986	52
Quapaw Red	453	98	1.2	803	77
Red Lake Hominy	698	273	2.0	1,364	95
Cree Corn	10	281	1.9	1,448	14,380

between varieties. The Chip Amber, Mandan Blue, Mandan Red Clay, and Bear Island saw poor growth, while the remainder saw average or greater than average growth.

Pest and disease conditions were problematic. Corn borers were found in 10% of the corn ears. Most corn varieties also showed symptoms of common corn rust, which exacerbated the negative effects of the drought. However, the percent seed germination of each variety increased significantly this year.

Management Tips

1. Seeds can be started in the greenhouse and then transplanted in the field or sown directly into warm field soil. Although it is unusual to transplant corn, it can be very successful if done when the seedlings are about 7 days post germination.

2. To prevent corn borer damage, plants should be treated with a *Bacillus thuringiensis* (Bt) spray as necessary throughout the growing season.

3. Seed should be stored in a cool (4-8°C) dry place over the winter.

Cooperators

Craig Hassel, University of Minnesota, St. Paul, MN
Albert (Bud) Markhart, University of Minnesota, St. Paul, MN

Project Location

From St. Paul, take I-35W north to Cty. Rd. 14 (Exit 123) and turn right (east) onto Hwy. 61 in Hugo. Turn left onto Hwy. 61 (north – 2.6 miles) to 170th St. (CR4) and then turn right (east – 3.2 miles) onto Jeffrey Ave. N. (you can only turn right (south) onto Jeffrey Ave. N. Take Jeffrey Ave. N. (south – 0.9 miles) to 16085 Jeffrey Ave. N. The Dream of Wild Health farm will be on the left when driving south on Jeffrey Ave. N. from 170th St.

Environmentally and Economically Sound Ways to Improve Low Phosphorus Levels in Various Cropping Systems Including Organic with or without Livestock Enterprises

Principal Investigator

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Project Duration

2006 to 2009

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Keywords

manure, organic farming, rock phosphate

Project Summary

The primary goal of this project is to seek viable alternative sources of phosphorus for farm operations where animal manures are not available or where commercial NPK fertilizers are not an option. Many organic farmers and others contemplating a transition to organic production do not have livestock and, consequently, do not have access to approved, readily available sources of phosphorus that are affordable.

The land included in the project has not been manured for over 40 years and has now completed transitioning to organic production. Yields have been diminishing steadily over the last 5 years, even with the abundant use of legumes, both as cash crops and as cover crops. The project is located a significant distance from any animal manure source. If we can begin to show how the organically approved sources of phosphorus impact yield and raise the phosphorus levels in fields without the use of animal manures, we can provide more opportunities for farmers without animals to transition to organic production. We can also become more creative in our crop rotations with improved soil phosphorus levels.

Project Description

Over time, it is becoming increasingly evident that many organic producers without livestock on their farms are facing phosphorus shortages in their fields. This can be explained in part due to the growing trend in the use of alfalfa as a cash crop in organic systems. Phosphorus is exported from the farm in the alfalfa hay and the cycle is broken if manure is not returned to the land.

For non-livestock producers, alfalfa is an excellent tool for weed management. For example, inclusion of alfalfa in the rotation helps control Canada thistle. Alfalfa is also a well known soil building crop.

The cropping systems on my farm are a constantly evolving and complex rotation of corn, soybeans, oats, winter wheat, barley, flax, dried field peas, and alfalfa. Presently, I have no livestock. However, I do have access to hog manure from a neighbor who is renting one of my buildings to finish hogs.

Our farmland is gently rolling with some terraces and a fair amount of tile drainage.

Carmen on his farm with hogs being used as manure source for phosphorus study.

Our soils are primarily silty clay loam which allows me to use most conventional equipment to do my field work. The farm consists of about 400 acres, 350 which are tillable. This size operation, using a diverse crop rotation, assures me that I can accomplish most of the work by myself especially given the fact that the crop rotation provides an evenly spread workload over most of the growing season.

The inspiration for this project came from extensive soil testing of a troubled field in the fall of 2006. For several years, production in this field dwindled. My primary complaint about the field was poor productivity. There was also inconsistent crop performance across the field. Soil samples were taken based on crop growth patterns. Soil test results showed very low phosphorus (3 to 5 ppm) uniformly across the entire field. These levels are low enough to easily explain the low crop productivity. The soil tests also showed a dramatic variation in pH. It is commonly known in the soil science community that soil pH is very influential in phosphorus availability to plants. What is unique about this site is that it has a range of pH values from slightly acidic (6.5) to strongly alkaline (8.3) all within the same field.

After consulting with several researchers and crop specialists, I decided the only two options available to me as an organic grower were animal manures and raw phosphate. In the fall of 2007 we applied two types of raw phosphate at a rate of 400 lb/A on GPS marked areas of the field and hog manure at a rate of 10,000 gal/A on a third area to begin the demonstration.

This project will allow us to assess the effectiveness of two different types of rock phosphate minerals (one originating in the southeast part of the U.S. and the other originating in the northwest part of the U.S.) against one manure source (hog manure). It will help us to determine how these different phosphorus sources will affect crop production across a wide range of soil pH levels and which should be used where.

Results

Soil tests are being taken each fall on the GPS marked areas throughout the field to match the test results from year to year. Manure is being analyzed along with application rates. We are taking yields and tissue samples from the growing crops to determine the effect of the three phosphorus amendments. Preliminary results after the first year showed very little movement in the phosphorus levels. However, it is my intention to continue the project for another two growing seasons to fully determine any change in phosphorus availability.

The dried field peas planted in the phosphorus treated areas yielded 10 bu/A. Part of this low yield can be attributed to the low soil phosphorus levels. A very hot spell right at blossom time also significantly curtailed the yield. As a result, our yield data is not directly correlated to the phosphorus issue. Alfalfa yielded 2.9 tons/A from four cuttings. A very hot and dry spell in late July and early August impacted the third cutting significantly. However, a wetter late August and early September contributed to a good fourth cutting.

As I mentioned above, phosphorus levels across the field have moved very little over the past growing season. Consequently, we have applied an additional 4,000 gal/A of hog manure on the alfalfa area of the field and have left the remainder of the area without any additional applications of raw phosphate.

I will be working with my crop consultant to better analyze what may or may not be going on regarding the phosphorus. In 2008, I am seriously considering planting a strip of buckwheat diagonally across the phosphorus treatments after taking the oats crop off to see if this may be an additional and more economical practice to free up phosphorus. I think this would be an appropriate action to take seeing as this is a demonstration grant and not a strict research project.

Cooperator

Glen Borgerding, Ag Resource Consulting, Inc., Albany, MN

Location

From Madison, MN go east on MN Hwy. 40 1.5 miles and look for the A-frame house on the left.

Other Resources

ATTRA – National Sustainable Agriculture Information Service. 2001. Alternative Soil Amendments. Available at: attra.ncat.org/attra-pub/PDF/altsoil.pdf

Brady, N.C., and R.R. Weil. 2000. Elements of the Nature and Properties of Soils. Prentice Hall, New Jersey. Pp. 391-411. Refer to p. 398, Figure 13.5 (the phosphorus cycle in soils).

Rotational Use of High-quality Land: A Three Year Rotation of Pastured Pigs, Vegetable Production, and Annual Forage

Principal Investigator

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Project Duration

2006 to 2009

Writer

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Keywords

diversify, forage, lambs, pigs, rotation, vegetables

Project Summary

Gale Woods Farm is a working educational farm owned and managed by Three Rivers Park District. The farm produces pasture-raised beef, lamb, chicken, turkey, and eggs, and operates a 60 share CSA organic vegetable garden. The farm also serves as a facility for agricultural and environmental education. More than 10,000 visitors a year visit for farm-sponsored events. Our Sustainable Agriculture Demonstration Grant project demonstrates a 3-year rotation of pastured pigs, annual vegetable production, and annual forage for finishing market lambs.

Project Description

We divided an existing pasture located on very productive soils into three sections of approximately 1.5 acres each. Our plan was to incorporate the following three components on each section each year, in a rotation. So far, we've learned that some components, notably pig pasturing, need more than 1 year to accomplish what we want (Figure 1).

Year 1: Pig pasture – pasture ten pigs from April through November to root and dig up the pasture in the first year of the rotation. At a stocking rate of 6.67 pigs/A, we expected pigs to forage for some of their nutritional needs and root up the pasture in preparation for a garden crop in Year 2. (The pigs can also be used for a short time in the garden section to clean up leftover vegetable material after the garden harvest is completed.) The tillage would prepare for:

Year 2: Organic vegetable production – for our community supported agriculture (CSA) program, followed by:

Year 3: An annual forage crop – for finishing pastured market lambs. After drilling in an annual forage crop in early spring, about half of our market lambs would be moved onto this section at the time of weaning. The remaining lambs would be raised on different pastures, allowing for a comparison of growth rates and health.

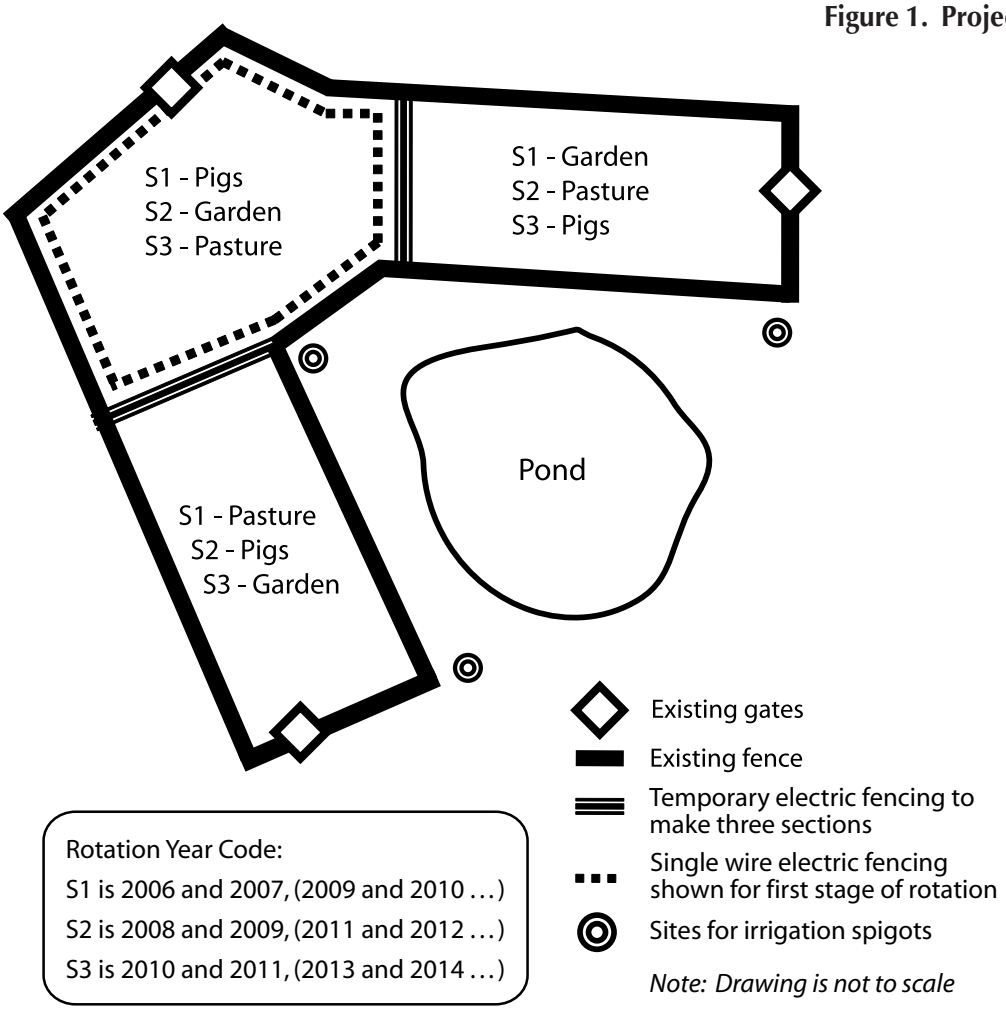
The 3-year cycle on each section of land would then start over again at the beginning.

We are seeking several environmental and economic benefits from this project, including:

- reduced off-farm inputs including purchased grain, tractor fuel, and labor;
- reduced need for chemical de-wormers because the rotation should reduce parasite loads on pasture;
- increased efficiency in pasture use by maximizing use of the pasture and making better use of areas of high soil fertility for garden production;
- expanded organic vegetable production with reduced inputs from the addition of the rotational portion for a garden;
- diversified farm products through the introduction of pigs; and

Pasture in 2007 after pig tillage and oat planting.

Figure 1. Project Design



- demonstration of innovative land use to consumers, students, and other farmers.

During the first year of this project, we established required fencing and watering infrastructure. We subdivided the existing pasture with temporary electronet fencing to create three separate sections. We also installed a single strand of electrical fencing tape inside the permanent perimeter fence in the pig section to prevent pigs from digging under the perimeter fence. We added a seasonal irrigation line along the perimeter of the pasture for livestock water and crop irrigation.

In the second year of this project, we focused on managing the pigs more intensively, to accomplish a more complete "rooting up" of the paddock that will be put into garden production next. We also found sturdily-mounted automatic waterers to be useful.

Results

Component 1 - Pastured Pigs

Both years, we purchased feeder pigs from the Van Der Pol family at Pastures a' Plenty Farm in Kerkhoven, MN. They were a Duroc/Berkshire cross with a trace of Chester White. In 2006, we purchased ten pigs, approximately 2.5 months old. In 2007, we purchased nine pigs, approximately 1.5 months old upon arrival. In 2007, they were put out on pasture on April 30, about 2 weeks earlier than 2006.

In both years, the pigs were fed a two phase ration from the local feed mill. They received 1.5 tons of grower ration and 1.5 tons of finisher ration. This ration lasted until the final 3 weeks when they were finished on approximately 500 lb of cracked corn. In addition, the pigs received ample quantities of garden waste and expired food from a local grocer. Butchering occurred on September 27, 2006 and on October 24, 2007.

2006
We provided one Port-A-Hut shelter on the pasture and moved it as needed to spread out the digging of the pigs. The pigs rooted up approximately 40% of the 1.5 acre field during 5 months on pasture. Eight of them were sent for processing at about 6 months of age, weighing between 225 to 275 lb. Their rate of gain was just less than 2 lb/day. We kept two gilts for breeding purposes. The pork was sold on-site through shares and individual cuts.

2007
In the project's second year, we reduced our animal costs by raising one less animal. We also reduced our feed costs by switching to a lower protein feed (cracked corn) earlier in the season. However, butchering costs increased because we processed the pork into more expensive items, such as sausage.

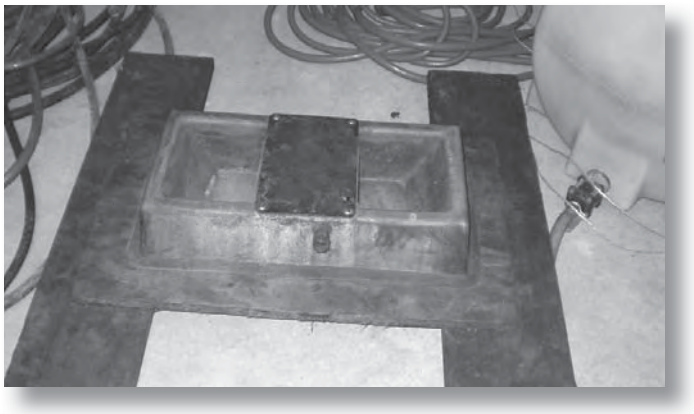
To guide the pigs' rooting activities, we again used one Port-A-Hut shelter on pasture, but this year we focused on more actively managing the rooting area by keeping them in a smaller area than we had in 2006. We used electronet fencing to make strips that were approximately .33 acre in size and placed all nine pigs in the strip. With this more intensive pasture stocking rate, the pigs rooted the entire 1.5 acre field very well.

The pigs were sent for processing at about 6 months of age, weighing between 175 and 275 lb. They gained an average of just under 2 lb/day, but their rate of gain varied greatly. Two of the pigs were "runts" and didn't gain as well, which we assumed was due primarily to genetics, rather than management. The pork was again sold on-site through shares and individual cuts.

In both years, the annual operating costs and revenue were nearly equal—without including capital and labor (Table 1).

Table 1: Costs Associated with Raising Pigs in 2006 and 2007

Costs (excluding capital and labor)	2006	2007
Animal Purchase	$806.00	$450.00
Feed	$850.00	$682.00
Butchering	$977.00	$1,637.00
Total Costs	$2,633.00	$2,769.00
Value of Pork Sold	$2,670.00	$2,685.00
Total Projected Gain/Loss	$37.00	-$84.00



Mounted automatic waterer.

However, a simple cost/revenue analysis is incomplete in the setting of this educational farm. It is hard to assign a dollar amount to the value of having pigs, particularly in this "pasturing for tillage" setting that is part of our educational programming.

Component 2 - Garden Production
2006
In the project's first year, we planted pumpkins, potatoes, popcorn, and winter squash on a loamy peat soil with an organic matter content of 17%. Eliminating the thick sod in this pasture (mainly reed canarygrass and bluegrass) before planting required approximately 30 hr of tractor time with a disc and field cultivator.

We then established garden beds and planted clover and buckwheat in the walkways. The cover crop didn't take very well due to the lack of moisture during establishment. We were unable to measure specific crop yields because of time constraints, but qualitative evaluation indicated very good yields which we credited to high quality soil and low pest/disease pressure. It was fairly dry during the middle part of the growing season. However, due to the nature of the soils, we only had to irrigate once or twice during August. We saw very few Colorado potato beetles and the ones we did see arrived very late. Striped cucumber beetles and squash bugs have been a problem in other areas of the farm but were present in relatively small numbers in this demonstration plot.

2007
In the second year, we planted the garden in the same field that was established in 2006. Since we wanted to keep the pigs in place another year, we did not rotate these fields as we had originally planned. Planting was much easier this year as the pasture sod did not need to be removed. After harvest, most of the garden plots were planted to annual rye and oats late in the fall, and were grazed by cattle in early November when other pastures had stopped producing for the year. The remaining garden plots will be planted to

a pasture mix in the spring of 2008 and will be grazed by spring born lambs. In 2008, the garden will move into the area that was tilled by the pigs in both 2006 and 2007. The sod in these areas was completely eliminated by the pigs, so perennial weed pressure should be greatly reduced.

Component 3 - Annual Forage

We did not plant the third section to an annual forage crop in either 2006 or 2007 as it had not yet been tilled by the pigs nor planted to the garden rotation. This component will be developed once there is a field section ready for forage, after pig and garden use.

Rotation of Three Components

In the initial plan for this project, we intended to rotate the sections every season; it would have taken 3 years of developing the system for all three components to function as part of the rotation. However, we discovered that ten pigs were not able to adequately root up their portion of the pasture under the original management scheme, so we gave them one more season of rooting in the same pasture. In addition, the garden section had fairly significant annual weed pressure in 2006 (mainly velvet leaf and pigweed), so we decided to give the garden another season of active cultivation before planting it to a forage. The low levels of pest and disease problems in this garden encouraged us to use it as a garden for one more season.

We discovered that it was better to modify our plan and manage each section in a more phased approach rather than rotating three complete sections too quickly. As the pigs slowly advance through the pasture, the garden will be phased in behind them. We now expect that most sections will require 2 years of pig tillage rather than one.

In 2006, about 4,000 people visited the project in conjunction with other educational programs at the farm. In 2007, we estimate that about 9,000 people visited; 22 of them attended a field day specifically about the project that was held on September 29, 2007. Unfortunately, we experienced heavy morning rain, which may have kept attendance down. For those attendees undaunted by the morning's weather, it was a good time to see the fields, as they were at the end of a season of pig tillage.

Management Tips

1. To achieve adequate tillage, manage the rooting of grazing pigs intensively. We found that forcing the pigs into an area of 6 to 8 ft^2/lb of animal works quite well. When we moved the pigs every 2 weeks, they were very successful at rooting up the sod in the entire 1.5 acre paddock.

2. To naturally manage the movement of pigs on pasture, provide shade and a wallow when it is hot and dry. We found moving the shade and the wallow 2 to 3 times/week facilitates the spreading out of the pigs' digging.

3. Find a local grocer or cafeteria that is willing to set aside expired produce or leftover food for pig feed. This can be an excellent and free source of additional feed.

4. Find a very sturdy automatic waterer and mount it on something the pigs can't tip over. Pigs are very curious and, especially when they are larger, they will tip over a waterer, chew through the hose, and make a mess if the water is not managed improperly.

5. To prevent weed growth on recently rooted up areas, plant a quick growing annual crop. We planted oats at the rate of approximately 100 lb/A to cover the soil and prevent weed infestations.

Cooperators

Wayne Martin, University of Minnesota, St. Paul, MN
Jim and Lee Ann Van Der Pol, Kerkoven, MN

Project Location

From Minneapolis/St. Paul take I-394 west. I-394 turns into US 12. Follow US 12 until the exit for Cty. Rd. 15 west. Follow Cty. Rd. 15 for approximately 8 miles until the town of Mound. At the intersection (stoplight) with Cty. Rd. 110, take a left. In approximately 2 miles, turn right at the sign for Gale Woods Farm. This road/driveway dead ends at the farm.

Keeping it Green and Growing: An Aerial Seeding Concept

Principal Investigator

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Project Duration

2006 to 2008

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Keywords

aerial seeding, cover crops, grazing, nitrogen cycling, soil erosion, winter rye (Secale cereale)

Project Summary

The goal of this project is to promote cover cropping in row crops in the Zumbro River watershed in SE Minnesota. We hope to reduce soil erosion and reduce nitrogen leaching through the soil by aerial seeding winter rye into fields of standing row crops – corn, soybeans, and sweet corn. Plant residue on these fields will be increased. Cover crops will remove carbon dioxide from the atmosphere and store it as soil organic matter. Cover crops will also provide additional fall and spring forage for livestock.

Project Description

My wife and I farm with my parents on our family farm. We have four children who love growing up on a farm. We raise corn, soybeans, hay, sweet corn, and peas. I have been involved with conservation work on our farm for several years including cover cropping, CRP, and installation of terraces and grass waterways. We use minimum till, no-till, and strip-till farming practices.

Our overall goal in our farming operation is to be good stewards of the land that we have been blessed with. We want to leave it to the next generation in as good or better condition than we have had the privilege of farming. We are working to accomplish this goal by reducing soil erosion, reducing tillage and trying to improve the soil by adding more cover crops. Cover crops build organic matter, reduce nitrate movement in the soil and increase crop residue on our fields. For several years we have been planting cover crops with a grain drill in our sweet corn and pea fields in July and August and we have seen good results. We felt our next step was to get a cover crop established on the corn and soybean fields at the right time and without a lot of expense.

We are using a helicopter to aerial seed winter rye into fields of standing row crops. The helicopter easily negotiates the small fields and rolling terrain in southeastern Minnesota. The row crops are field corn, sweet corn, and soybeans. The field corn includes fields that are harvested for grain and fields that are harvested for silage. We believe that we can establish the winter rye cover crop from 2 to 6 weeks earlier than normal by aerial seeding into crops before they are harvested.

The rye is seeded at a rate of 50-75 lb/A between August 1 and September 1. Normal harvest of the row crops occurs from 2 to 6 weeks later. The average date for harvesting is October 10 for soybeans and October 30 for corn. Corn silage harvest occurs in early September.

Winter rye is an excellent cover crop because it grows in cold weather, it overwinters, and it grows rapidly the following spring. On many of the participating farms, the rye cover is being grazed in late fall and again in spring.

The Hart family.

Results

In 2005 we successfully established rye on August 30 using a helicopter. In 2006 we promoted the aerial seeding concept in SE Minnesota and had good farmer participation. Fifteen farmers participated in Dodge, Goodhue, Olmsted, and Wabasha counties, aerial seeding 1,026 acres. In Winona and Fillmore Counties, ten farmers aerial seeded a total of 435 acres.

The rye was seeded on September 6, 7, and 8, 2006. This was later than we planned. The helicopter was not available until this time due to a commitment to spray for mosquito control in the Twin Cities metro area. The cover crop was seeded on top of the ground in the standing crop and relied on rain and heavy dew for germination and early growth. It is important to seed the rye before early leaf drop in the soybeans so the soybean leaves cover the rye seed. A dry period at this time of year or a later planting date will affect the stand and growth of the cover crop. Fortunately, we did receive some rain after it was seeded.

The helicopter spread pattern at a 50 lb/A seeding rate was not as good as it was last year. We had gaps in some of the fields and we are addressing this issue for next year. Some growers used a 75 lb/A seeding rate and had a more even seeding pattern and better stand.

The farmers particularly liked the efficiency of the aerial seeding. Each farmer lined up their own winter rye seed and had it in a pickup or wagon ready to go the day the helicopter came to seed their field. Once the helicopter landed and instructions were communicated to the farmer, the helicopter was loaded and seeding commenced. The average seeding rate was 100 A/hr. Most farmers had their fields completely seeded in less than an hour. Field conditions are not an issue with aerial seeding. The fields can be very wet but this will not stop the aerial seeding. However, the helicopter cannot fly in rain or windy conditions.

In the spring of 2007 we had good winter rye growth and this made excellent forage for the livestock producers. They were able to graze the winter rye fields and delay the grazing of their summer pasture by 2-4 weeks. This allowed for better summer pasture growth and helped carry the pasture longer into the summer.

By early August, 2007, we were eagerly anticipating another good year of aerial seeding in SE Minnesota. We had 14 farmers and 800 acres lined up to aerial seed in Olmsted, Wabasha, and Goodhue counties. We planned to increase the seeding rate to 75 lb/A and seed the winter rye between August 15 and August 31. But the summer weather turned against us. The day we had planned to start aerial seeding it rained and it seemed to continue to rain every day.

August, 2007 was one of the wettest months on record in SE Minnesota. It included a big rain event that produced widespread flooding. We had several days of rain and many days of high winds that prevented the helicopter from seeding. Even the helicopter had mechanical issues on one day. Finally, on September 15 we decided to cancel the aerial seeding for the 2007 season. The participating farmers were disappointed but they understood things just did not go right. Even with all the disappointments the farmers are very interested in trying aerial seeding again in 2008. We have addressed the problems we had in 2007 and think the 2008 season will go much better. We have been in contact with the helicopter company to work out a larger window of time for aerial seeding. We will seed from August 1 to September 7. The helicopter company has purchased two more helicopters capable of aerial seeding. This will work to our advantage when we pick a calm, clear window for seeding.

Farmers in SE Minnesota know that the best laid plans do not always work out. When this happens you just switch over to plan B. Most farmers know a cover crop can be established several ways. Several farmers simply switched from aerial seeding to using their tried and true systems

The helicopter coming in to reload.

they have used in the past. The cover crops were planted after sweet corn, field corn, or soybean harvest using a grain drill or fertilizer spreader. With the soils moist from the August and September rains the farmers had a good seed bed to plant the rye. Fortunately, the fall weather was warm and the rye grew quickly.

The winter rye was seeded at a rate of 50-75 lb/A depending on the intended purpose. If the farmer wants to graze it, he may plant a higher rate of seed to get more forage for grazing. If the farmer is using it solely as a cover crop he might use a lesser rate so he can no-till into it in the spring without having excess residue to work through.

The helicopter costs $10/A. The winter rye cost $5.50/A at 50 lb/A. The aerial seeding concept has proven to be a good choice. With this system, we can aerial seed a cover crop on a field before it is harvested, usually in late August when we are not so busy on our farm. When the field is harvested, the cover crop is already growing and we are done with that field until the following spring.

Table 1. Residue in Soybeans and Corn on Hart Farm (Fall 2006)

Crop	Cover	Residue (%)
Soybeans	Rye	70
	No Rye	45
Corn	Rye	80
	No Rye	65

The benefits of cover cropping are many. We feel that we have nearly eliminated soil erosion on the soybean and corn fields that were aerial seeded in August and not tilled until the following spring. We raised the amount of residue on our fields with the addition of the rye cover (Table 1 and Table 2). The added residue helps to build more organic matter in the soil.

Another benefit of cover crops is their capacity to reduce nitrate movement. When the current year's crop is done growing there can be leftover nitrates in the soil. They can move through the soil profile to the ground water supply, increasing the levels of nitrates in drinking water. The cover crop will use the leftover nitrates as fertilizer to grow and reduce the amount of nitrates moving down.

The cover cropped area of our test field showed less nitrate in the soil compared to the non-cover cropped area. The cover cropped fields that had the best stands and tallest growing winter rye showed the biggest reduction in nitrate (Table 3). This showed us that the sooner a cover crop is established and growing, the more nitrogen is captured.

Livestock producers who graze these cover cropped fields can get a good return on their investment. We have estimated a farmer can get between one-half and one ton of forage per acre of good grazing by fall grazing and spring grazing these fields. Hay costs were between $60 and $100/ton this year. So a farmer's return on investment was 4 to 7 times his initial costs of $15.50/A for cover crop establishment.

Table 2. Residue Levels for the Spring Crops 2007

Crop	Cover	Residue (%)	Change from Fall Residue (%)
Soybeans	Rye	90	+20
	No Rye	40	-5
Corn	Rye	90	+10
	No Rye	55	-10

Overall, most of the farmers who participated in this program were pleased with the results and are looking forward to doing more next year as we work out the "wrinkles" in the program.

Table 3. Effect of Rye on Soil Nitrate on Hart Farm (Sampling on November 2, 2005)

Crop	Cover	Nitrate on top 2' (ppm)
Sweet Corn	Rye	6.3
(extensive rye development)	No Rye	22.3
Soybeans	Rye	8.6
(intermediate rye development)	No Rye	23.8
Field Corn	Rye	22.6
(minimal rye development)	No Rye	20.9

Rye growing in the sweet corn stubble in late November.

Management Tips

1. In SE Minnesota seeding should be done from early August until mid-September. Aerial seeding done after mid-September can give you mixed results because the winter rye may or may not get established well enough by the aerial seeding method.

2. For later fall seeding, use a grain drill or a fertilizer spreader, working the winter rye in after spreading. The goal is to get the winter rye up and growing as soon as possible to have a good stand that will overwinter. Every year is different and it depends on what kind of a fall you have. If the fall is cold and dry, rye growth will be minimal.

3. The type of crop that you aerial seed your winter rye into will determine how much the cover crop will grow that fall. The cover crop needs sunlight. The sooner you can get sunlight to the cover crop, the faster it will grow.

4. If you aerial seed rye into a sweet corn field the last week of August and it is harvested in early to mid-September, the winter rye will grow fast and will be ready to graze in late fall.

5. We do not recommend aerial seeding into corn fields that have row spacing less than 30". The corn leaves will catch much of the winter rye. It does not shake out or blow out of the corn leaves once it is captured.

6. If you seed rye in a corn field for grain the last week of August and harvest the grain the first of November, there will not be much cover crop growth because the winter rye has not been exposed to direct sunlight. If you plan on grazing this corn field, consider harvesting this field first to allow the cover crop to be exposed to direct sunlight and grow faster in the fall.

7. Corn harvested for corn silage or high moisture corn is a good way to get direct sunlight to the cover crop. These fields are typically harvested earlier and the corn silage field will have most of the residue removed to allow sunlight in.

8. The field conditions at harvest will determine how well your cover will grow that fall. Harvesting when field conditions are wet and muddy will kill the winter rye.

9. Soybean fields that are aerial seeded with winter rye work real well. The ideal time to seed these fields is before the soybean leaves start to drop so the rye rests under the leaves of the soybeans. The soybeans drop their leaves quickly in September, allowing direct sunlight to the cover crop.

10. Timing is important; you do not want to seed soybean fields earlier than the last week of August in SE Minnesota. You do not want your cover crop to grow so fast that it will cause harvest issues. This has not been a problem in the past, but we have not been seeding any earlier than the last week of August.

11. Soybean fields that are no-tilled into last year's corn stalks may require higher seeding rates. We found that the winter rye was getting trapped in last year's corn stalk residue and not getting a good seed-to-soil contact. We did not experience this problem in conventionally tilled soybean fields. We suggest increasing the seeding rate in these fields from 50 to 75 lb/A.

12. Do not get frustrated with your cover crop plan. Be flexible and try to have a backup plan in place. What will you do if you get a month of wet weather? The weather does not always allow you to seed when you want to. You may have to switch to a grain drill or fertilizer spreader to get the cover crop seeded in the fall.

Beef cows grazing rye in late April prior to seeding field corn.

Cooperators

Dave Copeland, Natural Resources Conservation Service, Rochester, MN
Jennifer Ronnenberg, Zumbro Watershed Partnership, Rochester, MN
Mark Zumwinkle, Minnesota Department of Agriculture, St Paul, MN

Location

The location of one of the aerial seeded fields: From Rochester, take Hwy. 63 north 6 miles to Olmsted Cty. Rd. 21, travel ¾ mile and the field is on the south side of the road.

Other Resources

Ag Opportunities on the Air. Link to a Minnesota Department of Agriculture web site with information and an audio clip about aerial seeding: www.mda.state.mn.us/news/audio/default.htm

Minnesota Department of Agriculture. Greenbook 2003. Soil conservation of canning crop fields, pp. 69-72. St. Paul, MN.

Minnesota Department of Agriculture. Greenbook 2003. Aerial seeding winter rye into no-till corn and soybeans, pp. 89-91. St. Paul, MN.

Soybean harvest with rye growing in the understory.

Establishing Beneficial Bug Habitats in a Field Crop Setting

Principal Investigator

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Clay County

Project Duration

2006 to 2009

Writer

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Keywords

beneficial insects, buffers, bugs, diversity, habitat, native, pests, soybean aphid, wildflowers

Project Summary

We are organic farmers near Moorhead, MN and are testing how well living borders around our fields attract and maintain beneficial insects, provide a long-term habitat for beneficial insects, create biological diversity within our cropping system, and serve as a buffer between our certified organic fields and neighbors' conventional land. We think this technique offers conservation benefits since the living borders should provide a barrier that reduces soil erosion and provides habitat. We are using native plants, perennials, grasses, and forage plants, and counting beneficial as well as pest insects.

Project Description

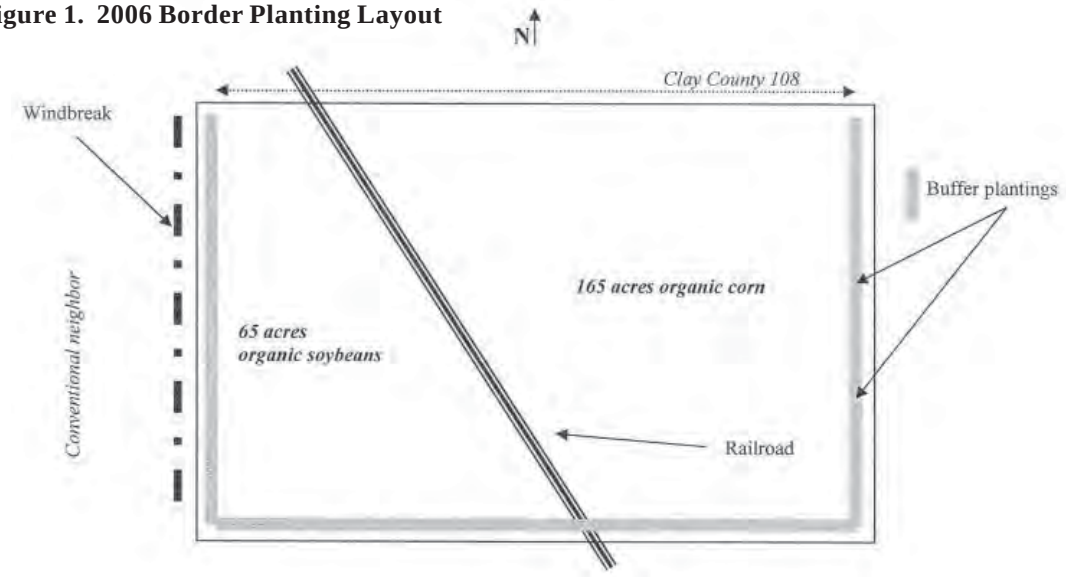
My husband Lee and I farm 1,200 certified organic acres near Moorhead, MN. Our typical rotation includes alfalfa/timothy mixture, corn, wheat, and soybeans.

Recently, soybean aphid pressure has moved into the Upper Midwest, including our part of Minnesota, where border-to-border monocultures of one or two crops adds to pest pressure problems. As organic farmers, our methods of controlling pests must be biologically and ecologically based and approved for use in organic systems. Establishing beneficial insect habitats may be one line of defense.

We believe this project has potential in several important ways. First, we want to increase the ecological diversity on our farm by providing a habitat that encourages beneficial insects to populate. Wildflowers can provide nectar sources for pollinating insects, small trees and native grasses can provide sheltered habitat for beneficial insects. We also suspect that increasing plant diversity will also have a beneficial effect on micro- and macro-biological diversity in the soil. Soil organisms can help maintain low populations of many pests through natural competition.

We think using this kind of mixed planting in our buffers will provide an economic benefit as well. Organic farmers must maintain a buffer zone between themselves and adjoining conventional land. Any production from the buffer must be considered conventional and cannot be commingled with organic crops, which is, harvested, stored, and sold separately. A buffer that helps attract nature's beneficial insects would reduce the management costs of segregating buffer zone production.

Figure 1. 2006 Border Planting Layout



2006

This was the first year of a three-year project. We established buffer strips on two fields (Figure 1). One field was 65 acres (planted to soybeans) and the other was 165 acres (planted to corn). We established border plantings on three sides of each field and left one side without a border planting for a control/comparison. The corn field border grew a little, but died out because of drought conditions. We planned to replant in 2007 and do more insect counts.

We had a very wet spring for planting trees in our clayey soil. We bought Juneberry, chokecherry, and ash trees from Clay County Soil and Water Conservation District (SWCD) and mudded them in along the border according to United States Department of Agriculture Natural Resources Conservation Service (NRCS) spacing guidelines in early June. We used heavy plastic tree matting to suppress weeds in the tree rows. In addition, we planted wildflowers, alfalfa, and buckwheat in between the tree rows. The wildflower seed was a mixture produced for this area that we purchased from Agassiz Seed[1]; we wanted to make sure the seed would be hardy for our growing zone. We broadcast the wildflower seed in the first part of June and worked it in gently with hand tools. We followed the same procedure for the grasses and forages. Species included alfalfa mixed with timothy and buckwheat. We had a check area where we planted nothing between the rows of trees/shrubs. Since wildflowers look like a bunch of weeds when they are just getting started, we also planted zinnias as a marker so we could monitor the area where the wildflowers had been planted.

North Dakota State University entomologist Evan Lampert was a great help to us. He taught us how to use nets to sweep for bugs and how to set up beetle traps. From the initial sweep of the border around the soybeans, the population of beetles which feast on weed seeds, seemed to increase. We also noticed beneficials moving in at the same time as the soybean aphids. Starting in the middle of June, we used insect nets weekly to "sweep" for counting and identification. We froze some insects that we needed further help identifying.

We had one public event on the farm. About 87 people attended. Evan Lampert was there to educate groups about beneficial insects, and Lee conducted field tours for the visitors.

[1] *Inclusion of a trade or business name does not imply endorsement of that product or business by the Minnesota Department of Agriculture, nor does exclusion imply non-approval.*

2006 Results

By midsummer, the conditions were extremely dry and the wildflowers had a hard time competing with the weeds. The wildflowers were slow to grow and looked more like weeds themselves at times. Those wildflowers that did emerge were showy and offered many different small flowers. The various flowers seemed to attract many different insects, including beneficial insects. We reseeded the wildflower areas with a stronger carrier.

Because 2006 was the first year of the project and borders were just being established, I did not have insect counts or insect inventories to report. We did observe that ground beetle numbers were higher in the alfalfa and buckwheat than in any other habitat. Beneficial insect numbers were highest after the soybean aphids started appearing in the soybean field. Green lacewings and ladybugs increased and were noted after soybean aphid levels reached between 200-250/plant, which is a recommended threshold for treatment. We hoped some of the beneficial insects would find winter homes in the tall grasses and we would see populations early in spring 2007. Unfortunately, significant amounts of insect activity did not begin until June.

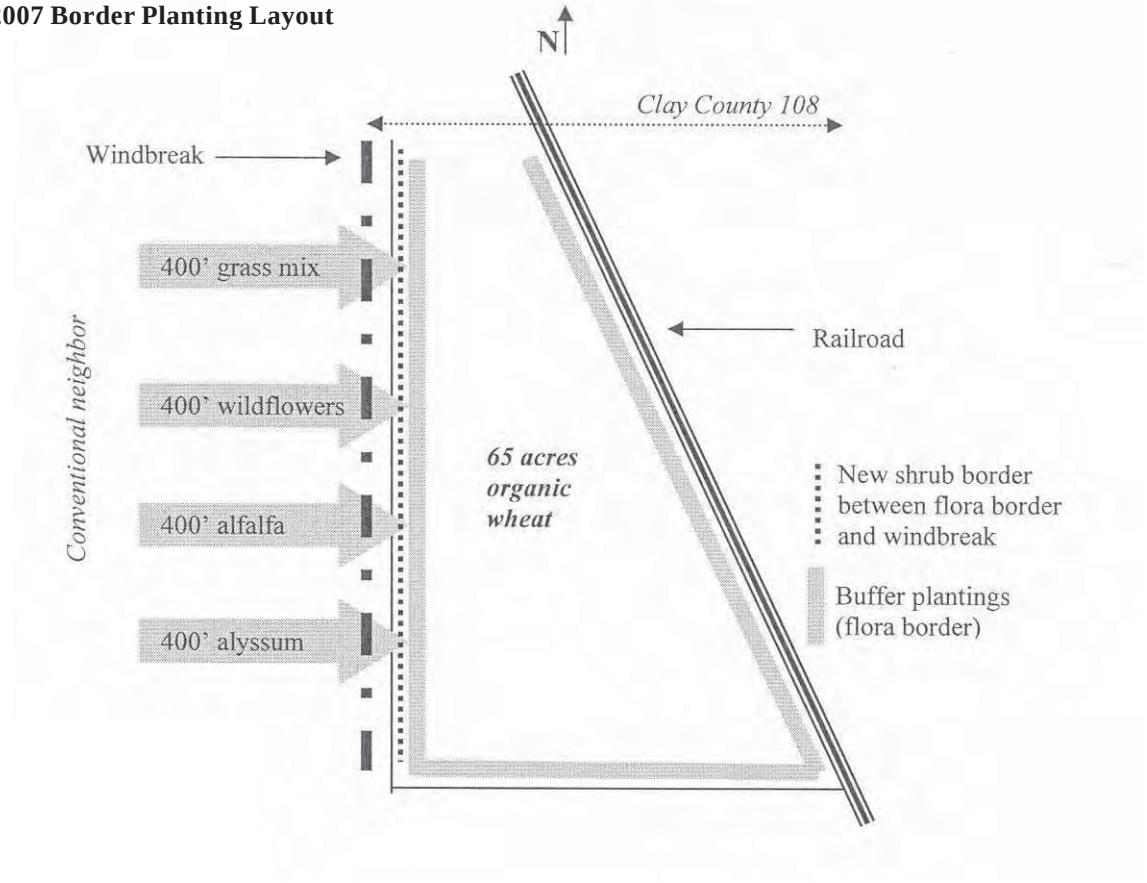
Although some of our friends and neighbors are skeptical about the value of this project, we are already getting calls from wineries and other businesses in the area who want to know when we will have chokecherries to sell. Lee and I have also already noticed indirect benefits, such as the fact that the living borders establish a visual guide to help us differentiate between fields. They also reduce the potential for spray drift.

2007

In 2007, we planted a 12' wide border strip running north and south along the edge of a hard red spring wheat field, separating it from adjoining conventional land (Figure 2). This field had been planted to soybeans last year. The strip was 1,700' long. In it, we planted about 400' each of alyssum, a grass mixture, alfalfa, and mixed wildflowers, and included zinnias with the wildflowers again this year as a marker. The alyssum (usually an annual) is a hardy variety that we are hoping will survive through the winter. We will reseed and regrow the other varieties each year. We planted shrubs, (chokecherry and Juneberry) in a 1,700' strip border 5' west of the floral border. We also had to replant about 25% of the trees we planted last spring.

The weed pressure was high and until the grasses, alfalfa, and wildflower mixtures got established, we had to mow and hand weed some areas. Aggressive grasses and a mixture of grass and alfalfa were important to suppress weeds (and keep the neighbors happy). We are thinking of including timothy grass in next year's planting.

Figure 2. 2007 Border Planting Layout



2007 Results

While in 2006 we had heavy rains and then drought conditions that ruined the planting, weather conditions were much better in 2007.

This year, we compared the tall grass, short cut grass, alyssum, wildflower mixture, and alfalfa to see how many beneficial insects they attracted. There was not a lot of bug activity in June so we did not begin collecting bugs until the first week in July. Once a week, for 6 weeks, we collected the various bugs that were in the border and compared populations of beneficial bugs (those that eat pests) to pest populations. With the supervision and help of our entomologist cooperators, we collected the bugs by "sweeping" with bug nets just before dusk. There was more bug activity during this time, as early morning dew and midsummer heat caused the bugs to be less active earlier in the day. Sweep results are summarized in Figures 3 and 4.

The tall grasses initially were not part of the study but grew in several sections where we were unable to mow. We noticed bug activity there, so we decided to include them in our comparisons. As it turns out, the tall grass seemed a little more appealing to beneficial insects and a little less appealing to pests than the same kind of grass that we kept short. We also recorded insect activity in the native grasses that grow on our land, as we noticed activity there too.

By and large, alyssum, native grasses, and tall grasses (and to a lesser extent the wildflowers) performed the best for providing a habitat for beneficial insects and showed the best results. The alyssum and wildflowers provided ongoing bloom and food for beneficials. In addition, we observed that the alyssum and tall grass were better at choking out weeds than the wildflowers; wildflowers take a while to establish and so remain susceptible to weed pressure.

We also observed that in the wildflower mixture there were large flowers and smaller ones, and the flowers that provided enough support for bugs to land on seemed to attract more bugs.

Alfalfa attracted many more pests then beneficial bugs and, when in bloom, teemed with bugs. Although alfalfa could be used as a secondary crop, our data indicate that it might attract pests that could damage crops that are sensitive to pests (e.g. corn and soybeans).

The profitability of our project has not yet been determined. In the short-term there is a loss due to inputs of plants, seeds, and labor (Table 1). However, in the long-term (especially if it is possible to sell some of the agricultural products from the trees and shrubs), it might be profitable.

There are several co-benefits to our project beyond attracting beneficial insects. There appears to be potential for selling berries from the fruit-bearing shrubs to local wineries and makers of jam and jellies. The border also provides wildlife access to berries and will potentially provide shelter as it matures. We also had some milkweed in the border that we allowed to grow and were delighted to see that it attracted monarchs.

We had two more successful field days in 2007. The weather was beautiful and the turnout was great, with over 200 people visiting the farm. Our events were covered by the local print media and featured on the television and radio news.

Table 1. Estimated Establishment Costs for 2006 and 2007

Item	Cost
Use of farm equipment	$1,320
Supplies (including seeds, shrubs, etc.)	$2,820
Analysis (including insect traps and identification)	$2,010
Labor	$1,740

Note: some additional costs were funded by the USDA Natural Resources Conservation Program's EQIP program.

Figure 3. 2007 Insect Activity by Type of Buffer Planting

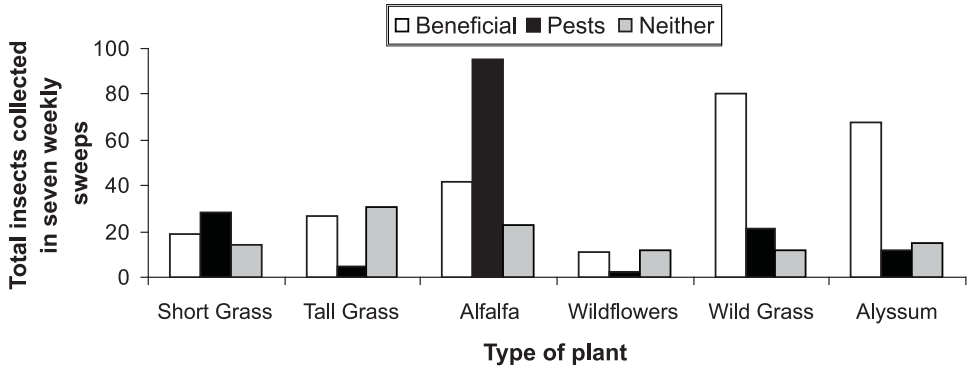
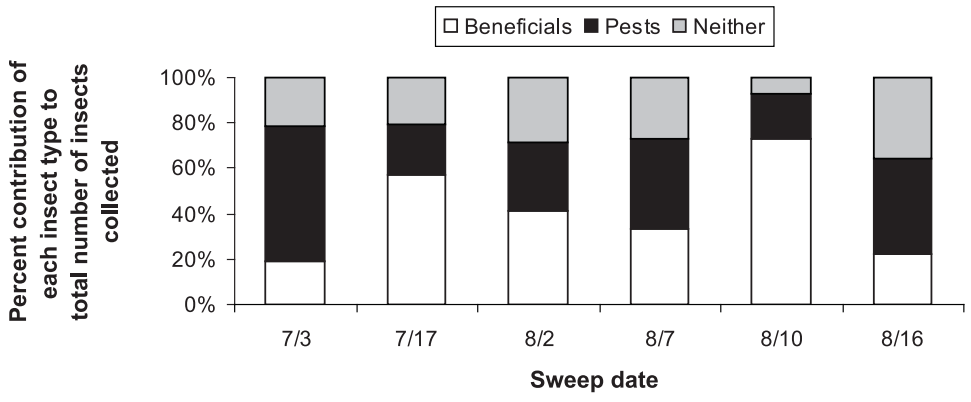


Figure 4. 2007 Insect Activity by Sweep Date



Management Tips

1. So far, our results suggest that alyssum and native grasses have the most potential for attracting beneficial insects while alfalfa attracts more pests.

2. Make sure the wildflower seed you buy is not coated with any product. This point is especially important in organic production. If you contact the seed house before buying season begins, this can usually be arranged.

3. Contact your county USDA Natural Resources Conservation Service office to find out if there are programs that might provide cost-share payments for the tree plantings.

4. If you do receive cost-share through the EQIP program, note that NRCS spacing guidelines must be adhered to, so be sure to consult an NRCS technician before you plant.

5. Be very careful when selecting species so that you don't inadvertently plant something like buckthorn, which acts as a soybean aphid host! Also, buckthorn is a very invasive plant and would end up becoming a pest.

6. If your beneficial border is going to abut someone else's land, be sure you are aware of the property line and discuss your plants with your neighbor. If you are planting along a roadway, check first into township regulations about the required distance from the road.

7. Planting on this scale is much easier if you have access to a grass seeder. This may be available to borrow or rent from your conservation district. Or, you could rent one from a landscaping company.

8. Watch for weed pressure. Try to plant the border when rain is in the forecast, but also note that wildflowers require a very shallow planting bed and are vulnerable to washing away in heavy rain events.

Cooperators

Evan Lampert, North Dakota State University, Fargo, ND
Jessica Gerchak, Environmental Science Teacher, Moorhead, MN
Phil Glogoza, University of Minnesota Extension, Moorhead, MN
Kevin Kassenborg, Clay County Soil and Water Conservation District, Moorhead, MN
Sharon Lean, USDA-NRCS, Moorhead, MN
Donna Nukuay, Moorhead Public Schools, Moorhead, MN

Project Location

From Moorhead, take US-75 north for about 9 miles until you reach Kragness. When you see a white house on your right, go north on Cty. Rd. 96 for about 2.5 miles. Our mailbox and drive are at the point where the power high line crosses the road. Turn right into the drive.

Other Resources

Agassiz Seed & Supply. West Fargo, ND, 701-282-8118. Web site: www.agassizseed.com

Organic certifying agencies. Ours are Global Organic Alliance, www.goa-online.org, and Organic Crop Improvement Association, Minnesota Chapter #1, www.mnocia.org

USDA-NRCS web sites about selecting and establishing plantings to attract pollinators. Web site: www.nrcs.usda.gov (type "pollinators" into search box).

Impacts of Aeration Incorporation of Turkey Litter on the Yield and Quality of Alfalfa Production in Northern Minnesota

Principal Investigator

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Project Duration

2007 to 2008

MN SARE Contact

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Keywords

aeration, alfalfa, alfalfa fertility, alfalfa stands, manure management, turkey litter

This sustainable agriculture demonstration project was a USDA North Central Region Sustainable Agriculture Research and Education Program producer grant.

Project Summary

We produce forage hay for equine, meat goat, sheep, beef, and dairy operations. I currently farm 320 acres of hay ground and have produced hay for almost 30 years. My project looks at the aeration of alfalfa fields fertilized with turkey litter. I want to find out if this practice will increase incorporation of the turkey litter into the soil thereby preventing nutrient losses to runoff, while simultaneously revitalizing alfalfa stands to improve both yield and quality.

Project Description

Alfalfa production is the primary focus and income of our farm. We produce forage hay for equine, meat goat, sheep, beef, and dairy operations. I currently farm 320 acres of hay ground and have produced hay for almost 30 years. I produce small square and large round bales and deliver them to local and regional customers.

The rise in demand for natural meat and milk products has also increased the need for high quality forage feed. This makes alfalfa an attractive crop for many organic hay producers as well as conventional farmers considering the production of alfalfa. In northern Minnesota, alfalfa producers are asking how they can increase yields and quality of their forage production using sustainable techniques. We believe that an answer to this question is spreading turkey litter (manure) as a fertilizer, then aerating to increase incorporation.

Turkey litter is one of the most readily available natural fertilizers in northern Minnesota. It is widely used as a fertilizer throughout Minnesota in the sustainable agriculture community. However, land application of poultry litter can cause contamination of surface water when not incorporated properly. The majority of poultry litter applied currently is not adequately incorporated into the soil, and thus nutrient losses due to water runoff occur frequently. The incorporation of poultry litter by aeration can alleviate this potential for nutrient and subsequent yield loss.

Aeration effects on alfalfa yield and quality have been recognized throughout the United States. Soil aeration has been shown to increase the relative feed value of forage alfalfa and has increased the longevity of

Jerry discussing his project at his 2007 field day.

established stands. Aeration stimulates new root formation in established plants and provides opportunity for water infiltration in soils that have been waterlogged or heavily compacted.

I fertilized our forage fields with turkey litter and found it to be cost effective and productive. I have just begun experimenting with aeration machinery and feel that the benefits have been plainly visible as well. The ability to prove the effectiveness of turkey litter incorporated with aeration will justify the adoption of this practice on organic and conventional fields. This project has the ability to enhance the adoption of sustainable alfalfa production during a time of a tremendous growth of the industry both in Minnesota and around the country.

I used 91 acres of grass and alfalfa planted in sandy loam soil for our test plots. The seeding was approximately 40% alfalfa and 60% grasses (mixture of orchard grass, meadow brome and timothy). This stand was seeded in 2005.

In fall, 2006, we pulled a Lawson Aerator over all the plots (91 acres). The aerator opens the ground with knives. Ten gallons of micro-nutrients per acre (at a cost of $7.00/A) was also applied to all plots. We then spread turkey manure at a rate of 4 to 5 tons/A on a 40 acre parcel. The cost of the turkey manure was $323 per loaded truck and there were 11 truckloads for a total cost of $3,553. On half of the 40 acre parcel, I went back over it again with the aerator to see if it made a difference to aerate after applying the turkey manure.

Results

In the 40 acre field with turkey manure application and aeration, we produced 4.5 tons/A of alfalfa and there was no difference in yield or appearance for the half that had the aeration following the turkey litter application. In the 51 acres that was aerated with no turkey manure applied, we produced 2.5 tons/A of alfalfa. An adjacent smaller section of the field that was not aerated and had no turkey manure applied yielded 1.5 ton/A of alfalfa per acre. The field that was treated with the aerator and turkey manure had better quality hay, 15% protein versus 8% protein with no turkey manure applied. We observed that the soil was looser in the aerated plots. There was no runoff in heavy rain and there were no standing water holes in the field. There was a lot less tire compaction, too.

I concluded that I have better quality hay and higher production from the hay fields when turkey manure is applied and the fields are aerated. We are planning on using the practice of aeration and turkey manure on more of our 310 acres next year.

Cooperators

Derek S. Crompton, University of Minnesota, Roseau, MN
David Grafstrom, Northland Community College, Roseau, MN

Project Location

Contact Grantee for directions.

Field Windbreak/Living Snow Fence Crop Yield Assessment

Principal Investigator

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Project Duration

2005 to 2007

Staff Contact

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Keywords

blowing and drifting snow, field windbreaks, living snow fences, soil erosion

Project Summary

Modern farming practices and the trend to till all available land for annual crop production has encouraged less surface crop residue and less perennial vegetation in many areas of Minnesota. This has allowed our rural landscapes to become vulnerable to increasing soil erosion and blowing and drifting snow for 6 months of the year. Field windbreaks and living snow fences, when placed in the proper locations, can serve the direct purpose of limiting wind erosion and reducing snow drifts on roadways while enhancing rural landscapes.

General information on windbreak design and crop yields near windbreaks are available in USDA publications. Many previous studies have shown that crop yields increase in the vicinity of windbreaks demonstrating a bell curve effect in yield. Crop yields closest to the tree plantings are usually lower, then progressively increase in the protected area, then level out to field averages. We sought to verify and update this yield information using plantings in Minnesota and modern yield monitoring technology. Local information would be helpful for producers interested in establishing these conservation practices.

The goals of this project were to:

- Compile crop yield data (using modern yield monitoring/GPS systems) for crops planted around field windbreaks and living snow fences in Minnesota;
- Document associated variables at these sites; and
- Summarize the data and share it with producers and other agricultural professionals.

Project Description

Field windbreaks and living snow fences (henceforth referred to collectively as windbreaks), when placed strategically, can serve multiple purposes and be very beneficial in enhancing rural landscapes. They benefit wildlife, enhance rural aesthetics, reduce blowing snow problems, protect top soil, and potentially increase crop yields. A world wide study (Kort, 1988) of field windbreaks and living snow fences suggests that there are yield advantages to these conservation plantings in the range of 12% in corn and 8% in soybeans. It is important to record crop yields around windbreaks using modern yield monitoring equipment to show producers where the yield increases and other benefits of these plantings occur. If crop yields are higher or equal to field averages, more producers may be encouraged to establish these plantings

Cottonwood County living snow fence planting, Honeysuckle shrub 10' tall. Note the snow drift on the south side of the planting. The protected highway is south to the right of the photo.

on their farm. The USDA cost-share and continuous CRP payments for these practices are economically beneficial to producers.

Our largest challenge was to identify existing tree sites and the operator with GPS equipment. We identified crop fields that not only had an established (2-30 year) windbreak planting but also a farmer that had yield monitoring and GPS mapping capabilities. We worked with NRCS/SWCD staff and regional crop consultants to identify fields that made good sites to study over a 3 year period (2005-2007).

Yields from the combine passes (commonly 30') were measured and documented. Yields were commonly in the shape of a bell curve: lowest near the woody planting, peaking at five passes away from the planting and then leveling out to the field average. Ten passes were recorded at each site.

Along with yield, we documented the direction of the planting (north-south or east-west), soil type, age of the planting, species of tree or shrub, slope, land use history, snow cover, erosion protection, wildlife benefits, and spring crop planting delays. Seasonal photographs of each site were taken to document snow depth distribution and crop development.

The reason we conducted the project was to share the yield data we collected. We wanted to update crop yields near tree and shrub windbreak plantings using modern yield monitoring systems. We assumed there were yield differences but we wanted to display this with data from current farming practices.

Results

Nine farms with existing windbreaks were located and participated in yield data collection. Two examples of the yield distribution across the fields are shown below.

The Arlen Klassen farm in Cottonwood County has an east-west field windbreak of mature green ash trees approximately 40' tall. Corn yields were recorded in 30' wide strips on both the north and south sides of the windbreak. The field average corn yield for 76 acres was 154 bu/A. There was a noticeable yield reduction from 0' to 30' on either side of the windbreak (Table 1 and Figure 1). From 90' to 270' on the south side the yield was 9.7% above field average. From 60' to 270' on the north side the yield was 5.7% above field average. The highest yield occurred at 150' on the north side and 180' on the south side.

Table 1. Corn Yield Distribution Near Mature Green Ash Field Windbreak on the Arlen Klassen Farm (Fall 2006)

	Average Yield of Entire Field (bu/A)	Average Yield Near Planting (bu/A)**	Yield Increase Near Planting (%)	Top Yield Near Planting (bu/A)*
North of Windbreak	154	158	2.2	170 (5th pass)
South of Windbreak	154	159	3.1	178 (6th pass)

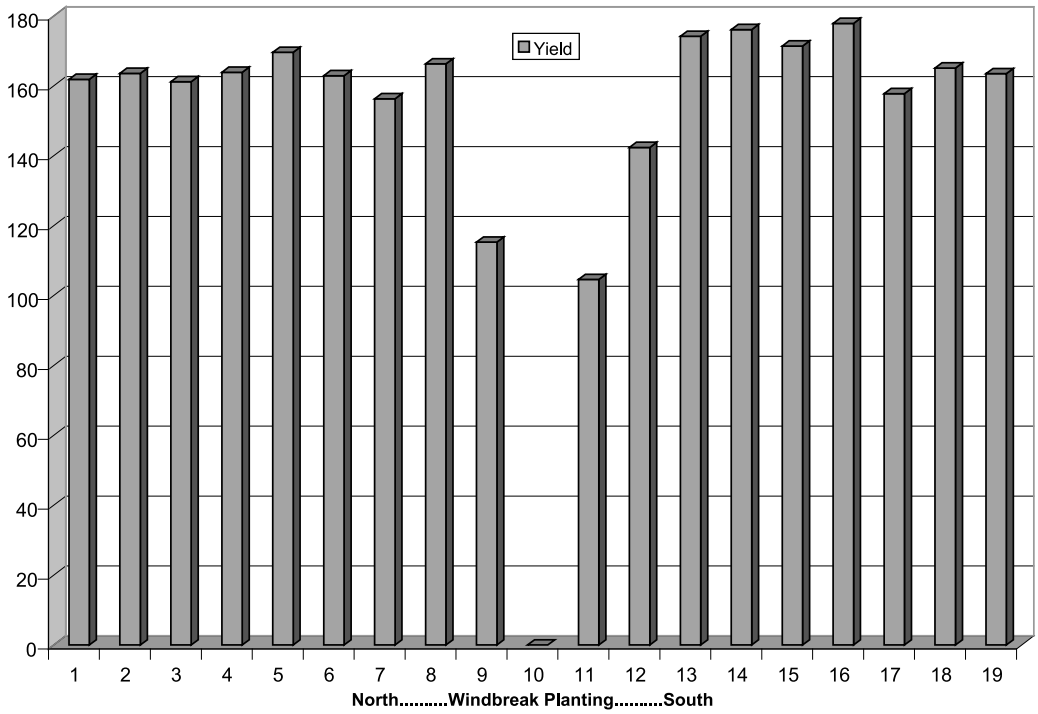
**One pass of combine = 30'* ***Six passes included in average near planting*

Table 2. Corn Yield Distribution North of Amur Maple – Red Cedar Field Windbreak on the Richard Flohrs Farm (Fall 2006)

	Average Yield of Entire Field (bu/A)	Average Yield Near Planting (bu/A)**	Yield Increase Near Planting (%)	Top Yield Near Planting (bu/A)*
North of Windbreak	184.7	189.4	2.54	203 (5th pass)

**One pass of combine = 20'* ***Seven passes included in average near planting*

Figure 1. Arlen Klassen Corn Yield (bu/A) Near Windbreak - Fall 2006



The Richard Flohrs farm in Martin County has an east-west field windbreak of Amur maple and red cedar. Corn yields were recorded in 20' wide strips on the north side of the windbreak. The field average corn yield was 184 bu/A. There was a noticeable yield reduction from 0' to 20' north of the windbreak but the overall effect of the windbreak increased corn yields by 2.5% (Table 2).

In 2008, we monitored a new site in Jackson County with a field windbreak of a single row of alternating green ash trees (35' to 40' tall) and honeysuckle shrubs (10' tall) planted north and south. The yield was recorded in 60' strips. The corn yield average for 101 acres was 136 bu/A. In this field there was a noticeable increase in yield on either side of the planting from 0' to 120', a noticeable decrease in yield from 120' to 240' and an increase in yield at 300'. From 0' to 300' on either side of the planting, the yield was lower than the field average. The west side was 61% (83 bu/A) and the east side was 64% (88 bu/A) of the field average. The soil type is sandy and may be an influencing factor in yield in this field. There is not a control site, so without the field windbreak the crop yield could be reduced even more than it was.

An east and west field windbreak in Cottonwood County was part of the study. This is a mature green ash tree planting approximately 40' tall. The yield was recorded in 30' strips. The corn yield average for 76 acres was 154 bu/A. There was a noticeable yield reduction on either side of the planting from 0' to 30'. From 90' to 270' on the south side the yield was 9.7% above field average (169 bu/A). From 60' to 270' on the north side the yield was 5.7% above field average (163 bu/A). The highest yield occurred at 150' on the north side and 180' on the south side.

In our recent hot dry summers, some farmers and crop consultants have noticed a furnace effect on crop fields north of gravel roads where yields have been noticeably reduced. This may be due to the lack of moisture in the soil from sun and wind exposure during the late summer drought. We have also noticed this effect (shorter plants and reduced yields) on the south side of east/west tree and shrub plantings. We have also noticed taller plants and increased yields on the north side of these east/west plantings due in part to shading and wind protection during the drought period.

Generally, we have found a wide range of both negative and positive yields 30' to 300' away from the windbreaks. Factors affecting yields were very site specific. Some sites documented an average yield increase of 2-3 % while other sites recorded average yield reductions of 0-2% from the field average. Variables such as soil type, topography, and weather conditions also affected crop yield.

Although this study did not show consistent yield increases nor increases as great as found in drier parts of the country, we still feel the plantings are justified, especially when the multiple benefits of snow capture and soil conservation are taken into consideration.

Management Tips

1. Assess your crop fields and property to see if a windbreak or a living snow fence could benefit your land or neighborhood.

2. Siting of windbreaks and living snow fences should also include non-yield benefits such as protecting top soil from wind erosion, increasing wildlife habitat, improving rural aesthetics, and reducing blowing and drifting snow on community roadways.

3. Contact your county FSA/NRCS/SWCD office to learn if you may be eligible for cost-share and continuous CRP incentive programs for windbreaks and/or living snow fences.

4. It is recommended that a grass buffer be established on both sides of the tree planting to reduce crop yield loss near the planting. Depending on soil type, there is a bump in crop yield further away from the planting. In many cases there is an increase in yield above field averages.

Project Location

Contact Gary Wyatt for directions to specific sites.

Other Resources

Gullickson, D., S. Josiah, and P. Flynn. 1999. Catching the Snow with Living Snow Fences. University of Minnesota Extension Service. Pub. # MS-07311. Web site: www.extension.umn.edu/distribution/naturalresources/DD7311.html

Grala, R., and J. Colletti. 2003. Estimates of additional maize (Zea mays) yields required to offset costs of tree-windbreaks in Midwestern USA. Agroforestry Systems 59: 11–20. Kluwer Academic Publishers. Printed in the Netherlands.

Josiah, S., and M. Majeski. 1999. Living Snow Fences. University of Minnesota Extension Service. Pub. # FO-07277-GO. Web site: www.extension.umn.edu/distribution/naturalresources/DD7277.html

Kort, J. 1988. Benefits of windbreaks to forage and field crops. Agriculture, Ecosystems and Environment 22/23: 65-190.

National Agroforestry Center. Web site: www.unl.edu/nac/ and www.unl.edu/nac/windbreaks.htm.

Cottonwood County living snow fence in the summer of the 2005 corn crop.

Redwood County field windbreaks with Black Hills Spruce.

Testing the Potential of Hybrid Willow as a Sustainable Biomass Energy Alternative in Northern Minnesota – Second Season Results

Principal Investigator

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Project Duration

2005 to 2007

Staff Contact

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Keywords

bioenergy, biomass, energy crop, fossil fuels, hybrid willow, renewable energy

Project Summary

The objective of this project is to test hybrid willow from New York as a potential energy crop for northern Minnesota that presents both potential market and wildlife benefits. We will determine the hardiness of this crop for the meadowlands area; develop a test demonstration planting that can be used to guide future research and development; and provide a northern clonal trial to compare to a similar plot that was planted in Martin County in spring 2004.

Project Description

Renewable sources of energy are becoming more important every day and Minnesota has been a leader in the use of renewables to replace fossil fuels as a source of energy. With the Governor's recent commitment to renewable energy, finding renewable fuel options has become more important. Woody biomass offers an important option for the production of biomass for energy. In addition to the energy benefits provided by willows, they also have potential for plantings in riparian areas currently in row crop production but which are periodically flooded and have relatively low agricultural productivity. If planted in such sites as a biomass crop, willow can provide a source of income for landowners while protecting soils from erosion and taking up excess nutrients before they enter and contribute to the contamination of surface waters.

Recently, there has been growing concern about global warming and interest in the potential to sequester carbon through terrestrial systems which could include willow plantings. To do that would require information on the growth rates of willow in diverse locations in Minnesota. This project along with other information being generated by parallel projects will allow us to better understand and estimate the potential of willow plantings to sequester carbon.

This project combines the efforts of a Minnesota farmer/landowner who is already involved in the planting and production of short rotation woody crops, researchers from the University of Minnesota and the University of Wisconsin-Stevens Point, and extension educators from the University of Minnesota. In addition, researchers from the State University of New York helped select willow species and varieties and provided planting stock. This unique partnership has allowed the project team to test the willow varieties (Table 1) under farm conditions and provide opportunities for dissemination of results in Minnesota as well as Wisconsin, contributing to the further development of biomass energy options in the North Central States and providing viable and sustainable options for Minnesota landowners.

In July, 2006, the project received and planted cuttings from Tim Volk, leader of the willow research in New York State. This planting is located in Toivola, Minnesota in St. Louis County. In addition, we have used this planting stock at the University of Minnesota

Table 1. Varieties Used in Planting Trials

Variety	Species
S365	*Salix discolor*
SV1	*Salix dasyc/ados*
SX61	*Salix sachalinensis*
SX67	*Salix miyabeana*

Table 2. Initial Survival and Biomass Production of Willow Plantings

Variety	Planted - # of plants	Survival - # of plants	% Survival	Oven dry wt of stems (g)*
S365	600	441	74	2.20
SV1	600	415	69	1.93
SX61	600	543	91	4.91
SX67	600	457	76	3.41

**An average of 18 plants/plot. There were 16 plots.*
Note: Plants were often multi-stemmed so the weight represents the weight of all the stems from one plant.

Southern Research and Outreach Center in Waseca and also at a site in Martin County. These two additional sites are not part of this grant project but give us additional sites with which to compare the plantings at Toivola. The willows at these three sites were planted in a standard research design which will allow us to compare the results among the three sites and with similar trials in New York. A total of 3,900 willow cuttings were planted with 2,400 cuttings in replicated block plantings following guidelines from researchers in New York. The remaining 1,500 cuttings were planted following a planting scheme that Gerald Wick, the landowner, has been using to establish poplar plantings. (See diagrams 1-5 for planting schemes.)

Survival was measured in the fall of 2006 (Table 2) and survival ranged from 74% to 91% among the four different varieties. The plants were trimmed back to about 2" above ground level in November, 2006 and the biomass was collected, dried, and weighed to provide an estimate of biomass production. There was considerable deer damage but some stems were over a meter in height. Production was probably lower than might be expected because of the late planting date and the relatively dry late summer weather this year.

In 2007, the willow plantings were subject to heavy weed pressure as well as deer browsing since establishment. In the summer of 2007, weeds on the plots were initially controlled mechanically with "weed whackers." We mechanically harvested the weeds a second time, with a weed whacker and then applied Roundup® between the rows of willows with a backpack sprayer being careful not to contact the willows. The willow responded well to weed treatments with the most successful varieties reaching a height of 7'-8' by the end of the summer (Table 3). Survival and growth will be measured again in 2008.

This trial will also be used as a demonstration for landowners and natural resource professionals with the first demonstration visits occurring in the fall of 2007. We plan to hold a second field day during the summer of 2008. With the assistance of the landowner and others, we hope to continue to monitor and expand willow trials in Minnesota.

Cooperators

Gerald Wick, Farmer, Meadowlands, MN
Dennis Gibson, Minnesota Agroforestry Cooperative, Montevideo, MN
Diomides Zamora, University of Minnesota, Brainerd, MN

Other Resources

Short Rotation Woody Biomass Program. State University of New York – College of Environmental Science and Forestry. Syracuse, NY. Web site: www.esf.edu/willow

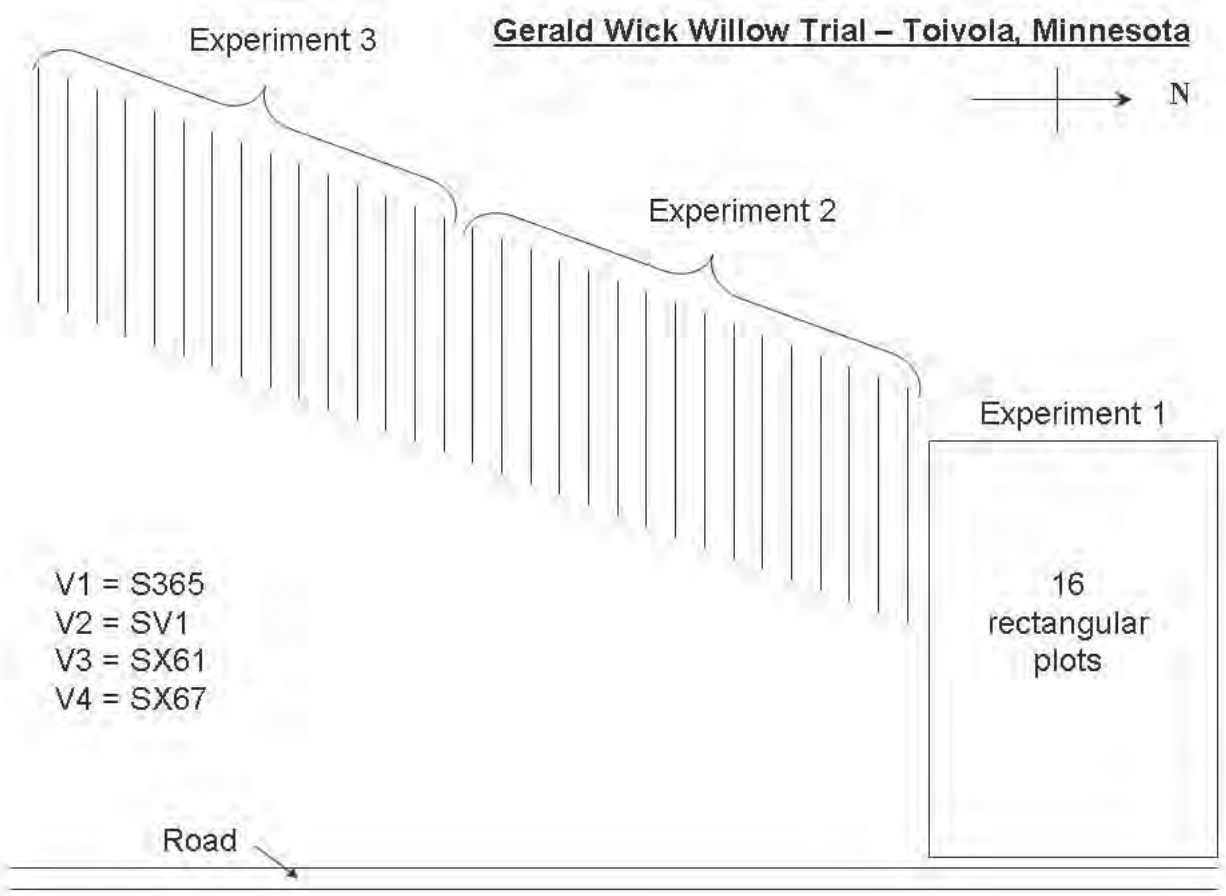
University of Minnesota - Center for Integrated Natural Resources and Agricultural Management (CINRAM) is a partner-based organization that catalyzes the development and adoption of integrated land use systems. Web site: www.cinram.umn.edu

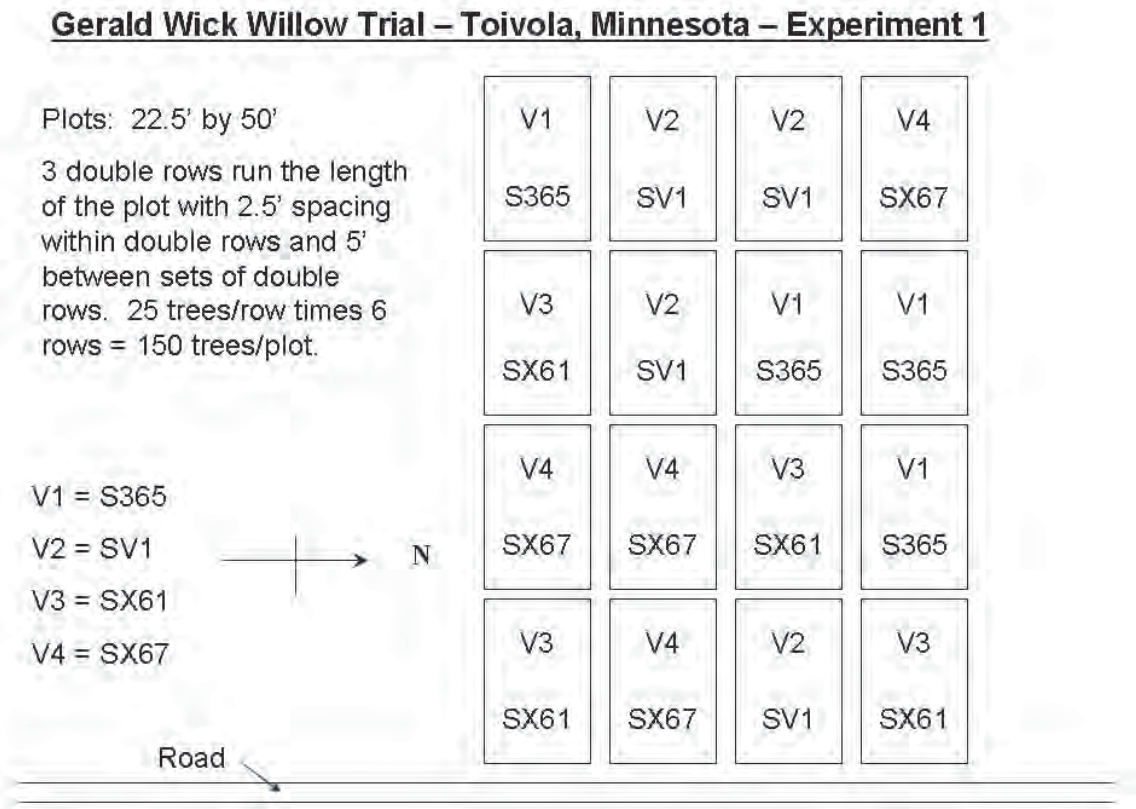
Volk, T.A. The Potential of Willow Biomass Crops for Bioenergy in Central New York. Slide show in pdf. format. State University of New York – College of Environmental Science and Forestry. Syracuse, NY. Web site: www.esf.edu/willow/ED%20MODULES/PDF%20Format/SlideShow-rev.pdf

Willow Biomass Project brochure. State University of New York – College of Environmental Science and Forestry. Syracuse, NY. Web site: www.esf.edu/willow/PDF/brochures/willowbrochure.pdf

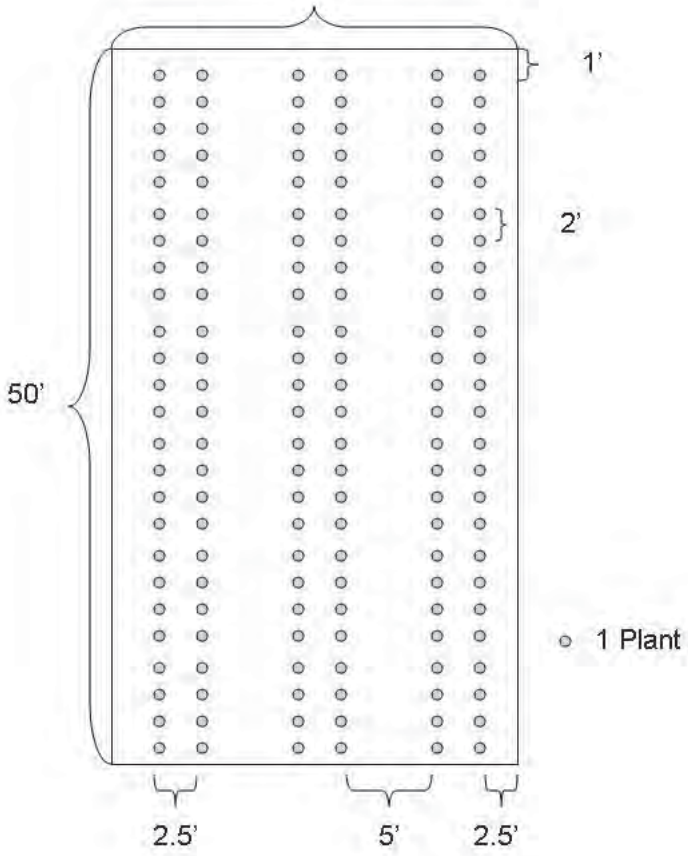
Table 3. Growth of Four Varieties of Willow in 2007

Variety	Growth (ft)
S365	2 - 4
SV1	2 - 5
SX61	4 - 6
SX67	6 - 8

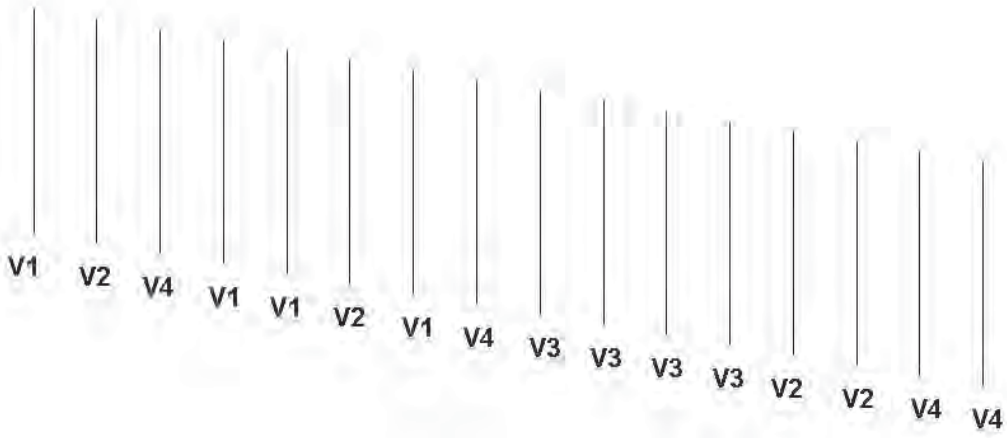

Gerald Wick Willow Trial – Toivola, Minnesota
Experiment 3
Experiment 2
Experiment 1
N
V1 = S365
V2 = SV1
V3 = SX61
V4 = SX67
16 rectangular plots
Road


Gerald Wick Willow Trial – Toivola, Minnesota – Experiment 1
Plots: 22.5' by 50'
3 double rows run the length of the plot with 2.5' spacing within double rows and 5' between sets of double rows. 25 trees/row times 6 rows = 150 trees/plot.
V1 = S365
V2 = SV1
V3 = SX61
V4 = SX67
N
Road
V1 S365
V2 SV1
V2 SV1
V4 SX67
V3 SX61
V2 SV1
V1 S365
V1 S365
V4 SX67
V4 SX67
V3 SX61
V1 S365
V3 SX61
V4 SX67
V2 SV1
V3 SX61

Plot Layout – Experiment 1



Experiment 2

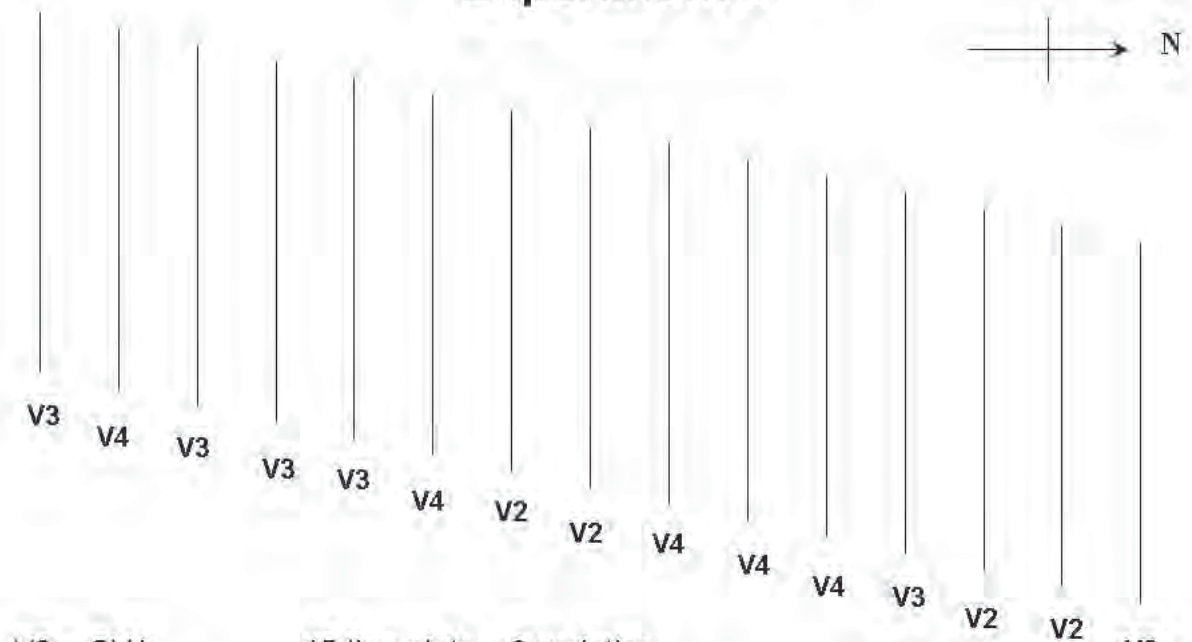


V1 = S365
V2 = SV1
V3 = SX61
V4 = SX67

16 line plots – 4 varieties

2' spacing along lines with different varieties.
100' long plots with 50 trees/plot.

Experiment 3



V2 = SV1
V3 = SX61
V4 = SX67

15 line plots – 3 varieties

1.5' spacing along lines with different varieties.
100' long plots with 66 trees/plot.

On-farm Biodiesel Production from Canola

Principal Investigator

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Project Duration

2007 to 2009

Staff Contact

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651-201-6616

Keywords

biodiesel, canola, diesel, energy, oil, oil press

[1] *Steve is a canola producer. He is a former president of the United States Canola Growers Association. He currently serves on the Minnesota Canola Council and is the president of Farmers Union Oil Company.*

Project Summary

The ability to produce biodiesel fuel from canola grown on the farm seems like a great idea. The technology exists to make this idea a reality. However, the economics of making this idea a sustainable and viable part of rural agriculture are unknown. In this project we hope to be able to put an exact cost on each component of production.

Within Minnesota, there are a great many farmers and small business owners who are interested in producing their own fuel. We hope our project will help those individuals who are interested in producing biodiesel make an informed decision based on the true costs and benefits of using canola to make fuel.

Project Description

The majority of canola acres in Minnesota are grown in or near Roseau County. Farms in this area are very diverse in the number of different crops grown. This diversity is important in spreading the risk involved with severe weather impacts and spreads out the workload throughout the crop year. Canola is an oilseed crop that could enhance the diversity of farms in other parts of the state, as well as providing a source of on-farm fuel.

This project involves a lot of collaboration among the farmers involved with this project, the University of Minnesota, and the Northwest Regional Sustainable Development Partnership (NRSDP). The oil seed press to be used in this project was purchased by the NRSDP and they have allowed us to use the press throughout the course of this project.

The Komet[1] oil seed press is a 2-screw mechanical cold press that has the capacity to crush 1,100 to 1,200 lb of canola seed per day over a 24 hour period. This production would result in 50 gallons of oil per day. If the press were operated for a period of 300 days per year, it would produce approximately 15,000 gallons of vegetable oil to be used or processed into biodiesel. A partnership among several farms might be a great way to utilize the press for efficiency, ease of transport, and processing of fuel.

We set up a farm-scale production facility to produce biodiesel from canola seed. Our plan was to crush canola seed with the Komet press, producing both oil and canola meal. The canola meal would be fed to the

[1] *Inclusion of a trade name does not imply endorsement of that product by the Minnesota Department of Agriculture, nor does exclusion imply non-approval.*

We had a sign made in order to acknowledge all project contributors.

livestock of our producers. The canola oil would be sold directly or processed into biodiesel. We thought this approach would provide us with a chance to feed the canola meal as a by-product, establish a market price for the meal, and determine the cost of processing the oil into biodiesel.

2007 Results

In the summer of 2007, the Komet press arrived from Germany, and was delivered and set up in a building dedicated to the project in Wannaska, MN owned by Kraig Lee. Materials for the press hopper and stand were created and assembled by Tony Brateng and Erik Dunham prior to the spring planting season beginning. The setup of the press was completed by July, and the crushing of canola began after harvest season was completed. We had to spend some of our budget on electrical work done so the press would run properly, and had to spend more than we expected for purchasing canola seed, since between the time we wrote our proposal and when we started crushing, the cost of canola jumped by $0.08/lb.

This year, we documented the specifics of running the canola through the press, such as how much canola oil versus canola meal is produced per hour. In a 24 hour period, pressing 1,200 lb of canola yielded about 800 lb of canola meal and 50 gal of canola oil. Documentation also included the specifics of press setup and settings to assure the most efficient process of canola through the press. There is no doubt that the learning curve was steep on the basics of the press operation, but running successfully for a couple of weeks enabled us to feel very comfortable in addressing any issues that came up while processing.

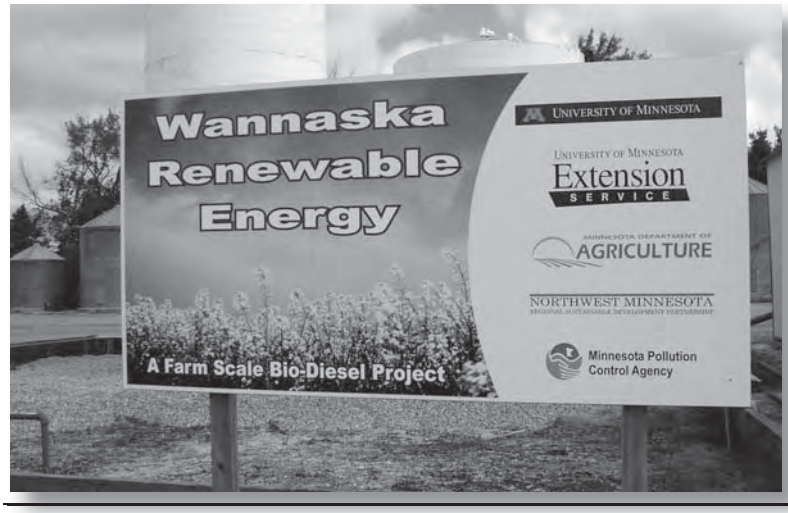
We discovered that the press can be filled with canola seed in the morning and be allowed to run without any attendance throughout the entire day. It is really a nice system which doesn't require a lot of babysitting from farm help. We felt very good about the final system arrangement and efficiency.

As we planned, our producers are feeding the canola meal by-product to their beef cows. Their goal is to feed around 1 lb/day, as the energy content in the meal is very high. They report that the results of feeding the meal to cattle have been favorable up to this point.

The production of biodiesel was limited by the weather conditions in 2007. Our building is not heated, which prevented us from working with the oil once the temperatures fell below freezing. We plan to process our stockpiled canola oil into biodiesel when the weather warms up again in the spring of 2008.

In the meantime, the NRSDP's press was moved to the University of Minnesota - Crookston campus where canola, sunflower, and soybean pressing and biodiesel pressing could be done in their heated facility. We hope that the faculty there will be able to run tests on biodiesel quality and emissions during the winter. The University also plans to feed the canola meal to the dairy herd located on campus and note any increases in milk production. The press will return to us in the spring of 2008 so we can complete our experiments and finalize the production costs of producing biodiesel from canola on the farm.

As we began this project, the price of canola seed was around $0.12/lb and economics of producing biodiesel on-farm at this price looked favorable. However, as we prepare this article (the end of 2007), prices for canola seed have jumped to $0.20/lb. We didn't anticipate this price increase at the onset of the project. Thus, as we look at continued research for 2008-2009, we think it may be worth investigating the use of raw (unrefined) vegetable oil for heating purposes. The cost effectiveness of this approach to on-farm energy production depends not only on the price of canola seed, but on the price of petroleum-based diesel, too.



The Komet press in Wannaska.
Photo credit: Paul Porter

We feel that this project might be a good business for an individual who may want to crush canola on a part-time basis, sell the meal as feed to local livestock producers, and sell the vegetable oil to local customers for home heating.

Our best estimates of our cost of production are shown in Tables 1 and 2. We expect to see some of these numbers change after we are able to press more oil and complete the process of refining the oil to biodiesel. One of the factors is the value of the by-product—the meal. We have found it difficult to sell the meal for what we think we should get for it, as there are not a lot of meal buyers in our area who are familiar with canola meal pressed in this manner. The value of soybean meal and cottonseed meal currently used in dairy livestock rations is around $350/ton. The pressed canola meal we have been selling has been priced at $250/ton, but should have a value closer to $300/ton based on the nutritional value.

Management Tips

1. As producers begin to consider the possibility of growing fuel on their farm operation, we recommend that they take the time to research the current presses that are marketed and sold in North America.

2. It may be helpful to attend a class offered by the manufacturers of biodiesel conversion equipment to become familiar with the process and by-products of biodiesel.

3. The University of Minnesota is just beginning to research this topic, but has available contacts of biodiesel product manufacturers and companies for folks interested in getting started. Contact Derek S. Crompton at 218-463-0295.

Project Cooperators

Branon Anderson, Farmer, Wannaska, MN
Tony Brateng, Farmer, Roseau, MN
Erik Dunham, Farmer, Wannaska, MN
Seth Fore, University of Minnesota, St. Paul, MN
Kraig Lee, Farmer, Wannaska, MN
Paul Porter, University of Minnesota, St. Paul, MN
University of Minnesota Northwest Regional Sustainable Development Partnership, Crookston, MN

Project Location

From Roseau, travel 13 miles south on Hwy. 89 to building site on the Kraig Lee farm, ½ block west of the Lee's Hardware Store.

Other Resources

Utah Biodiesel Supply. Web site at: www.utahbiodieselsupply.com
Fuelmeister. Web site at: www.fuelmeister.com
Canola Council. Web site at: www.canola-council.org/grow_canola.aspx

Table 1. Sample Biodiesel Budgets for Canola - Including Different Land Tenures

	Owned Land	Cash Rent	Purchased Feedstock
Yield per acre (lb)	2,000	2,000	2,000
Cost per lb	$0.11	$0.13	$0.16
Expenditure ($/A)	$225.80	$269.60	$318.00
Pounds of oil per acre	645	645	645
Gallons of oil per acre	85	85	85
Cost per gallon ($/gal)	$2.66	$3.18	$3.75
Conversion cost per gallon ($/gal)	$0.59	$0.59	$0.59
Biodiesel cost, per gal. w/o meal credit	$3.25	$3.76	$4.33
Meal per acre (lb)	1,355	1355	1,355
Meal price ($/lb)	$0.05	$0.05	$0.05
Meal credit ($/A)	$67.75	$67.75	$67.75
Meal credit/gallon	0.80	0.80	0.80
Cost/gal to produce canola biodiesel	$2.45	$2.97	$3.54

This data is from the University of Minnesota Center for Farm Financial Management FINBIN database www.finbin.edu. Numbers are from 2006 (2007 data available when we prepared the report on which this article is based). This summary was prepared by University of Minnesota student Seth Fore and University of Minnesota – Crookston student Jade Estling.

Table 2. Assumptions

Methanol 15% v/v	$2.55
KOH 5% v/v	$1.50
Press Efficiency	75%
Canola Oil %	43%
Biodiesel Wt	7.6 lb
Market Meal Price	$100/ton

Evaluation of the Potential of Hybrid Willow as a Sustainable Biomass Energy Alternative in West Central Minnesota

Principal Investigator

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Project Duration

2007 to 2009

Staff Contact

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651-201-6240

Keywords

carbon sequestration, hybrid willow, renewable energy

Project Summary

The overall objective of this project is to evaluate the potential of hybrid willow as an alternative energy crop for west central Minnesota. Willow offers economic and ecological potential for landowners. It serves as a bio-energy crop that has potential market value because of the increasing demand by biomass burning plants for bio-energy production. Ecological benefits of planting willow include improved wildlife habitat, improved water quality, and carbon sequestration. Specifically, this project will:

- determine the hardiness of willow varieties from New York and compare it to the local varieties of willow growing in the Wadena County area;
- establish demonstration trials that can be used to guide future research and development in Minnesota;
- provide a western clonal trial to compare to similar plantings in Martin and St. Louis counties; and
- compare yield between willow and hybrid poplar at the end of the project.

Project Description

Renewable sources of energy are becoming more important as the state is striving towards energy independence from fossil fuels. Woody biomass offers an important option for the production of biomass for energy. Short rotation woody crops like willow provide both economic and ecological benefits. Willows are often planted along riverbanks at the edge of row crop fields to prevent erosion while improving water quality. In west central Minnesota, high levels of nitrate in soil water exist due to intensive agricultural production. Willows provide a perennial system that utilizes the excess nitrate before it reaches surface or ground water (a process called phytoremediation). If planted in such sites as a biomass crop, willow can provide a source of income for landowners while realizing these ecological benefits. Willows are also used to sequester carbon in other parts of the country. This research could serve as a carbon sequestration pilot project in Wadena in the future.

Dean Current displays a stand of hybrid willow at Meadowlands.

This is a collaborative project involving a partnership among Minnesota farmer/landowners, researchers at the University of Minnesota Extension Service, and the Center for Integrated Natural Resources and Agricultural Management (CINRAM) of the University of Minnesota. The 2 acre project is being conducted at a farm located in North Germany Township in Wadena County. The farmer owns 240 acres of land in the area.

Table 1: Willow Varieties to be Used in Wadena Trial Experiment

Variety	Species
S365	*Salix discolor*
SX61	*Salix sachalinensis*
SX67	*Salix miyabeana*
SV1	*Salix dasyclados*
MN Native Willow 1 (Laurel Willow)	*Salix pentandra*
MN Native Willow 2 (Black Willow)	*Salix nigra*

In addition to hybrid willow cuttings from New York, we will also include two native willow varieties growing in Wadena in our experimental design (Table 1). This will allow us to compare biomass production of hybrid willows to that of native willows in Minnesota. The cuttings will be planted using the experimental design as illustrated in Figure 1. Survival will be measured in October, 2008.

Results

Efforts were made to get the project going in the spring of 2007, including land preparation for planting by the farmer. Activities included tilling the soil and application of Roundup® herbicide. However, planting stock was not available from New York. Planting stock has been successfully secured for the spring 2008 planting season. While we had hoped to get the project going as scheduled, we see important benefits in the delays of our planting operation. It provided us the opportunity to prepare the land for a higher percentage of willow survival and reduce weed competition. Willow plants excel in an environment with less competition.

Markets for biomass are developing in this region of the state. For instance, the Central Minnesota Ethanol Cooperative in Little Falls, MN has recently shifted its focus toward using biomass as a heat source in their boiler system for ethanol production. Willows are an appropriate option in this situation and can turn a profit in 3 to 4 years.

Willow excels in various environments. Hybrid willows have proven to be a very high yielder of biomass in New York and surrounding states. A current companion study in Meadowlands, MN, funded by the Minnesota Department of Agriculture, involves testing the hardiness of willow varieties that are succeeding in New York. Please refer to the article "Testing the Potential of Hybrid Willow as a Sustainable Biomass Energy Alternative in Northern Minnesota" in this year's Greenbook for detailed hybrid willow survival rates in Meadowlands.

Meadowlands is characterized by a high water table and peat soil. The low water table and sandy soil characteristic of Wadena County can be a limitation for mainstream cropping systems. Willow can also excel in this environment.

The willow cuttings will be planted in a standard research design, which will allow us to compare results with trials in New York, in Meadowlands, and at the University of Minnesota Southern Research and Outreach Center at Waseca.

Cooperators

Curtis Kreklau, Farmer, Wadena MN
Dean Current, Center for Integrated Natural Resources and Agricultural Management (CINRAM) – University of Minnesota
Tim Volk, State University of New York, Syracuse, NY

Location

From Verndale, MN, take Cty. Rd. 23 north 13.5 miles to the project site.

Other Resources

Minnesota Department of Agriculture. Greenbook 2007. Testing the potential of hybrid willow as a sustainable biomass energy alternative in northern Minnesota, pp. 11-15. St. Paul, MN.

Short Rotation Woody Biomass Program. State University of New York – College of Environmental Science and Forestry. Syracuse, NY. Web site: www.esf.edu/willow

Willow Biomass Producer's Handbook. 2002. State University of New York, Syracuse, NY. Web site: www.esf.edu/willow/pdf/2001%20finalhandbook.pdf

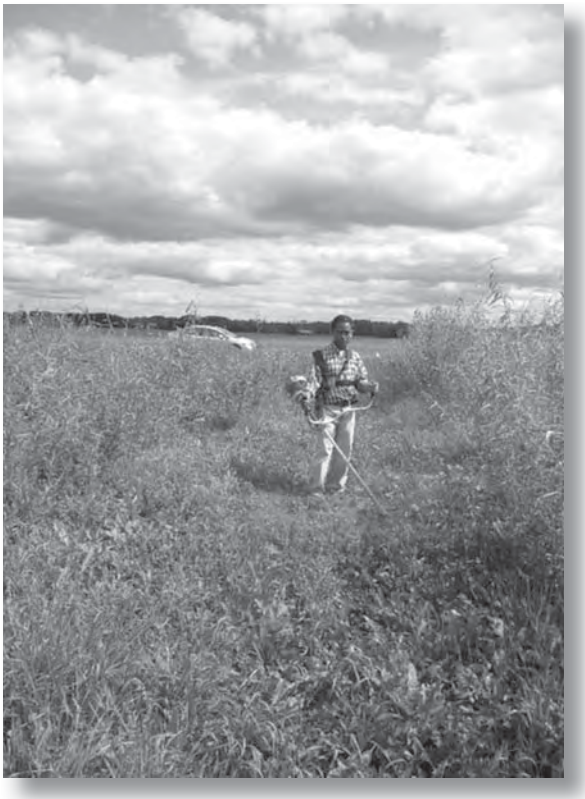
Figure 1. Experimental Setup of the Willow Trial in Wadena

Plots: 22.5′ x 50′.
3 double rows run the length of the plot with 2.5′ spacing within double rows and 5′ between sets of double rows.
25 trees per row times 6 rows = 150 trees per plot.

V3 SX61	V5 Laurel	V6 Black	V1 S365	V2 SV1	V4 SX67
V5 Laurel	V1 S365	V2 SV1	V3 SX61	V4 SX67	V5 Laurel
V2 SV1	V4 SX67	V3 SX61	V4 SX67	V6 Black	V1 S365
V5 Laurel	V1 S365	V6 Black	V2 SV1	V3 SX61	V6 Black

Road

N



Diomides performs weed control in hybrid willow.

Chokecherry *(Prunus virginiana)* Production in Western Minnesota

Principal Investigators

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Project Duration

2006 to 2008

Staff Contact

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Keywords

chokecherry *(Prunus virginiana)*, chokecherry variety "Garrington," Farmers' Market, jelly, root suckers, "wild black cherry"

Project Summary

We want to see if commercial chokecherry *(Prunus virginiana)* production is economically feasible with our cattle and strawberry operations. In 2006, we established an experimental chokecherry orchard in a cattle pasture near our strawberry fields. In 2007, we completed the planting using seedlings bought from both a Montana and a Minnesota nursery. We hope to compare growth rates and yields between plants from Minnesota and Montana. So far, the plants are growing very slowly. Root suckers only sprouted where the main stem was broken. In 2007, we had a small harvest of chokecherries on trees planted in 2006, but not enough to sell.

Project Description

We farm 700 acres of wheat, soybeans, and corn near the city of Detroit Lakes. We graze 25 head of beef cattle on the hilly pastureland near our house. Five years ago, we started a new business called West View Berries. We started with strawberries. This year, due to customer requests, we diversified by putting in a quarter acre of raspberries. We currently have a little more than a quarter acre of chokecherries in one corner of the cattle pasture.

We are limited to the types of berries we can grow because our soil is very alkaline. The strawberry plants in one section of our field have been declining due to iron chlorosis caused by a pH of 7.5 and heavy soil. Chokecherries are native to parts of the country with alkaline soil, and we are hoping that they will grow well on our farm. Eventually, we plan to allow cattle to graze in the chokecherry planting.

By growing chokecherries, we hope to increase our on-farm income so that Michelle can spend more time with our three sons. We hope to build on the success we have had marketing our strawberries. Michelle has been selling jellies at the local farmers market and flea market, and she could use a reliable source of chokecherries. Chokecherries will increase the amount of money we make off land currently devoted only to pasture and they are harvested at a time when there is little work to be done in the strawberry field.

Chokecherries spread underground through root suckers similar to aspen and raspberries. We would like to grow the plants in a hedge that could be mown periodically. We will also keep the plants short to make harvest easier.

Results

New Plants. We have had some difficulties finding nurseries with chokecherry plants that were selected for fruit quality. Many Canadian nurseries carry chokecherry varieties that were selected for fruit quality, but stone fruit trees cannot be shipped from Canada to the U.S. due to the plum pox virus quarantine. The best combination of price and tree quality we have found are plants started from seeds that are collected from wild trees. In 2006, we planted 150 seedlings from Montana. In 2007, we purchased and planted 150 additional trees from Lawyer's Nursery in Montana and 100 seedlings from Bergeson's Nursery in Fertile, Minnesota, not far from our farm. We planted with a spade and it took 6 hours to plant all 250 new trees. We then put a mulch of chopped wood and bark over the rows.

Growth. Although we had abundant rainfall in June, the chokecherries grew poorly in 2007. Most plants were 3' high when planted, but some plants have only put on 2"- 4" of additional growth in 2 years. We were expecting the plants to start sending up root suckers in their second year after planting but most are still only single trunks. Most plants have buds on their root suckers just below the ground but those have not sprouted. In three plants, the top died last year after planting and about five shoots came up from the ground, growing about 12" this year. We would like to have more

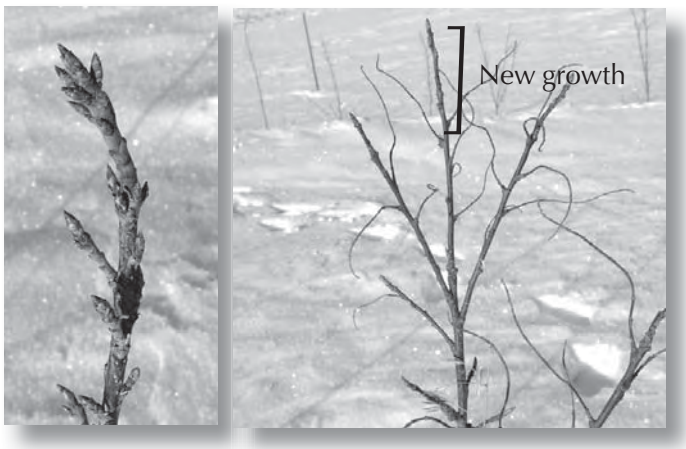
root suckers sprouting so that the rows fill in. During the summer, we cut the tops of ten trees to see if cutting the main trunks could increase the number of root suckers.

Yield. The trees we planted in 2006 all bloomed and bore fruit (Figure 1). Since the plants were small, the crop was small and we only harvested one 5 quart pail of berries off 150 trees. 2007 was an "on" year for chokecherry production in northwest Minnesota. All the wild chokecherry trees, in pastures and roadsides near our farm, had a heavy crop. Commercial chokecherry production will be more successful if our cultivated trees bear crops during those years when the crop on wild trees fails.

Figure 1. Chokecherry blooms and fruit on one year plants

Fruit and Plant Quality. The disadvantage of using seedlings instead of root suckers is that seedlings show a great deal of genetic variability. Some trees bloomed earlier than others, some ripened earlier than others and some had red fruit while others had black fruit. Some trees grew 3'- 4' this year, while others did not grow at all (Figure 2). We will probably see some variability in disease resistance and growth as the plants mature.

Figure 2. The seedling on the left grew 4", while the seedling on the right grew less than ½"



Diseases. The biggest disease in chokecherry is plum knot. Plum knot is caused by a fungus that infects the branches. The fungus grows on the branches, covering the branch with a black growth that makes the branches look like deer antlers in velvet. In most cases, the plum knot girdles and kills the branch. 2007 was a bad year for plum knot. The fungus spread easily with the heavy rains in June and three of the seedlings planted in 2006 developed plum knot (Figure 3). We will cut and remove all infected branches this winter and keep track of the plum knot next summer. We are hoping to be able to control the plum knot with minimal dormant pruning. If the plum knot becomes excessive, we could mow the plants and let them regrow from root suckers.

Taste Tests and Marketing. We repeated the taste test from last year where we compared chokecherry jelly labeled as "wild black cherry" with jelly from the same jar labeled as "chokecherry" jelly. The jelly labeled "chokecherry" was rated the same as the jelly labeled "wild black cherry". One respondent figured out that the two jellies were the same. All the respondents had tasted chokecherry jelly before and presumably were not prejudiced against the name "chokecherry". We would still like to run the taste test with people who have not grown up eating chokecherry jelly. The results reinforce our conclusions that the name chokecherry should not be changed.

Chokecherries and Beef Cattle. We put the chokecherry plants in a block of land we use as a cattle pasture. We practice rotational grazing and put the cattle into the pasture at two times. In the cattle pasture with the chokecherries, we time the grazing so that the cattle do not interfere with the strawberry customers, usually before picking in June and in August. When the trees grow larger, we plan on allowing the cattle to graze in the chokecherry orchard. Cattle generally avoid chokecherries if there is sufficient forage in the pasture. Since the trees are small enough to be damaged by cattle sampling the leaves, we have put a single wire electric fence around the chokecherry planting. We are keeping the weeds down by mowing between the rows.

The pasture where we put chokecherries has both musk thistle and Canada thistle. We have been controlling the thistles in the pasture with a yearly spray of either Cimarron Max or Milestone. Both herbicides could damage chokecherries, so we have not sprayed any herbicide in the section of the pasture with the chokecherries. The thistles are getting out of control near the chokecherries. Wild chokecherries almost never have thistles, and we are hoping that as the trees grow, they will crowd out the thistles. In 2008, we will be trying to find a way to control thistles near the chokecherries. In November, we sprayed Roundup® next to the plants to kill grasses and thistles in the tree rows, but we have not sprayed to kill the thistles between the rows.

Figure 3. Plum knot girdling a chokecherry seedling

Management Tips

1. Chokecherries should be kept at a short height in order to make picking easier.

2. The seedlings we planted bore the second year, but we need more growth in order to get high yields.

3. Try to control weeds around the plants to make picking easier and to help the trees grow. If possible, kill any thistles before planting.

Cooperators

Thaddeus McCamant, Northland Community and Technical College, Detroit Lakes, MN

Project Location

West View Berries is located north of Detroit Lakes. Take U.S. 59 north for 7.5 miles to the old town of Westbury. Take a left on 240th St. The berry patch is a mile down the road on the north side.

Other Resources

Manitoba Agriculture, Food, and Rural Initiatives. February, 2006. Chokecherry Production in Manitoba. Web site:
www.gov.mb.ca/agriculture/crops/fruit/bla01s00.html

Intercropping within a High Tunnel to Achieve Maximum Production

Principal Investigator

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Project Duration

2007 to 2010

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Keywords

high tunnels, intercropping, season extension, vegetable production

Project Summary

For many vegetable growers, the growing season is too short! Just when the season's harvest enters the profit zone, cold weather storms in and the party is over. High tunnels provide a wonderful solution to this problem by greatly extending the season. High-value primary crops such as tomatoes, cucumbers, and pole beans have proven to be very lucrative in high tunnels. However, by the time a high tunnel is built, considerable expense is involved. Is there a way to make the high tunnel even more productive?

The purpose of this project is to measure the profitability of planting secondary crops along with the primary crops of tomatoes and cucumbers. Generally, secondary crops such as onions, lettuce, radishes, spinach, beets, and carrots are of lesser economic value and would not occupy space alone in a high tunnel as the primary crop. But, if they were planted along with the primary crop, the added income would be a bonus. We also wanted to find out which of the secondary crops will do well in the high tunnel. We learned a lot from our first year of the project and found that some secondary crops do have a place in a high tunnel.

Project Description

Bluebird Gardens of Fergus Falls, MN got its meager start in 1978 on 5 acres of land (1/2 under water) with a Troy Bilt Tiller, a Garden Way cart and a Ford Pinto. We began selling vegetables directly to customers from a stand on the main street in Fergus Falls. We gradually expanded over the last 30 years to 90 acres of vegetable production with six self-serve vegetable stands in Fergus Falls and the surrounding area.

We built two high tunnels (30' x 96') in the spring of 2006. Even though we got a late start planting, we saw such potential that we leveled our old dairy barn in the fall of 2006 and used that land to build the frames for four more high tunnels along with a starting greenhouse. This project took place in two of the new high tunnels.

Our goal was to quickly get the plastic and ends on the new high tunnels in early April. However, winter arrived in early April along with a wet, cold spring so the high tunnels weren't ready until the second week of May. Even then the soil in the high tunnels was so wet that tilling made the ground lumpy. But, with the addition of peat, we proceeded to plant.

Trellised cucumber intercropped with lettuce.

The primary crop in the first high tunnel was Estiva tomatoes. We planted them 18" apart. In row one, we planted D'Avignon radishes on each side of the tomato row. This variety was promoted to do well in the high tunnel. The radishes were planted with a walk behind planter. Row two was planted with Tyee spinach in a similar fashion. Row three was planted with Hybrid Sweetness III carrots. Row four had no secondary crop to serve as the control group. Row five had Walla Walla onion plants planted 4" apart. Row six was planted with Grand Rapids Red Romaine lettuce plants that had been started four weeks earlier in the starting greenhouse. They were planted 4" apart. Row seven had Hybrid Scarlet Supreme beets. The second high tunnel followed the same pattern except that the primary crop was Tasty Jade cucumbers.

Results

In any experiment, one can expect the unexpected. Often the mistakes provide the best learning. We learned many exciting things that should have a profound effect on next year's profit!

1. The radishes grew well, but were extremely hot in flavor, almost too hot to sell. The late planting may have been a factor since harvest did not occur until early June. By that time, the outside radishes were ready and had good flavor. Nevertheless, each 96' row produced about $45 worth of radishes.

2. The Grand Rapids Red Romaine lettuce, which was planted as plants, produced very well. Each row produced about $350. Like the radishes, the last lettuce we harvested was very strong in flavor. I personally like it that way but I think we lost some sales due to the strong flavor. Once again, the late planting was a factor. Next year, with the high tunnels already up, planting should occur in late March or early April instead of the second week of May.

3. Spinach, beets, and carrots were all planted from seed. They germinated very poorly, likely due to the lumpy soil from the wet start. We have learned that the use of transplants will maximize the precious time there is to grow in the high tunnel. The use of lettuce transplants proved that.

4. The onion plants did poorly compared to the same ones planted outside. We learned from the tour of University of Minnesota high tunnels in later August that we had not applied enough nitrogen. In fact, the professors have found the most common mistake made by high tunnel growers across the state was underfertilizing. High tunnel production is intense and takes more fertilizer than one would expect. With an earlier start and more nitrogen, onion plants should perform better next year.

5. With the secondary crop experiment, we decided not to use plastic mulch. That decision invited a battle with weeds that never ended. The enormous time we spent weeding wiped out any benefit of secondary cropping. The more painful the lesson, the better it is learned!

6. We will expand our intercropping experiment in 2008 to include relay intercropping. In our operation, the high tunnels supply the strong demand for tomatoes in June and July. After that, the outside tomatoes take over. So far, we have planted indeterminate tomatoes. This year, we plan to plant determinate varieties in some high tunnels. As soon as these earlier ripening tomatoes are finished, we will try staggered plantings of spinach and lettuce for September and October harvest. If each row nets $350 as the spring lettuce did, the seven inner rows could produce an extra $2,450. If the two outside rows are also used, the total fall profit will be $3,150. If the spring and fall harvest are equal, each high tunnel will net an extra $6,300 per year.

Management Tips

1. Unless the soil is totally free of weeds, plastic should be used in the high tunnel. The warm, wet environment provides deluxe germination and growth of weeds.

2. If at all possible, transplants should be used instead of seeds. Transplants maximize the use of time in high tunnels. Next year, we will plant lettuce and spinach in the starting greenhouse in stages. Hopefully, the stages will allow production over a greater period of time until the outside lettuce and spinach is ready. We will experiment to find which varieties hold the best flavor in the high tunnels.

3. It is vital to watch the supply of nutrients. In addition to soil testing, watching the plants is a key to finding the balance between excessive leaf growth and good production. With enough nitrogen, onion plants planted early should provide good yields. The value of onions is high so our goal is to make them thrive in the high tunnel.

4. Radishes, carrots, and beets do well outside and are of a lower economic value. We will not grow them in the high tunnel again.

Cooperators

Terry Nennich, University of Minnesota Extension Service, Crookston, MN
David Birky, Ag Resource Inc., Detroit Lakes, MN

Location

We are located 4 miles NE of Fergus Falls on Cty. 1 and 3 1/2 miles east on Cty. 18.

Other Resources

Minnesota Department of Agriculture. Greenbook 1997. Community shared agriculture and season extension for northern Minnesota, pp. 57-59. St. Paul, MN.

"Minnesota High Tunnel Production Manual for Commercial Growers." University of Minnesota Extension Service, 2004. (You may obtain copies from Marilyn Johnson, Minnesota Fruit and Vegetable Growers Association, 763-434-0400.

"The Hoophouse Handbook." Edited by Lynn Byczynski, Growing for Market, Fairplain Publications Incorporated, PO Box 3747, Lawrence, KS 66046, 800-307-8949.

Trellised cucumber intercropped with onions.

Controlling Western Striped Cucumber Beetles Using Organic Methods: Perimeter Trap Crops and Baited Sticky Traps

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Project Duration

2007

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Keywords

baited sticky traps, Blue Hubbard and Burgess Buttercup squash varieties, cucurbit crops, perimeter trap crops, PyGanic®, western striped cucumber beetle (*Acalymma trivittatum*)

Project Summary

Our project examined the effectiveness of different management techniques in controlling western striped cucumber beetles (*Acalymma trivittatum*) in cucurbit crops, specifically pumpkins and winter squash. In the past, we have relied on a certified organic spray called PyGanic®. PyGanic® is a broad spectrum insecticide that, although being certified organic and allowable under National Organic Program (NOP) rules, is still toxic. Application is costly and time consuming. Looking over past research, we found that two other methods have been effective in controlling cucumber beetles. These other methods are perimeter trap crops and baited sticky traps. We set out to use these methods in different combinations to determine their usefulness.

Our project consisted of three test plots, each measuring 100'x100' (approximately 1/4 acre). Each plot was managed differently to test the effectiveness of PyGanic® spray, perimeter trap crops, and baited sticky traps. Plot 1 was treated with PyGanic® over the entire plot. Plot 2 had a perimeter trap crop planted along either edge which was then sprayed. Plot 3 was also planted along either edge with a perimeter trap crop. This third plot also had baited sticky traps placed amongst the perimeter trap crop, thereby totally eliminating the need to spray PyGanic®.

Our objective was to determine the effectiveness of perimeter trap crops and baited sticky traps in decreasing the damage done by cucumber beetles on pumpkins and winter squash and therefore increasing yields and decreasing the use of insecticides. We hoped to find more pleasant and cost effective ways of achieving higher yields.

Perimeter trap crops and baited sticky traps were found to be most effective when used together. We had yields that were nearly 50% greater with only slight increases in the cost of management ($519.50 for management in plot 3 (1/4 acre) vs. $429 for management in plot 1 (1/4 acre)). The cost in subsequent years for plot 3 will decrease to $399.50 because the traps are durable and should last for years. (It is a coincidence that in subsequent years, plots 2 and 3 will cost the same to manage. The cost of the spray used ends up equaling the cost of labor to manage the traps. This probably would vary from

Peter setting baited sticky traps among the just emerging trap crop on a windy early summer day.

Squash harvest curing in our overflow greenhouse.

year to year, but the figures for 2007 came out that way.) By using perimeter trap crops and baited sticky traps, we were able to increase profitability while increasing job satisfaction and decreasing insecticide use on our farm.

Project Description

On our certified organic farm we have a variety of pest issues. Arguably, the most damaging of these problems is the cucumber beetle infestations that hit our cucurbit crops, specifically our winter squash and pumpkins. We needed to find a way to deal with this problem. Apart from the use of a certified organic broad spectrum pyrethrin based spray (PyGanic®), the use of perimeter trap crops and baited sticky traps have been used by others with good results. We tried these other methods of dealing with cucumber beetles and recorded their effectiveness.

Our project consisted of three test plots, each measuring 100' x 100' (approximately 1/4 acre). Each was managed differently to test the effectiveness of PyGanic® spray, perimeter trap crops, and baited sticky traps. On May 24 we planted the trap crops in plots 2 and 3. We followed this planting with the planting of the main crop in all three plots on June 4.

In plot 1, we planted six varieties of winter squash (Waltham Butternut, Delicata, Table Ace Acorn, Spaghetti, Sweet Dumpling, and Carnival) and two varieties of pumpkins (Howden and Baby Pam). As soon as we saw the first infestation of cucumber beetles in this plot, we started to spray PyGanic® once a week when needed. This was traditionally the way that we handled this problem. We did not find this way of managing the problem to be satisfactory. The use of harmful insecticides was something we wanted to get away from. PyGanic® is expensive and application is time consuming.

In plot 2, we planted the same six varieties of winter squash and two varieties of pumpkins. We planted slightly less butternut in this plot to allow for space to plant the perimeter trap crop. This trap crop consisted of two rows (3' apart) on either edge of the plot planted with varieties of winter squash that are more desirable to cucumber beetles due to their chemical composition (higher levels of cucurbitacin, a bitter chemical that the beetles are attracted to). The varieties we used for the trap crop were Burgess Buttercup and Blue Hubbard. As was suggested by previous studies using perimeter trap crops, we planted the trap crop 2 weeks before the rest of the crop and sprayed the trap crop every 7 days when necessary. Past studies found that trap crops were quickly decimated when not protected in some way. This plot was designed to see if we could decrease the amount of insecticide without totally eliminating its use.

In plot 3, we planted the same six varieties of winter squash and two varieties of pumpkins. We also planted the same perimeter trap crop varieties along either side in the same fashion as in plot 2. Rather than using any spray in this plot, we constructed baited sticky traps and placed them in the trap crop. There were 40 baited sticky traps in the 1/4 acre plot. Twenty traps were placed along each edge of the plot scattered throughout the trap crop. The traps were covered with "Stikem" (non-drying glue) and sprinkled with dehydrated powderized buttercup squash from the previous year's harvest. This method was previously used by the Missoula County Extension in Montana as an attractant for cucumber beetles. Plot 3 was not sprayed with insecticide.

During the first week of July, the first cucumber beetle infestation occurred. This was slightly later than usual. The postponed arrival could have been the result of better weed cultivation, proper irrigation, or some unknown factor. At this point we began spraying in plots 1 and 2. We checked the sticky traps in plot 3 and found various insects (flies, mosquitoes, and a couple of bees) but no cucumber beetles. There was a low number of bees for pollination in plot 3 as they got caught in the sticky traps. Bees weren't found in huge numbers, but they were present.

By the end of the third week of July, it appeared that the first cycle of adults had gone underground to lay eggs. From this point on, cucumber beetle infestations were not widespread, but were spottier in all three plots, with one exception. The trap crop in plot 2 was becoming skeletonized by cucumber beetle pressure and there was substantial leaf yellowing in the trap crop.

Table 1. Number of Pumpkins and Squash Harvested from the Three Experimental Plots

	Plot 1	Plot 2	Plot 3	Total by Variety
Acorn	482	416	502	1,400
Delicata	382	280	505	1,167
Butternut	854	562	938	2354
Hubbard	0	172	467	639
Buttercup	0	88	100	188
Pie Pumpkin	170	204	255	629
Dumpling/Carnival	102	116	77	295
Spaghetti	494	678	794	1,966
Pumpkin	19*	24*	24*	67
TOTAL	**2,484****	**2,516****	**3,638****	**8,638**

** We counted the pumpkins rather than weighing them.*
*** This is the total weight in pounds of the entire plot not including the weights of the pumpkins since we just counted them.*

By the second week of August, we were only able to spot spray in plot 1 due to the vining of the plants. This was okay because the beetles were still only here and there and there was no huge infestation. The trap crop in plot 3 looked far better than it did in plot 2. However, we are still concerned about loss of pollinators in the sticky traps. The sticky traps in plot 3 were surprisingly devoid of cucumber beetles.

We harvested all of the squash and pumpkins on September 15. This is earlier than we would have liked to, but we had two unexpected early frosts. The first frost around September 10 killed most of the leaf canopy exposing the squash to potential damage by another frost. There was a heavy frost on the night of September 15 so we scrambled to get all of the squash in and under cover.

Results

Perhaps the best way to determine the efficacy of each management technique is to compare the quantities of marketable produce harvested from each plot.

As can be seen from the harvest results, plot 3 produced nearly 50% greater yields than either plot 1 or 2. The increase in Blue Hubbard yield from 2 to 3 was about 270%. Plots 1 and 2 were approximately the same for totals, each having better yields with different varieties. Plot 3 had the best yields in all but one variety category, the sweet dumpling and carnival group.

We were concerned with more than just the overall yields. We were also concerned with the amounts of spray used, the amount of time used to manage each plot, the overall satisfaction with each management technique, and the cost of each. Table 2 addresses these concerns. Plot 3 used the least spray, the least time, was most satisfactory, and, in the long-term, cost the least, while at the same time having the highest yield and therefore the highest profitability.

Discussion

The only reason for greater yields in plot 3 that I can see would be that the PyGanic® somehow created an environment that was advantageous to the cucumber beetles. This seems counterintuitive since it is a spray designed to kill this very pest. However, this being the only chemical difference between the plots, this must have something to do with the yield difference.

There are some questions and concerns that we are left with after conducting this study. The most glaring question is why were there so few cucumber beetles found in the traps in plot 3? We found mostly flies and mosquitoes in the sticky traps. What effect were these traps having if they weren't actually trapping the cucumber beetles directly? Unless the beetles were repelled by the presence of the traps in some other way than by being trapped, we have to assume the difference has something to do with the absence of PyGanic®. On the other hand, if the beetles were repelled by the presence of the traps, the yield difference isn't perhaps due to the absence of PyGanic®. The way that the traps would act to repel the beetles is a mystery, especially since the traps were painted a color to attract them and not repel them. We are a little baffled by the results ourselves. If we had found hordes of beetles on the baited sticky traps, the results would make perfect sense. This lack of beetles on the sticky traps just doesn't seem to fit. Something else must be going on.

There has been some research done on phytochemicals in plants that act as natural insecticides. It is thought, by some, that using insecticides decreases the need for plants to create their own phytochemical insecticides, thereby making them more susceptible to insect attack than their unsprayed counterparts. Another possibility is that PyGanic® harms beneficial insects or at least diminishes their presence. Since it is a broad spectrum spray, it could very well reduce the amount of pollinators and therefore reduce yields. This might be the simplest and most likely explanation.

Also, what effect does a cleaner, more weed free environment have on the subsequent cucumber beetle infestation? Was the late arrival of beetles and their minor impact caused by our increased vigilance in these plots? Finally, we had an exceptionally hot and dry midsummer. While we were able to irrigate to keep the plants growing, what effect did this weather have on the beetle infestations?

Management Tip

1. Plant *Cucurbita maxima* variety trap crops 2 weeks prior to your main crop planting.

Cooperators

Nathan Winter, McLeod County Extension Educator, Hutchinson, MN

Project Location

August Earth is a 40-acre certified organic CSA vegetable farm located a few miles west of Hutchinson, MN.

Other Resources

Andersen, J.F., and R.L. Metcalf. March 1986. Identification of a volatile attractant for *Diabrotica* and *Acalymma* sp. from blossoms of *Cucurbita maxima* duchesne. The Journal of Chemical Ecology, Vol. 12 No. 3. pp 687-699.

Bellows, Barbara C., and Steve Diver. September 2002. Cucumber Beetles: Organic and Biorational IPM. Available at: www.attra.ncat.org/attra-pub/PDF/cucumberbeetle.pdf

Boucher, T. Jude. 2005. Perimeter Trap Crop Approach to Pest Management on Vegetable Farms. Report Number LNE03-177. Available at: NCR-SARE grant database: www.sare.org/reporting/report_viewer.asp then enter the Report Number into the "Search Type" box.

Hoffman, Michael. 1999. Developing Sustainable Management Tactics for Cucumber Beetles in Cucurbits. Report Number ANE95-022. Available at: NCR-SARE grant database: www.sare.org/reporting/report_viewer.asp then enter the Report Number into the "Search Type" box.

Table 2. Comparison of the Three Experimental Plots

Plot	Amount of spray used	Time used	Overall satisfaction	Total cost per ¼ acre plot*	Gross worth if sold wholesale at $0.70/lb
1	4 oz	39.5 hrs	- difficult to spray after vining - lowest yield - insecticide use is undesirable	$429	$1,738.00
2	1.25 oz	38 hrs	- spray time is minimized, but handling of toxic chemical is still undesirable	$399.50	$1,761.20
3	0 oz	37.75 hrs	- cannot tractor cultivate easily over traps - loss of pollinators in traps is a concern - no spraying at all and checking traps is very quick	$519.50 (subsequent years will be $399.50 due to the durability of traps)	$2,546.60

**Includes spray, trap crop seed, traps, labor to maintain during growing season @ $10/hour. Does not include harvest labor, fuel, land, etc.*

Apple Scab Control Project

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Project Duration

2005 to 2007

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Keywords

apple scab, ascospores, data logger, leaf wetness, sulfur sprays

Project Summary

Our farm consists of 120 certified organic apple trees on 2.5 acres of land just west of Taylors Falls, MN and the St. Croix River Valley. One of the challenges of growing certified organic apples is controlling fungal diseases on the trees and fruit using only inputs approved for certified organic apple production. We've applied sulfur to our orchard in the past and have not noticed any improvement in disease control when compared to trees that did not receive sulfur protectant sprays. Our assumption has been that the timing of our sulfur applications has not been correct, and that we needed a better method of timing our sulfur sprays. Our project involves studying the effectiveness of applications of a sulfur protectant based on degree days, leaf wetness, and temperature.

Project Description

All of the trees were planted in 1997 and started producing fruit in 2005. The trees were planted in an old livestock feedlot which has provided nitrogen rich soil for starting the young apple trees. The main challenge in managing our orchard is eradicating diseases on the apple trees and fruit using only those inputs approved for organic apple production by the federal National Organic Program and through the Organic Materials Review Institute (OMRI).

As our trees have grown, we've noticed ongoing mottling of the leaves caused by apple scab. This disease has reduced the quality and quantity of our apple production. We've also noticed that the Honeycrisp tree variety appears to be the most negatively impacted from this mottling. Apple scab has affected 50 to 70% of the total leaf area of the orchard in the past few years. Since the majority of our orchard is the Honeycrisp variety, solving this mottling issue would greatly improve the success of our orchard operation.

Our goal is to determine if improving the timing of protectant sulfur sprays will have any impact on reducing apple scab infections in our apple trees. There have been many studies performed that depict the life cycle of scab infections and the percentage of ascospores which will be discharged under various environmental conditions. Dr. W.D. Mills at Cornell University charted scab infection periods in the 1920s through the 1940s to show the relationship between average temperature and length of wetting period and the compounding effects on primary infection. His findings were that if the leaf surface dries soon enough, a scab infection can be prevented naturally. If, however, the optimum temperature and leaf wetness occur during the accelerated phase of ascospore maturation, a protectant needs to be applied. Sulfur has been advertised as a protectant against apple scab and is approved for use in organic apple production.

Weather data logger in orchard.

We've been using sulfur as a protectant spray for the last 6 years and have questioned whether the benefits outweigh the costs. We've compared the difference in scab infection between a few apple trees that were not sprayed and the rest of the orchard that received sulfur sprays. We have not noticed any appreciable difference between the sprayed trees and those trees not sprayed. In the past, our assumption has been that there must have been some environmental reason for the differences. However, given the close proximity between the sprayed and unsprayed trees, that assumption does not seem logical. Our only other conclusion is that our timing of the sulfur sprays was missing the period when the leaf needed the most protection. We believe we can improve the effectiveness of our sprays by deciding when to make those sprays based on tracking the primary scab season which is between 300 and 700 degree days (where degree days are calculated by subtracting a 32 degree base temperature from the mean daily temperature, that is the high and low divided by two) and the leaf wetting period.

In addition, Dr. William MacHardy at the University of New Hampshire discovered long-wavelength red light (daytime) plus wetness are necessary to trigger spore release. Therefore, leaf wetness would only need to be tracked from sunrise to sunset. If the leaf remains wet for more than 6 hours and the temperature is between 60 - 75°F during the 300 to 700 degree day primary scab season, a sulfur spray would be applied within the 6 hour leaf wetness time frame.

We are testing our theory that timing is everything with sulfur sprays by setting up a weather station to track degree days and leaf wetness. Our measure of success will ultimately be the percentage of apple scab damage to the leaves and fruit. Apple scab has affected 50 to 70% of the total apple leaf area of the orchard in the past few years.

Results

2005

Our first application was a lime/sulfur spray on April 17, 2005 at a rate of 5 gallons of lime/sulfur for every 100 gallons of water sprayed on 2.5 acres. The lime/sulfur was used to eliminate any overwintering spores. We began tracking degree days and leaf wetness using a weather station on April 30, 2005. Based on Dr. W.D. Mills' studies and our weather monitor data, our primary scab season in 2005 started in the middle of May at 300 degree days.

Our second application of sulfur spray was on June 5, 2005 at a rate of 1.25 gallons of sulfur for every 100 gallons of water sprayed on 2.5 acres. The second spray timing was a futile attempt to protect the trees from previous ascospore events. Due to the unusually early warm temperatures and spring rains, earlier applications of sulfur sprays would have been more effective. By the time our weather monitor was installed, we may well have been into the primary scab infection period and past the 300 degree day mark when sprays may have been more appropriately timed. By mid-June we were well past the primary scab season, secondary scab infections had a foothold, and mottling of the tree leaves was evident.

After reviewing the data collected from the weather monitoring equipment, our primary scab infection period (300 degree day reached) started on May 17 and ended on June 4 for the 2005 growing season. Using the leaf wetness sensor, sulfur should have been applied May 18, 19, 27, and 28. The other days when the leaf sensor indicated wetness periods longer than 6 hours had either occurred at night, early morning, or evening when the exposure to red light was not present.

2006

We did not apply an early spring lime/sulfur spray to kill overwintering spores this year as it was determined from 2005 data that there weren't any noticeable differences in the persistence of scab between the sprayed and the unsprayed group of trees.

Due to the unusually early spring in 2006, it didn't take long to reach the 300 degree day total on April 10, 2006. Our first application of sulfur spray was on April 22, 2006 at a rate of 1.25 gallons of sulfur for every 100 gallons of water sprayed. Our second spray was on April 28 at a rate of 1.5 gallons of sulfur for every 100 gallons of water. The third and final application took place on May 1 at a rate of 1.5 gallons of sulfur for every 100 gallons of water. All solutions were sprayed over 2.5 acres. On May 2, we had reached the 800 degree day total.

After reviewing the data collected from the weather monitoring equipment, our 300 degree day started on April 10 and raced toward our 800 degree day on May 2 for the 2006 growing season. Using the leaf wetness sensor, sulfur should have been applied April 20, 21, 22, 28, 29, 30, and May 1. We were able to spray on April 22, 28, and May 1, which provided adequate coverage during these wetting periods.

As a result of the weather monitor readings and the early, well-timed sprayings, on May 23, 2006, we had come to petal-fall and had noticed little, if any, scab infection at this point. By mid-June, however, the apple scab had become established and quickly led to a secondary scab infection causing leaf mottling.

2007

During the third year of our study, we were able to start collecting degree day information from the very start of the year. I would characterize 2007 as having a typical spring where we reached the 300 degree day total on May 26. We reached 800 degree days on August 12, 2007. It was a very dry summer with little or no rainfall for the entire month of July. Due to the unusually dry conditions, no sulfur spray was applied. Even so, the amount of apple scab that occurred in 2007 was about the same as it was in 2006 based on visual observations of apple leaves. It was disappointing to have not discovered the "magic bullet" for controlling apple scab. However, we have at least determined what doesn't work so we can keep searching for what might work.

Management Tip

Growers should use a weather station to help monitor and track degree days especially if you are applying sprays to your orchard.

Cooperators

Patrick Lynch, Breezy Hill Orchard, Maple Lake, MN

Project Location

From Minneapolis/St. Paul, take I-35 north to North Branch. Turn onto Hwy. 95 east through Almelund to mile marker 70. Take gravel road north (Teal Ave.) to the first red farmhouse on the left.

Other Resources

Earles, Richard, et.al. 1999. Organic and Low-Spray Apple Production. 38 pp. Available from Appropriate Technology Transfer for Rural Areas (ATTRA) – USDA. 800-346-9140. Web site: http://attra.ncat.org/attra-pub/summaries/apple.html

La Crescent Orchard Supply in La Crescent, MN. Flowable sulfur and other orchard supplies.

Phillips, Michael. 2005. The Apple Grower, A Guide for the Organic Orchardist, 2nd Edition. Chelsea Green Publishing. 320 pp. Available at: 800-639-4099

Sweezy, Sean L., et al. 2000. Organic Apple Production Manual. University of California. Pub. No. 3403. 72 pp. Available at: 800-994-8849.

Establishing Healthy Organic Asparagus While Utilizing Minimal Labor and Maintaining Proper Soil Nutrition

Principal Investigators

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Project Duration

2005 to 2007

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Keywords

asparagus, organic production, soil pH, weed management

Project Summary

Breezy Hill Organic Orchard is located approximately 50 miles west of Minneapolis in Maple Lake, MN. We have been certified organic since 2002 through the Midwest Organic Service Association. We sell to west metro cooperatives as well as the Mill City Farmers' Market in Minneapolis in the summer months. Our produce is harvested, sorted, and delivered to our markets within days during the summer months. Our goal is to diversify our farm into three main crops; asparagus, summer raspberries, and apples. We have selected each crop based on customer desire and ease of growing them organically. We had hoped to develop an effective weed control strategy with three different management methods in the asparagus test plot.

Project Description

Over the past three growing seasons, we have put a lot of time and effort into growing our asparagus crop. Since we are certified organic, we are not able to use conventional herbicides for weed control. For this grant project, we utilized a 1/2 acre section of our 3 acre production to test three methods of weed control. The three methods of weed control were recycled tin, landscape fabric, and black plastic mulch. All methods were covered with wood chips.

We began this project with three test rows of asparagus in our garden. The rows were spaced 7' apart with 1.5' between the crowns. Each test row was 25' long and was spaced intermittently within our garden space. Two of the test rows (landscape fabric and black plastic mulch) were hand weeded and were labor intensive. The weeding often needed to be delegated out to a hired hand due to other projects on the farm. The third test row had recycled tin and wood chips as a weed barrier which is fairly easy to manage.

Results

Our goal for this project was to maintain a commercial asparagus crop utilizing an effective weed barrier with minimal hand and mechanical weeding. We also focused on maintaining a healthy soil with a pH of 6.5 - 7.5 which is ideal for asparagus.

In 2007, we had a lot of rain in April and by May we had hot days with no rain. The weather proved to be difficult for harvesting our first crop of asparagus for market. The heat and drought conditions created a hardpan soil and the spears had a tough time coming up. We were not able to go into production with the lack of asparagus. By late summer, the asparagus had recovered and grew nicely giving us another year of maturity until the next market season.

In 2007, the asparagus grew nicely in the recycled tin plot. Despite the drought-like conditions of early spring, the asparagus grew into thick spears and grew abundantly. The soil gradually warmed up in the spring under the tin and then maintained the heat, allowing the spears to grow. The wood chips hold the moisture, making it possible for the spears to emerge from the soft soil. The only criticism of the tin is that it does shift and can cover the crown if you are not careful. Also, obtaining recycled tin for commercial production is not cost effective and it is not obtainable in large enough quantities.

The black plastic mulch and landscape fabric were laid in the early spring. You must have your rows well marked to lay the weed barrier and provide enough room for the crowns to mature and allow for shifting of the barriers. Both barriers did shift even with pins and

wood chips for covering. The asparagus spears were larger and more mature versus the no weed barrier rows. The plastic mulch and landscape fabric heat the soil consistently thereby providing consistent growing conditions. The wood chips, again, did aid in much needed moisture due to the lack of rain. Two disadvantages to these methods are that the barriers do move and can cover the crowns making the spears search for an opening. If this happens, the spears are not able to mature to a green color. The other disadvantage is that under certified organic rules, you must remove the barriers in the fall and then return them in the spring, which can be a lot of extra work for a commercial production. Ultimately, using either the black plastic mulch or landscape fabric does minimize labor in weeding and results in consistently matured asparagus spears. We will use these barriers in the future.

Unfortunately, during the summer of 2007, we encountered a shortage of wood chips in our area. They were in demand by the energy plants and the cost to purchase them went up by 100%. As a result, we were unable to purchase them. We did experience a hard pan this past spring due to the high temperatures with no rain. We did not use irrigation and do not intend to in the future.

In the spring, we harvested, laid down the materials, and hand weeded. Cultivation and hand weeding were done, when necessary, through the summer months by two hired hands and us. We did not have a crop to sell in 2007 due to weather conditions. However, we do intend to have a crop for spring 2008. Our markets are looking forward to our certified organic, locally grown asparagus and will be willing to take our crop when it is ready.

Management Tips

1. Select a field with good drainage and soil amendments before planting the asparagus. Organic matter such as green or composted manure will loosen up loamy clay soils, which aid in spear growth.

2. Leave some room between the asparagus row and your weed barrier for shift. Make sure to eliminate any grasses before planting asparagus crowns. The grasses will compete with the asparagus until the crowns are established. Also, the grasses are unbelievably difficult to hand weed.

3. Due to the intensive labor involved in the planting, installing the weed barrier control, and hand weeding, it was difficult to keep laborers in the field.

4. For planting it was easier to furrow plow (with the use of the tractor) rows for crowns and sped up the process altogether.

Project Location

We are located 50 miles west of Minneapolis off of Hwy. 55. Go west from 494 to Cty. Rd. 37 just past Maple Lake. Take 37 south to Iresfeld Ave. NW and take a left to first farm on the left.

Other Resources

Kuepper, George and Thomas Raven. 2001. Organic Asparagus Production. Available from USDA Appropriate Technology Transfer for Rural Area (ATTRA). Web site: www.attra.org/attra-pub/summaries/asparagus.html or 800-346-9140.

Ohio State University Extension. 1993. Asparagus Production Management and Marketing Bulletin 826. Web site: http://ohioline.osu.edu/b826/

University of Minnesota Extension Service. Revised 2005. Growing Asparagus in Minnesota - A Production Guide. Pub. No. WW-01861. Web site: www.extension.umn.edu/distribution/horticulture/dg1861.html

Insect and Disease Pressure in Unsprayed Apple Orchards in Central and Northern Minnesota

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Project Duration

2007 to 2008

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Keywords

apples, apple diseases, insects

Project Summary

During the summer of 2007, we looked at disease and insect pressure in unsprayed apple trees across Minnesota. Codling moth and apple scab are rare in northern Minnesota, even in orchards that have never been sprayed with pesticides. We wanted to see if: 1) codling moth and apple scab pressure decreased in a predictable pattern from southeast to northwest Minnesota; 2) northern Minnesota has natural advantages for organic apple production and; 3) low scab pressure in northern Minnesota is due to a lack of infection periods or other factors.

We found less apple scab and codling moth in northern and western Minnesota than in eastern Minnesota, but there was variability between orchards in the same part of the state. Apple maggot or plum curculio (depending on location) caused more losses than apple scab or codling moth in four out of nine orchards. The only way to find out which pests are most important in Minnesota orchards is to monitor.

Project Description

In most parts of the U.S., the two biggest pest problems in apple are apple scab and codling moth. Apple scab is a fungus that deforms the fruit and can cause leaf loss. Codling moth larvae are worms that burrow into the center of the fruit. Both apple scab and codling moth are rare in northern Minnesota. Apple scab is rare in parts of the country that have little rain in May and June, but northern Minnesota has frequent spring rains.

I monitored pests in nine orchards at seven towns across the state with the help of the orchard owners (Figure 1). Some orchards were well managed, while others were completely neglected (Table 1). The Redwood Falls 1 orchard was sprayed for apple scab once and insects twice. All other orchards had no insecticides or fungicides for the summer. Most orchards had new Minnesota cultivars, but two had trees so old that their identity had been forgotten. Leaf wetness and temperature monitors were

Figure 1. Approximate Location of Orchards

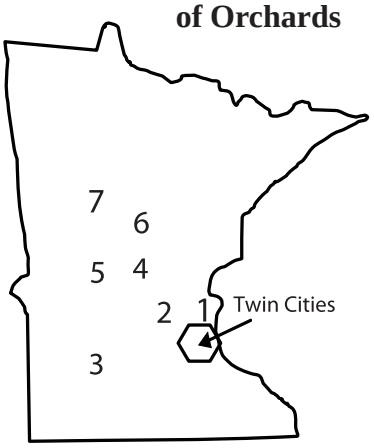

Table 1. Characteristics of Orchards Involved in the Project

Number on Map	Location	Age of Trees	Cultivars	Care
1	Shafer	25	State Fair, Unidentified	Abandoned
2	St. Francis	10	Honeycrisp, Sweet 16	Mowed
3	Redwood Falls 1	20	Most MN Varieties	Mowed, irrigated, pruned, sprayed
3	Redwood Falls 2	30+	Honeygold, Haralson	Mowed
4	Upsala	15	Most MN Varieties	Mowed
5	Glenwood	30+	Snow, Unidentified	Mowed, pruned, fallen apples removed
6	Staples	8	Most MN Varieties	Mowed, pruned, irrigated, fallen apples removed
7	Frazee 1	6-25	Honeygold, Honeycrisp, Chestnut Crab	Mowed, pruned, fallen apples removed
7	Frazee 2	8	Haralson, Spartan	Mowed, pruned, fertilized

placed at each site to estimate scab infection periods. We downloaded the information from the leaf wetness monitors each month and calculated the number of scab infection periods for each site. In late May, we placed codling moth pheromone traps in each orchard. In late June, we placed red ball apple maggot traps with volatile lures. In August, we began sampling apples in order to determine the number of fruit with each type of pest injury. In most orchards we sampled at least two times between August and October.

Results

At three orchards, over 90% of the apples were blemish free and could be considered marketable (Table 2). As predicted, two of the orchards with a high percentage of marketable fruit were in the northern half of Minnesota, but one of the orchards was just north of the metro area, 40 miles west from an orchard with no marketable fruit. At two orchards, over 95% of the apples were unmarketable. In the remaining orchards, the marketability of the fruit varied between cultivars. Fruit damage was caused by the following apple insect pests: codling moth, apple scab, apple maggot, plum curculio and first generation leafrollers.

Table 2. Marketable Fruit at Each Orchard

Site	% Fruit Marketable	Major Pests*
Shafer	<5	PC, AS, CM
St. Francis	90	CM
Redwood Falls 1	75	CM, AS, LR
Redwood Falls 2	<5	AS, CM, PC
Upsala	40	AS, AM, CM, PC
Glenwood	60	AM
Staples	95	LR
Frazee 1	80	PC, AM
Frazee 2	95	LR

**PC = Plum curculio, AS = Apple scab, CM = Codling moth, AM = Apple maggot, LR = Leafroller*

CODLING MOTH. Codling moth pressure was highest in southern Minnesota, lower in central Minnesota, and absent in northern Minnesota. In the southern part of our study, codling moth infection rates were about 25% in late August. The highest infection rate was near Redwood Falls in an old orchard that had a light crop. There was no obvious difference in infection rates between cultivars in any orchard.

The moths in southern Minnesota occurred in two distinct generations. There was no sign of overlapping generations that is common in states to our south (Table 3). At most sites, pest pressure was highest from the second generation. The higher pest pressure in late summer was probably due to a combination of a higher survival rate in the ripe fruit and a rise in moth population from the first to the second generation. The pheromone traps caught more second flight moths in five of six orchards, with the greatest increase at the Redwood Falls 2 orchard. All orchards had at least five times more injury from the second flight, which indicates the moths were more likely to survive in the mature fruit.

First generation codling moth larvae infect small, green fruit that can be removed during thinning or that drop to the ground. Second generation larvae infect fruit that is in the process of ripening. Apples with codling moth larvae ripen before healthy apples and often drop prematurely. We found almost no apples with codling moth in October, because infested fruit had dropped to the ground.

APPLE SCAB. Every orchard had some apple scab either as fruit lesions or in leaves in late summer (Table 4). The only orchards that lost yield to apple scab were Shafer, Upsala, and Redwood Falls 2 (Redwood Falls 1 was sprayed with fungicide). Cultivars with the most fruit lesions were Honeygold and Zestar. Haralson and Honeycrisp had little or no scab in any orchard. Trees at most orchards lost a few leaves in late summer to apple scab, but leaf loss varied little between cultivars.

Table 3. Codling Moth Pressure at Each Orchard

Site	First Flight (Late May-June)		Second flight (late July-August)	
	Trap Counts at Peak Flight	% Fruit Infected	Trap Counts at Peak Flight	% Fruit Infected
Shafer	8	2	14	20
St. Francis	7	0	6	7
Redwood Falls 1	35	2	26 (sprayed)	0
Redwood Falls 2	3	0	18	25
Upsala	5	1	24	10
Glenwood	3	0	4	1
Staples	0	0	0	0
Frazee 1 and 2	0	0	0	0

Table 4. Apple Scab Infection Periods (Mills) During the Month after Bloom and Corresponding Crop Loss

Site	Infection Periods	Fruit with Lesions
Shafer	3 light, 1 med, 1 heavy	42%
St. Francis	1 light, 2 med, 2 heavy	0
Redwood Falls 2	1 light, 1 med, 2 heavy	33% (Honeygold)
Upsala	2 light, 2 med, 1 heavy	35% (Wolf River, Zestar)
Glenwood	3 light, 3 med, 4 heavy	0
Staples	1 light	1% (Zestar)
Frazee 1 and 2	1 light, 3 med, 2 heavy	1% (Honeygold)

In this study, computer disease models did not accurately predict which orchards had scab and which had little or none. Latitude was a greater predictor of apple scab infections than the number of infection periods. The three western Minnesota orchards, Redwood Falls 2, Glenwood, and Frazee 1 and 2 all had infection periods. Thirty-three percent of the Honeygold fruit in Redwood Falls 2 had scab lesions compared to 1% of the Honeygolds in Frazee 1 and 2.

Computer disease models for apple scab are quite accurate. They have been tested and used in all major apple growing districts in the U.S., but in this study, they only predicted infections in the southern third of the state. Factors other than summer moisture appear to limit apple scab infections in the northern two-thirds of Minnesota. Two factors that may be limiting scab include reduced inoculum and cold soil temperatures. Inoculum refers to the fungus that overwinters in lesions on fallen leaves. In spring, the lesions produce spores, or inoculum that infects new leaves and fruit each summer. The orchard in Glenwood was mowed more frequently than in Upsala, and had fewer fallen leaves on the orchard floor in the spring, along with less inoculum and less scab. The difference in apple scab between Upsala and Glenwood can be partly explained by the amount of inoculum. The orchards in Glenwood, Frazee, and Redwood Falls 2 were similar in age, amount of care, and air circulation. All three orchards had similar infection periods, but only Redwood Falls 2 had apple scab. The low apple scab pressure in Glenwood and Frazee is most likely due to cold soil temperatures or other factors.

CEDAR-APPLE RUST was rare in all orchards. The highest rate of cedar-apple rust was in St. Francis, where two trees averaged over three lesions per leaf, and less than 1% infected fruit. No trees were defoliated by cedar-apple rust in any orchard.

APPLE MAGGOT. Apple maggot was the major pest in Upsala, Glenwood, and Frazee 2. We first started trapping flies on July 10. We did not see fruit damage until late August. Some early ripening cultivars ripened before the maggots hatched.

In Upsala and Glenwood, we tried to control apple maggot with mass trapping – putting many traps in the orchard in order to trap adult flies before they mated. In Upsala, the traps were "Delicious" apples from the store covered with tanglefoot, while the traps in Glenwood were large red spheres covered with tanglefoot. The traps appeared to reduce apple maggot in both orchards. In Glenwood, the number of damaged fruit dropped from 100% in 2006 to 30% in 2007. In Upsala, the traps eliminated infestation in Zestar, which had many apple maggots the previous year. In both sites, whether or not the traps caught flies depended on the location of the tree where the trap was placed. In

Figure 2. *The amount of apple maggot flies caught in the traps depended on where the traps were placed. These traps were Delicious apples covered with tanglefoot. The trap on the left was placed in a tree with no fruit and caught two apple maggot flies. The trap on the right in a nearby State Fair tree was covered with flies.*

Figure 3. *The McIntosh apple (left) had no apple maggot, while the apple from a nearby tree (right) was riddled with apple maggots. Note, both apples had codling moth.*

trees with no fruit, the traps caught no flies (Figure 2) while the trap on a neighboring State Fair was covered with flies. The same pattern was seen in both Glenwood and Upsala regardless of whether the trap was an apple covered with tanglefoot or a red sphere.

Unlike codling moth, apple maggot injury was concentrated on certain cultivars. Often, the differences were dramatic, with one tree having no maggots and a nearby tree having a 100% infection rate (Figure 3). Unfortunately, the trees were not replicated, so we cannot say that certain cultivars are resistant to apple maggot. The difference in infection rates between cultivars is partially due to the ability of the maggot larvae to survive after hatching. The uninfected McIntosh in Figure 3 had many oviposition scars but no maggot tunnels.

PLUM CURCULIO. The orchards with 5% or less marketable fruit all had plum curculio damage. Like apple maggot, plum curculios are found in some orchards and not others, with little or no influence of geography. Plum curculios are found in northern Minnesota. Plum curculios are small weevils that can only fly short distances. Young orchards will not have curculios if there is no source of weevils nearby, which may explain why the St. Francis, Staples, and Frazee 2 orchards had no curculio. Plum curculio may be the biggest limiting factor for organic apple production in northern Minnesota. If an orchard has no plum curculio, owners can concentrate on controlling apple maggot or codling moth. The orchard in Glenwood had one tree with minor curculio damage. They also had a flock of domesticated turkeys. Poultry can lower curculio damage by eating the insects on the orchard floor.

LEAFROLLERS. All orchards had leafroller damage on the fruit. We were unable to tell if obliquebanded or redbanded leafrollers were causing the damage. All of the leafroller damage was due to first generation leafrollers that attacked fruit in early June. Some of the damaged fruit fell off or was removed by thinning, while the rest carried superficial scars at picking. The number of fruit at harvest with first generation leafroller damage was below 5% at all orchards. Damage from late summer generations of leafroller was extremely rare, with one or two apples per orchard showing late summer fruit damage. Many organic orchardists claim that leafrollers will be sufficiently controlled by natural predators if the trees are never sprayed. This study appears to validate that claim.

Management Tips

1. People growing apples in northern Minnesota should not assume that they will never have pests, nor should they spray their trees every two weeks as recommended in most books on apple growing.

2. Always monitor for pests. Codling moth and apple maggot traps are two of the best investments an apple grower can make. Both are reasonably priced. Place apple maggot traps in summer ripening trees like State Fair.

3. Use cultural controls to control pests. In small orchards, removing fallen apples will reduce apple maggot. Always prune trees to increase air circulation and decrease apple scab. Mow the orchard after the leaves have fallen to reduce overwintering scab inoculum. Scab pressure is low in most parts of northern Minnesota. Make sure it stays that way!

Cooperators

Shirley Judd, Living Legacy Gardens, Staples, MN
Kathy and Coleton Lahr, Orchardists, Glenwood, MN
Darwin Pless, Orchardist, Redwood Falls, MN

Project Location

Participating orchard: Living Legacy Gardens, Central Lakes Ag Center (north of Staples), 1830 Airport Rd. Staples, MN. There are signs on Hwy. 10 west of Staples.

Other Resources

Minnesota Department of Agriculture. Integrated Pest Management for Minnesota Apple Orchards. 2007. Available at: www.mda.state.mn.us/plants/pestmanagement/applemanual.htm

UAP Great Lakes, N15721 Schubert Rd., Galesville, WI 54630, 608-539-2090. Source of codling moth and apple maggot traps.

Novel Preplant Strategies for Successful Strawberry Production

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Project Duration

2006 to 2008

Staff Contact

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Keywords

soil solarization, strawberries, weeds

Project Summary

Our project examined the effect of the combination of preplant soil solarization and canola degradation on weed seed germination with the long-term objective of reducing weed competition for strawberry plants. We specifically wanted to test the effect of biodegradable plastic mulches in combination with plant-generated compounds to reduce weed growth and reduce environmental impact. We tested two biodegradable plastics in combination with canola, to produce an almost weed-free bed. After the preplant treatments were applied, strawberries were planted in early August, overwintered, and produced fruit in June, 2007. Previous experimental trials have demonstrated that, by delaying strawberry planting until August, weed competition was reduced, fewer runners developed, and branch crowns increased, leading to earlier harvest the following year. Floating row covers were used to encourage strawberry plant growth into the fall and again in early spring to maintain soil temperatures for adequate growth. We were unsuccessful with this system. The plastics degraded considerably faster in our trial compared to previous research, probably due to hotter than average temperatures during June and July in Morris.

Project Description

Biodegradable plastics fit into sustainable agricultural systems. They avoid the negative impacts on the environment of regular plastic mulches while having all of the desirable characteristics such as increasing soil temperatures. Research done at the University of Minnesota Southern Research and Outreach Center in Waseca (Fritz, 2005) has shown some biodegradable plastics can increase soil temperatures to at least 90°F for varying periods of time. These plastics also have differing degradation times ranging from 3 to 10 weeks. We applied these plastics in combination with canola degradation to evaluate if there was a reduction in weed seed germination prior to planting strawberry plants.

Biodegradable plastics often are thinner than traditional polyethylene but otherwise are quite similar. They may be made from renewable resources such as starch, cellulose, or degradable polymers. Biodegradable plastics are degraded by sunlight, heat, and mechanical stress, thus eliminating the need for pick-up and disposal at the end of the season. The biodegradable plastics eventually are converted through microbial activity in the soil to carbon dioxide, water, and natural substances. Biodegradable plastics are not the same as the photodegradable mulches that were previously available and left residues in the fields.

Canola being flail mowed.

Mowed canola next to standing canola.

Planting strawberries next to drip irrigation.

Commercial strawberry growers in Minnesota have a limited harvest season. Add to the short season, the other hurdles in production practices such as few labeled agrochemicals for pest control, and you have a very challenging crop to produce. Our producer/researcher group has pioneered the use of novel ways to produce strawberries and this project added to the current body of knowledge. This group has successfully completed research projects in alternative weed control strategies in strawberries since 1998. Past and current research efforts have shown the value of wool mulch within the row and canola mulch between rows as a tool to suppress weeds in strawberries (Forcella and Poppe, 1998; Forcella, F. et al. 2003). A needle-punched wool mat was very effective in suppressing weeds within the strawberry row and was as effective as hand weeding, and possibly better than standard herbicides. The wool mulch use within the row, and canola planted between rows, effectively controlled weeds throughout the planting year with minimal hand labor.

Research was conducted at two sites, the West Central Research and Outreach Center (WCROC) in Morris, MN and the Berry Ridge Farm in Alexandria, MN. Our preplant protocol on both sites was the same. We planted canola on May 16, 2006. On June 18, 2006, Roundup® herbicide was sprayed to kill the canola. Four days later, June 22, the dying canola was flail mowed on the two biodegradable plastic treatments. Immediately after mowing, the canola was shallowly incorporated with a walk-behind rotovator. On the same day we applied the plastic mulches using a plastic mulch laying machine. Drip irrigation was installed on all treatments on this same date. The two biodegradable plastics were Eco-One and Mater-Bi Green. Eco-One mulch was reported (Fritz, 2005) to degrade after approximately 21 days with soil temperatures reported at over 90°F for a 3 week period. Mater-Bi Green mulch degraded in approximately 48 days with soil temperatures of over 100°F for the 6 week period.

On August 8 and 9 respectively, dormant Honeoye strawberry transplants were planted at Morris and Alexandria. The plants were planted through what remained of the two biodegradable plastic treatments and the canola treatment. The in-row spacing of strawberry plants was 12” in a staggered double row for a high density planting. Each row was 12’ long, with three rows per plot. This experiment was blocked with nine rows per block, four blocks per site, and two sites.

On September 22, 2006, floating row covers were laid over the strawberry plants on all treatments on both sites. Row covers, made of spunbonded polyester material, kept temperatures elevated, admitted light, air, and water thus extending the growing season into the fall. This component was a necessary part of the system to keep the plants growing later into the fall to promote increased flower development for the following year. On November 13 and 15 respectively, the row covers were removed and straw mulch was applied to the strawberry rows for winter protection at the Morris and Alexandria sites. In early spring, the straw was removed and row covers reapplied to improve early season growth. The row covers stayed on until 10% bloom was achieved and then removed for pollination.

This project combined the use of soil solarization with biodegradable plastics to evaluate weed seed germination and disease presence in combination with the degradation of canola releasing a natural preemergent herbicide. We were interested in combining these two preplant techniques with our development of the annual strawberry system to produce a low input, sustainable system for strawberry producers.

Results

As stated earlier, the two biodegradable plastic treatments were predicted to not degrade for approximately 21 days for Eco-One mulch and 48 days for Mater-Bi Green mulch. However, the mulches began disintegrating after 8 days for Eco-One mulch and 25 days for Mater-Bi Green mulch. This left the soil uncovered for a longer period than predicted leading to weed seed germination in the two plastic mulch treatments. The treatment with canola killed and left in place had fair to good weed control throughout the season.

From our West Central Research and Outreach Center weather records, the May through August, 2006 temperatures were above normal. During this same period, there were 9 days above 90°F. July was the second driest month on record dating back 117 years. Our original objective of applying biodegradable plastics in combination with canola degradation to reduce weed seed germination prior to planting the strawberry plants was not achieved. The warmer than normal 2006 temperatures probably was responsible for degrading the plastic mulches faster than predicted.

Our dormant strawberry plants were ordered from a reputable strawberry nursery in Nova Scotia, Canada. They were aware of our research project and tried very hard to make sure we received the plants in approximately 48 hours. Unfortunately, after the plant order crossed the Canada/US border the shipper took 8 days to deliver the strawberry plants. On August 8 and 9 respectively, dormant Honeoye strawberry transplants were planted at Morris and Alexandria. Because of the delay in strawberry plant delivery, numerous plants did not leaf out or grow. For this system to work, plants need to be planted in early August. We could not reorder and wait an additional period of time for new plants. Our earlier research with this annual production system concluded that any strawberry transplanted after August 10 would not be productive the following year.

Strawberry plant growth vigor was very poor at both experimental sites in the spring of 2007. As stated earlier, in August, 2006, numerous plants did not leaf out or grow. Those plants that did establish themselves in 2006 and did overwinter led to a poor harvest in June, 2007.

During the 2007 fruit production season, no ripe fruit were harvested or weighed from the strawberry rows of each treatment plot as previously planned. Visibly, the strawberry fruit was of inadequate size and number to warrant any yield data from this experimental trial. We need further experimentation with biodegradable plastics to find a material that degrades over a longer period of time to reduce weed competition in this annual strawberry production system.

Canola control treatment in July.

Eco-one mulch just laid down in June.

Mater-Bi Green mulch just laid down in June.

Canola control treatment in September.

Eco-one mulch in September after 3 months in the field.

Master-Bi Green mulch in September after 3 months in the field.

Management Tips

1. Using canola decreased labor when compared to the traditional matted row system.

2. Annual production of growing strawberries could increase land use efficiency. A cover crop or other short season cash crop (peas, radish, broccoli, cabbage, and cauliflower, etc.) could be grown on the same land before strawberries are planted in late summer.

3. Further experimentation with biodegradable plastics will continue in order to find one that lasts long enough to reduce weed competition in this annual strawberry production system.

4. A better way to ensure prompt delivery of strawberry plants in August, an off-season time for nursery producers, is needed.

Cooperators

Ron Branch, Owner/operator, Berry Ridge Farm, Alexandria, MN
Vincent Fritz, Professor, University of Minnesota, Southern Research and Outreach Center, Waseca, MN
Emily Hoover, Professor, Department of Horticultural Science, University of Minnesota, St. Paul, MN
Cindy Tong, Associate Professor, University of Minnesota, Department of Horticultural Science, St. Paul, MN

Project Location

This project is located at the University of Minnesota, West Central Research and Outreach Center (Hwy. #329 just east of Morris, MN) and Berry Ridge Farm (1301 Fireman's Lodge Rd. SW, Alexandria, MN

Other Resources

Fritz, V. and J. Hebel. 2005. Optimizing Zone of Influence from Colored Plastic Mulch for Improved Reflective Benefit and Impact on Glucosinolates in Cabbage. (Contact author).

Forcella, F., S. Poppe, N. Hansen, W. A. Head, E. Hoover, F. Propsom, and J. McKenzie. 2003. Biological Mulches for Managing Weeds in Transplanted Strawberry (*Fragaria X ananassa*) Weed Technology. 17:782-787.

Forcella, F. and S. Poppe. 1998. Gylphosate-treated canola mulch inhibits weeds during strawberry establishment. In J. Jannick (ed.) New Crops and New Uses: Biodiversity and Sustainable Agriculture. Association for the Advancement of Industrial Crops.

Equine Forestry: Promotion of a Low-impact Forest Harvesting Method

Principal Investigator

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Project Duration

2007 to 2008

MN SARE Contact

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Keywords

draft horses, equine forestry, horse logging

This sustainable agriculture demonstration project was a USDA North Central Region Sustainable Agriculture Research and Education Program producer grant.

Project Summary

I started my business, Cedar River Horse Logging and Wood Products, 16 years ago and use draft horses for sustainable forest management. Horse logging is a low-impact tree harvesting method that promotes sustainability, decreases soil erosion and compaction, and promotes healthy growth of the remaining trees. It is a highly skilled career that is viable in rural and suburban areas with large and small forest acres, and where terrain does not permit mechanized harvesting. The practitioners with horse logging skills are aging and retiring, but the demand for this service is growing, so there is an immediate need to recruit and train new horse loggers. There is a significant lack of public awareness that inhibits the recruitment of potential loggers for training. We saw a need to educate the public about equine horse logging and to bring young people into the profession. I worked with Twin Cities Public Television to produce a 30 minute video that addressed the environmental benefits of equine forestry while allowing viewers a glimpse into sustainable forest management, as well as ideas for forest recreation and woodworking projects.

Project Description

In my 16-year-old horse logging business, I use Percheron draft horses in the woods. I work with landowners to determine their goals for managing their land and harvest their trees with my team. I currently manage 3,000 acres and have a vertically integrated operation including sawmill and kiln operations, plus furniture production. I also teach a horse logging course and do horse logging demonstrations.

In the last 5 years, I have seen a sharp increase in the demand for horse logging services from private landowners and forest landowner cooperatives who do not want heavy machinery on their land.

Horse logging is a low-impact tree harvesting method that promotes sustainability, decreases soil erosion and compaction, and promotes healthy growth of the remaining trees. Logging with heavy machinery can often compact and erode soil, leave ruts in roads, and damage the remaining trees. Horse logging is a sustainable method of forest management that minimizes soil compaction and erosion, supports biodiversity of large and small forest plots, and encourages the production of residual forest resources. Horses significantly minimize soil compaction and trees are selectively

Tim with his draft horses.

cut by highly skilled loggers, resulting in little, if any, soil erosion. Trained horse loggers know how to fell trees accurately to prevent damage to unharvested trees. Required roads are narrow and the skidding of log-lengths rather than tree-lengths allows for tight turns without damaging remaining trees. Horse logging is particularly well suited to smaller parcels of forest and is tailor-made for rolling hills, steep slopes, and suburban/urban areas where the use of heavy machinery may not be feasible. Nationally, there are over 9.9 million forest owners and 93% of those individual holdings are smaller than 100 acres each. Horse logging also makes good, sustainable economic sense. When logging with horses, there is an increase in residual production because mature trees are selectively harvested while the younger trees that are not harvest are not damaged. This opens up the crown so that the younger trees can grow more quickly and the area can be relogged in 10 to 30 years compared with 60 to 120 years for a clear cut area. I have analyzed the cost of using horses, including depreciation, over an 8 year period and calculated a cost of $1.89/day for the work of pulling.

Horse logging is a highly skilled career that is viable in rural and suburban areas with large and small forest acres and where terrain does not permit mechanized harvesting. Unfortunately, this rural occupation is at a crossroads. The generation with horse logging skills is dying, but the demand for this service is growing, so there is an immediate need to recruit and train new horse loggers. A lack of public awareness inhibits the recruitment of potential loggers for training.

Results

I worked with Twin Cities Public Television to film "Equine Forestry," a 30 minute documentary about the set-up and operation of our horse logging camp in Hayward, WI in 2007. We had a 20-man crew, four sawmills, and 11 horses, and produced 36,000' of lumber in 8 days. The documentary addressed the environmental conservation aspects of horse logging as well as its financial viability.

The documentary premiered on Twin Cities Public Television (TPT-17) out of St. Paul, MN on January 12, 2008. Within 10 days of the first broadcast, I received 32 requests to work with people and with draft horses, and I have three apprentices working with me now and two more that have enquired. The show has since aired again twice, in February and March, 2008.

Project Location

Contact Tim Carroll.

Cooperators

Don Arnosti, Forest Program Director, Institute for Agriculture and Trade Policy, Minneapolis, MN
Keith Parker, Director of Special Partnerships, Twin Cities Public Television (TPT), St. Paul, MN
Barb Spears, Chair, Minnesota Forestry Association Metro Chapter, St. Paul, MN

Other Resources

The Art and Science of Horse Logging. Filmed on our job site at the Assisi Heights Convent in Rochester, MN. This is a 1 hr and 15 min "how-to" videotape that covers topics on the logging horse, the logging team, the chainsaw, advanced directional felling techniques, and basic skidding with horses. It is available for $39 from Cedar River Horse Logging. Training courses and demonstrations are also available. For more information go to: www.cedarriverhorselogging.com

Equine Forestry. Tim Carroll and TPT17. To see a copy of the DVD, please contact the NCR-SARE office at: ncrsare@umn.edu or 800-529-1342. You can also order a copy for $14.95 plus shipping and handling from Tim Carroll, tcarroll@smig.net or 507-438-2164.

Forestry Program, Institute for Agricultural and Trade Policy. Web site: www.iatp.org/forestry

Minnesota Forestry Association. Web site: www.mnforest.com

A Comparison between Cornstalk and Soybean Straw for Bedding Used for Hogs and Their Relative Nutrient Value for Fertilizer

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Project Duration

2007 to 2009

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Keywords

composting, cornstalk bedding, fertilizer values, hoop barns, soybean straw bedding

Project Summary

In this project, I am comparing cornstalks to soybean straw to determine which makes the most effective bedding material for hogs in hoop houses. I am evaluating the two materials in terms of keeping the animals dry, how easily they can be put into and removed from the hog hoop barns, the ease of composting, and the nutrient values they provide as fertilizer.

Project Description

I have two hoop barns that hold 175 hogs each. There is a 20' cement pad in each barn for the waterers and feeders. The majority of the barns are dirt based and where bedding is used.

One hoop house will be bedded with cornstalks and the other with soybean straw. The bales are 4' x 5' round bales. I will keep track of the bales used, how long it takes to clean the barns, temperature of the compost piles, how long it takes to compost the bedding, and the nutrient values of the compost.

2007 Results

I bedded one hoop barn with corn stalks and the other with soybean straw for each batch of hogs. After the hogs were sent to market, I cleaned the barns and composted the manure from each of the barns.

Bedding:
I used 39 soybean straw and 43 cornstalk round bales for bedding in 2007. Using the Versatile 9030 tractor, I put in two round bales each week into each barn. I spread the bedding around a little. It took me about 20 minutes to do the bedding.

I noticed some differences between the soybean straw and cornstalks as bedding. Soybean straw absorbed moisture better than the cornstalks, so I used a few more cornstalk bales. However, the soybean straw bedding is more difficult to clean than cornstalk bedding and rolls up and holds its shape making it difficult to remove without a grapple on the bucket. The cornstalks broke apart and were removed easily with the bucket.

Cleaning a hoop barn took between 2.5 and 3 hours using the Versatile with a rock bucket. The rock bucket is deeper and larger than the factory bucket. I do not have a grapple for the bucket, but I plan to get one. I found the Versatile 9030 too large to clean next to the walls. I cannot feel the wall when I get close and I hit the wall a few times. I plan to use a skid loader to clean next to the walls.

Composting:
As I removed the bedding from the hoop barns I made compost piles of 20' x 20' x 10' high, one pile from the soybean straw and another pile for the cornstalks. I have found that making piles this size are much easier to turn and, if the piles are much larger, they have a tendency to get too hot and potentially start on fire. I turned the piles three or more times a week with the Versatile. I turned from one side one week and turned from another the next week.

The composting process is different for the two bedding types. The cornstalks heat-up really fast and will get over 200°F. When the pile gets this hot, I fill the bucket with water and dump it on top and then turn the pile. This helps keep the pile from getting too hot and burning. The cornstalk piles stay quite hot for 7 to 10 days and then cool down to 90°F and remain at that temperature. The cornstalks remain in the 90°F range for a few more weeks and break down to dirt. When the cornstalks looked like dirt, I sent the compost into the lab to see what the nutrient analysis was. The cornstalks had an analysis of 25 lb/ton for nitrogen, 45 lb/ton phosphorus, and 3 lb/ton potassium (Table 1).

The composting process for the soybean straw is much different than cornstalks. The soybean piles did not heat-up as fast or get as hot as cornstalks. The hottest the soybean piles have gotten is 175°F. The piles stay at this higher range longer, sometimes 3 to 4 weeks, than the cornstalks. The soybean straw does not breakdown to dirt like the cornstalks do. After six months in the piles, you can still see stalks and hulls of the soybean plants. The nutrient analysis for the soybean compost is different than the analysis for the cornstalks. Nitrogen was 9 lb/ton, phosphorus was 44 lb/ton, and potassium was 38 lb/ton (Table 1).

I used two types of manure spreaders to spread the compost on crop fields, a Hesston 390 box spreader and a Meyers 3954 with an auger. The Hesston worked better to spread a more even amount of compost. I wanted to apply the compost using sound agronomic rates so I tried determining application rates by spreading on a tarp over a measured area. However, I could not get a consistent weight and I spread by looking at how much was applied.

The two compost materials look much different when applied. The cornstalk compost looks like dirt and therefore is not easy to see when applied to soil. For the cornstalk compost I tried to spread the material so that it covers the soil with a light coating. The soybean compost still has a lot of stalks and hulls so it can be seen when applied. To apply enough soybean stalk compost I spread it quite thick. The soybean compost often spread in clumps which would bunch up in piles when worked into the soil with the harrow. To try to improve the soybean straw breakdown I am going to try a finer straw chopper on the combine in 2008.

I am looking at options for applying the compost. I would like to place the compost directly in the row by deep banding the compost. Using an air system on the fertilizer boxes on the planter may work well to place the compost directly in the row.

Management Tips

1. Keep the compost piles smaller rather than larger. It is easier to manage smaller piles.

2. Turn the piles often, at least three times a week.

3. Keep the piles moist to help keep the temperatures from getting too hot and add water when temperatures approach 200°F.

4. A large tractor with a bucket works well for cleaning the majority of the hoop barn. Use a skid loader to clean along the walls.

5. Sell compost to gardeners for increased income.

Table 1. Nutrient Analysis of Cornstalk and Soybean Straw Compost

Nutrient	Cornstalks	Soybean Straw
Nitrogen	25 lb/ton	9 lb/ton
Phosphorus	45 lb/ton	44 lb/ton
Potassium	3 lb/ton	38 lb/ton

Cooperators

Wayne Martin, Integrated Livestock Production Systems Program, University of Minnesota, St. Paul, MN

Project Location

From Belle Plain take State Hwy. 25 north and west for 9 miles to Sibley Cty. 16. Go south on Cty. 16 (gravel) for 2.5 miles. Turn right on 230th St., the farm is the first on the right.

Other Resources

Integrated Livestock Production Systems Program, University of Minnesota Extension, 385 Animal Science Building, 1988 Fitch Ave., St Paul, MN 55108, 612-625-6224.

University of Minnesota Extension Service. Compost Barn Basics (PDF) Web site: www.extension.umn.edu/dairy/05dairydays/CompostBarnBasics.pdf

University of Minnesota Extension Service. Compost Happens (PDF) Web site: www.extension.umn.edu/county/sherburne/mgardeners/documents/Composting101.pdf

University of Minnesota Extension Service. 2001. Hogs your way: Choosing a Hog Production system in the Upper Midwest. Publication No. BU-7641-S. University of Minnesota Extension, St. Paul, MN, 612-625-8173 or 800-876-8636.

University of Minnesota Extension Service. 1992/2000. INFO-U: What Can You Compost? Pub. No. BG275. Web site: www.extension.umn.edu/info-u/plants/BG275.html

University of Minnesota Extension Service. 1999. Swine Source Book: Alternatives for pork producers. Publication No. PC-7289-S. University of Minnesota Extension, St. Paul, MN, 612-625-8173 or 800-876-8636.

University of Minnesota Extension Service. 2005. Using Manure and Compost as Nutrient Sources for Vegetable Crops. Pub. No. M1192. Web site: www.extension.umn.edu/distribution/horticulture/M1192.html

Comparing Alternative Laying Hen Breeds

Principal Investigator

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Project Duration

2005 to 2007

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Keywords

Aracauna, Buff Rock, chickens, eggs, hens, layers, Leghorn, Silver Gray Dorking, Speckled Sussex

Project Summary

This project was designed to determine the feasibility of raising alternative laying hen breeds in relation to their long-term egg production. Ideally, I would like to have a flock in which individual birds only need to be replaced every 4 to 5 years, whereas the popular Leghorn is typically replaced every 2 years. If my strategy proves successful, it will help diversify my farm operation and demonstrate to other farmers the potential benefits of raising alternative breeds. I think that pursuing this project is very important in order to offer farmers alternatives to the Leghorn laying hens. The ability to direct market a diversity of crops over an entire year is important to the success of my farming operation and for all sustainable farmers at large. I feel that it is important to investigate farming alternatives and acknowledge customer preferences.

Project Description

This study directly compares Leghorns with other chicken breeds to see if they can compete in terms of egg production over time. If they can, using alternative breeds may result in savings, as they require replacement less often, and so continue producing eggs for a longer time. Most egg-laying operations consist solely of commercial Leghorn breed chickens, which must be replaced every 1 to 2 years. Other objectives include comparing the cost of egg production among the breeds and assessing customer preference for egg color.

Table 1. Layer Species Used in the Project

Breed	Egg Color
Buff Rock	Dark brown
Dorking (2006) Aracauna (2007)	White Green
Leghorn	White
Speckled Sussex	Light brown

The breeds I used are listed in Table 1. Speckled Sussex and Silver Gray Dorkings (Dorkings) are long-established European breeds, while Buff Rocks are a traditional American breed. They cost roughly 1.5 to 2 times as much as Leghorns, which originated in Italy. The Sussex and Buff Rocks are larger than the Leghorns and have a longer life expectancy. However, the Dorkings' egg production was so poor that I removed them from the project in the fall of 2006 and replaced them with Aracaunas, which lay green eggs.

My cooperator son, David Stanislow, holding an Aracauna chicken.

I began the project on April 1, 2005 with one rooster and 15 hens each of the Buff Rock, Leghorn, and Speckled Sussex breeds. The Dorkings started with 14 hens. All of the birds were about 1 year old and already laying when the project started. To reduce the possibility of recording errors in monitoring egg production, I kept the birds in two separate pens inside a converted dairy barn. Each pen contained one white egg breed and one brown egg breed, along with a nesting box and roosting area. Speckled Sussex and Dorkings (later the Aracaunas) were housed in one pen, and Buff Rocks and Leghorns were housed in the other. My research indicated that there was not a significant difference in feed consumption among breeds, so this setup made daily chores easier. The hens were allowed to go outside when the weather was warmer than freezing, and they were given continuous and unlimited access to fresh water, meal feed, oyster shells, and grit (winter only).

I also researched different cost efficient feeding methods that are well tolerated by the chickens. I started off with a 17% protein, corn, and soybean meal mixture. In December of 2005, I switched to a 19% protein fish meal because the chickens did not seem to like the soybean meal. The change in protein content improved egg production rates in all breeds except the Leghorns. In 2006 I started mixing my own 19% bulk mixture. I bought the feed components directly from our local cooperative feed mill and a local farmer. Although the fishmeal blend was more expensive than the soy, I still saved money by blending it myself. When I first began, I was hoping to produce organic eggs, but the cost of the premixed feed and transportation were prohibitive; production costs exceeded egg revenue. It is not economically feasible for me to maintain an organic egg operation with my small number of hens.

Customer Egg Color Preference

In addition to looking at egg-laying longevity, I also wanted to investigate the effect of egg color on buyer choice. Through my research I found that my customers greatly preferred the brown eggs over the white eggs. (Although on the East Coast, white eggs are more popular because the brown eggs are what is in the store!) It is still too early to have definitive information on preference between the green and white eggs, though it seemed that the green eggs were more popular once customers got used to them.

Results

The results of my project are provided in Figure 2. The Leghorns outlaid the Buff Rocks and the Speckled Sussex over the course of the project. Preliminary data on the Aracaunas indicated similar production to the Buff Rocks and the Speckled Sussex.

During March, 2007, the birds were attacked by a mink that got almost exclusively Speckled Sussex birds, but also fatally injured two Aracaunas. (The mink was eliminated by the resident rat terrier, "Milo," but not before the damage was done.) We decided to butcher the remaining birds in April, because they stopped laying in February and did not restart as they had done in the previous 2 years. The value of the birds varied significantly with size, with the residual market value (after a $2/bird processing fee) of the Buff Rocks and Speckled Sussex between $3 and $5/bird (at $2/lb), and the Leghorns only $1 to $2/bird.

My overall favorite breed for a market operation was probably the Buff Rock, closely followed by the Speckled Sussex. Leghorns are so small that once they are done laying, they are barely worth cooking, so their residual value is negligible. They are also more sensitive to cold than the other, larger breeds. Plus, I have started hatching my own chicks, and the bigger breeds are heartier babies when hatched at home.

As a result of this project, we have decided that because of the intense competition among egg producers for egg buyers – both at the farmers' market and at grocery stores – we plan to keep only enough hens as will lay eggs for ourselves, and we will then focus on more profitable markets—like duck eggs or guinea hens. I recommend having chickens as a small part of the farming operation (i.e., for yourself) or having at least 100 hens in order to make the time spent on the enterprise worthwhile—economically speaking.

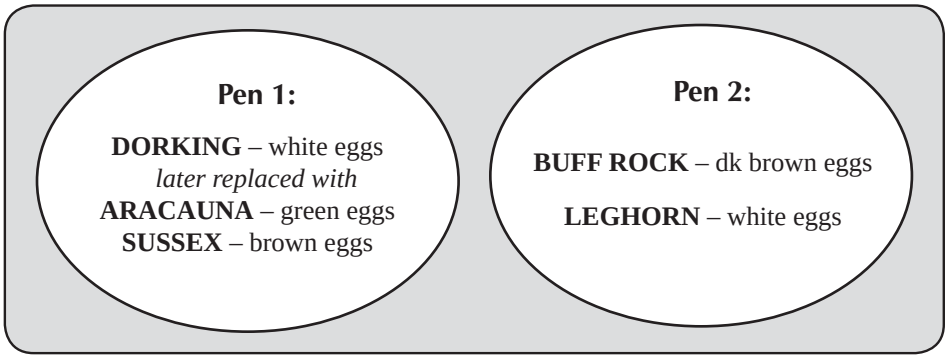
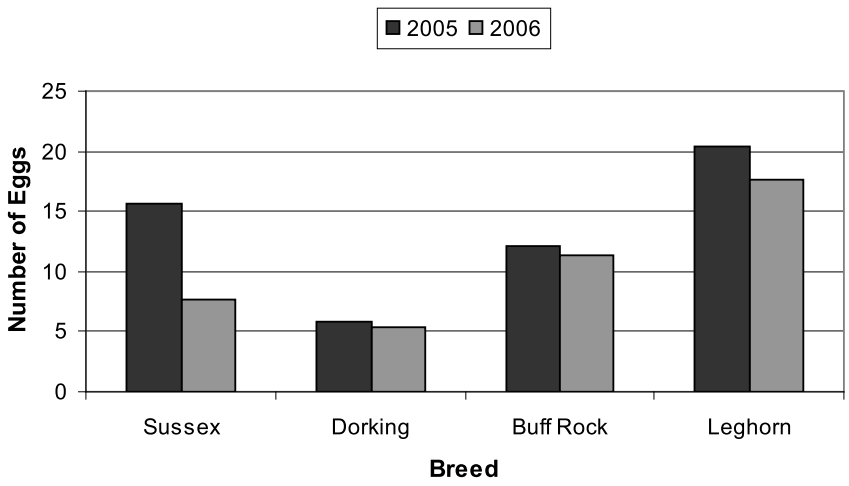


Figure 1.

Pen Setup – To make it easier for us to track laying rates accurately, each pen housed one breed that lays brown eggs and one that lays white (or, in the case of Aracauna chickens, green) eggs.

I have found that consumers appreciate what I do on my farm and buy eggs from me because they know me personally. However, eggs are just one aspect of my farm operation. I also raise Tibetan yak, Icelandic and Shetland sheep, meat/dairy cross goats, potbelly pigs, Satin Angora, French Lop, and Holland Lop rabbits, llamas, and an alpaca. We also have a small market/herb garden and raise meat chickens in the summer. I am currently marketing my goods to the Foreston creamery and the St. Cloud Area Farmers' Market. I recently began selling my yak meat at the Mill City Market in Minneapolis, where there is a large consumer population that is interested in purchasing it.

Figure 2. Average Eggs per Bird per Month



Management Tips

1. Artificial light is important to egg production, especially during short winter days. Fluorescent or incandescent lights can be used (they do not need to be bulbs that replicate the "daylight" spectrum), but use them consistently or the birds may stop laying.

2. Temperature does not appear to make a significant impact on egg production, but I suggest keeping the birds' living area above freezing.

3. Higher protein egg mash made a difference in egg production of some species, but had little effect on the Leghorns.

4. Pay attention to which eggs sell first; our farmers' market and direct market customers prefer brown eggs to white, and darker brown eggs over lighter brown eggs.

5. Guinea fowl are fairly effective for rat control, although if you can convince a cat to stay in the pen with the chickens, it is even better. Rat breed dogs are also effective, but they often like to eat the eggs.

6. I noticed that the Aracaunas and Leghorns are much more active than the bigger Sussex and Buff Rock breeds and benefit from being allowed outside. They also like to eat hay in addition to their regular feed.

Cooperator

David Staneslow, Foley, MN

Project Location

From US Hwy. 10 in St. Cloud go northeast on Benton Cty. 3 (approximately 20 miles). It will become Morrison Cty. 30 which comes to a "T", and then it becomes Morrison Cty. 26 or Nature Rd. Go right (east) at the "T". In approximately 1.5 miles the farm is on the north (left) side of the road. Sign says "Azariah Acres Farm."

Other Resources

American Pastured Poultry Producers Association. 6475 Norton Creek Rd., Blodgett, OR 97326, 541-453-4557, www.apppa.org

ATTRA-National Sustainable Agriculture Information Service. Various poultry publications available free of charge in English and Spanish. 800-346-9140 or www.attra.ncat.org

Minnesota Department of Agriculture. 2005. Poultry Your Way. Available by calling 651-201-6012 or at: www.mda.state.mn.us (contains a chapter on pastured poultry and an extensive "Resources" section).

Salatin, Joel. 1993. Pastured Poultry Profits. Available from some libraries and booksellers and from Polyface, Inc., 43 Pure Meadows Ln., Swoope, VA 24479, 540-885-3590.

Sustainable Farming Association of Minnesota. Local chapters offer many field days and workshops. You can find your local chapter at: www.sfa-mn.org

Demonstration of How Feeding In-line Wrapped High Moisture Alfalfa/Grass Bales will Eliminate Our Fall and Winter "Flat Spot" in Grassfed Beef Production

Principal Investigator

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Project Duration

2006 to 2008

Staff Contact

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Keywords

baleage, forage, rate of gain, relative feed quality (RFQ), winter stored forage

Project Summary

Graziers who want to grass finish beef are in need of ways to achieve a consistent rate of gain on their market animals throughout the year. Having a way to store forage for winter feed that is close to the quality of forage during summer grazing is a huge challenge. This project will demonstrate the use of an in-line round bale wrapper to seal high moisture round bales as baleage for use during the non-grazing season. Weighing animals during the grazing season and during the winter will help determine if consistent weight gains are achievable year around. Both the grazing forage and the baleage will be analyzed for relative feed quality (RFQ). RFQ measures the total energy consumed by the animal.

Project Description

Four grassfed beef producers will weigh cattle on 60-90 day intervals and test the grazing forage and the stored forage to try to find a connection between the feed quality and the rate of gain. During the non-grazing time, some of the farms will use only high moisture wrapped baleage, some will use baleage and dry hay, and one will use only dry hay for the first year of the project.

All of the cattle used in the project have EID tags that identify them as they walk onto the electronic scale. The weights are automatically recorded in the scale computer which then calculates average daily gain. Information about each animal such as date of birth, breed, and other data the producer chooses to input is already recorded in the computer.

2006 Results

The baleage was made at four cuttings on one farm and only at the last cutting on two farms. Dry hay was made at the fourth farm. Two methods of cutting were used: a 14' windrower and a 10' disc mower with a conditioner. The hay was left in a wide windrow for a day. The next morning when the hay was still tough, two windrows were

Grassfed steers at baleage feeder.

The plant species and percent of forage and baleage at the different farm sites were:

Site #1: For grazing – 65% tall fescue, 15% white clover, 5% red clover, 15% mixed grass
For baleage – 50% alfalfa, 50% tall fescue

Site #2: For grazing – 25% tall fescue, 25% Italian rye, 25% white clover, 25% Berseem clover
For baleage – 80% alfalfa, 20% orchardgrass

Site #3: For grazing – 50% wheatgrass, 25% smooth bromegrass, 15% alfalfa, 10% ryegrass
For baleage – no baleage was used, dry hay similar to grazing mixture

Site #4: For grazing – 30% smooth bromegrass, 30% orchardgrass, 20% alfalfa, 20% red clover
For baleage – mature 30% smooth bromegrass, 30% orchardgrass, 20% alfalfa, 20% red clover

raked together and the round baler was right behind as we wanted to get 40% moisture hay. The bales were hauled to the storage site and wrapped as soon as possible on the same day.

We took forage samples from each field and at each cutting. The RFQ was better on the baleage from later cuttings. We identified the rows of wrapped baleage that each sample was from so that we could use the forage that best fit the needs of the cattle. Fat cattle received the best baleage, growing calves were next, and the cows got the lowest quality usually mixed with purchased grass hay.

The RFQ samples for most of the pasture forage samples were also higher for the forage samples taken at the late summer grazing (Table 1). There was a shortage of moisture in 2006 which impacted the results of the first weight period, especially on farms #1 and #3. The RFQ at farm #4 was low due to the forage being very mature at the time of cutting and baleage wrapping. Farm #1 grazed into December and had a high RFQ of 205 on December 11.

The average daily gain was also higher at the winter weighing than the late summer weighing. The late summer rate of gain was in the 1.2 to 1.9 lb/day range. The rate of gain at the winter weighing was between 1.94 to 2.5 lb/day. This can also be attributed to the lack of moisture at the time of the late summer weighing causing poorer quality forage on the pasture. Feeding baleage in winter months is proving to be successful at putting weight on grass-fed cattle.

Table 1. Comparison of Relative Feed Quality for 2006 on Four Farms in Western Minnesota

Farm	Date	Forage Type	Relative Feed Quality (RFQ)
#1	7/19/06	pasture	153
#1	12/11/06	pasture	205
#2	8/15/06	pasture	162
#2	9/15/06	pasture	175-230
#2	8/11/06	baleage	182-232
#3	8/15/06	pasture	152
#3	10/06/06	pasture	208
#4	9/12/06	pasture	196
#4	10/18/06	pasture	120

2007 Results

In 2007, all four producers were in drought disaster declared counties so pasture growth and forage production were definitely not average. It was interesting to see that in the drought limited forage production, quantity went down but quality actually increased. In the stored forage this was easy to evaluate and not a problem but in the grazing situation the animals were eating high quality forage but were having a hard time getting enough physically eaten in the time they were willing to spend grazing. So we saw some loose manure because the cattle were not getting enough fiber in the rumen for proper digestion.

Now that we have 2 years of data on the pasture forage and stored forage, we are focusing on matching the stage of cattle growth with the quality of the forage to maximize growth. To help with this, we

developed a table (Table 2) called "Two Year Comparison of Forage Test to Daily Rate of Gain." This table is valuable because all the information about the quality of forages is in the table and helps us match the cattle growth stage with the feed source. This is different than the usual way of measuring performance by using gain per acre or cost per pound of gain.

Two examples of how to use this Table 2:

Example 1: If the cattle are in the 500 to 800 lb range we want to focus on growth and feed forage high in Neutral Detergent Fiber (NDF) and Neutral Detergent Fiber Digestibility in 48 Hours (NDFD 48). Sample 2 has high values in both, and also is high in sugars which make the forage taste good.

Example 2: If the cattle are in the 800 to 1,000 lb range we shift to focusing more on putting on fat to marble the meat. Here we want to look for forage high in Non-fiber Carbohydrates (NFC). Samples 3, 9, and 10 are good choices for cattle in this range. Samples 9 and 10 are the same baleage but were sampled at different times.

We looked at which forage values relate to growth (meat and bone) and which values relate to fat production (inter-muscular and cover). In the rumen, microbes break down the NDF into acetic fatty acid which is important for growth of the animal. Other microbes break down the NFC, the pectins, and sugars into propionic acid which is used in the production of fat.

We tracked the progress of 80 grass-fed steers in 2007 to see how they performed. These steers weighed 492 lb on December 27, 2006. From December to March 31, 2007 they gained 1.9 lb/day eating stored forage. They were then rotationally grazed on orchardgrass, bromegrass, red clover and alfalfa pasture until late June at which time the grass stopped growing.

From late June to the weighing on August 2, 2007, they open grazed in a 50 acre pasture. They gained only 1.1 lb/day in 76 days during this time. It was very hot and dry and the grass wasn't growing but we didn't have any place to go that was better.

On August 2, we moved them to another pasture and started supplementing with baleage that was intended for winter feed. On October 13, they had gained 1.45 lb/day for 72 days. The cattle were then fed the best baleage and gained 2.35 lb/day for 77 days.

In October we used ultrasound to scan for meat quality. We were pleased with the ribeye area, the ribeye shape, and tenderness. These qualities are highly inherited. The inter-muscular fat and the back fat were lower than we

Table 2. Two Year Comparison Forage Tests to Daily Rate of Gain on Four Farms in Western MN

Sample No.	1	2	3	4	5	6	7	8	9	10	11	12	13	
Date Sampled	Oct-07	Oct-07	Dec-06	Aug-06	Sep-06	Sep-06	Oct-06	Dec-06	Jul-07	Oct-07	Oct-07	Oct-07	Aug-07	Apparent Desired Range
Plant Description	PRG,OG,MF TF,AC,BFT	PRG,OG,MF TF,AC,BFT	TF,PRG,AC	Alfalfa	TF,AC	OG,RC	BR,CWG	1st Cut Alfalfa, OG	Alfalfa	Alfalfa	TF,AC	BR,CWG	BR,Quack Diverse	
Established	May-07	May-07	May-02	May-02	Aug-05		Aug-05		May-02	May-02	Aug-05	Aug-05	NA	
Forage Type	Pasture	Pasture	Pasture	Baleage	Pasture	Pasture	Pasture	Hay	Baleage	Baleage	Pasture	Pasture	Pasture	
Comment	Mature	Immature	Very Dense	3rd Cut Baleage as wrapped	Lush Pasture			Very Mature	2nd Cut Baleage as wrapped	2nd Cut Baleage as fed	2/3 of diet RFQ 155 Baleage		Mature	
CP (%)	11.4	18.5	14.3	22.2	19	22.1	25	11.3	15.94	16.1	21.7	24.7	22	14-17%
NDF (%)	45	44	40	38	39	42	38	54.53	34.3	35	40	40	49	36-52%
NDFD 48 (%)	70	90	67	58.5	74	67.9	65	35.3	45.8	49	73	73	73	70-90%
Sugar (%)	14.4	16.7	19	7	15.8	11.6	11.3	2.73	15.24	7	12	9	11.9	12-20%
NFC	33	24	36	31.75	29	23.42	23	21.91	40.48	40	26	24	19	> 25
RFS	64.5	63.5	62.8	54	57.9	51.94	47.7	41.16	57	57	55.2	53.2	54.8	> 50
RFQ	0-167	0-183	160-206	167-193	165-231	147-197	166-209	93-71	186-187	181-183	160-218	155-215	0-136	>180 RFQ
NEG (Mcal)	37.6	43.3	38.1	36.25	41.7	36.55	38	4.22	35.8	33.9	40.7	40.8	37.6	>36
Predicted DMI (% of body wt)	2.66	2.7	3.01	3.16	3.06	2.86	3.13	2.2	3.5	3.39	2.97	2.87	2.44	>2.7
Actual Gain (#/day)	2.2#		2.4#	2.15#	2.5#	1.9#	1.9#	0.45#		2.35#	1.45#	2#	1#	2-2.5#

CP	Crude Protein
NDF	Neutral Detergent Fiber
NDFD 48	Neutral Detergent Fiber Digestibility 48 hours
NFC	Non-fiber Carbohydrates
RFS	Relative Feed Score
	RFS Calculation = (NDF x NDFD 48)/100 + NFC
RFQ	Relative Feed Value - Relative Feed Quality
NEG	Net Energy for Gain
Predicted DMI	Predicted Dry Matter Intake
Actual Gain	Pounds per day

	Same forage tested twice
	Same pasture, different maturity
PRG	Perennial Ryegrass
OG	Orchardgrass
MF	Meadow Fescue
TF	Tall Fescue
AC	Alice White Clover
BFT	Birdsfoot Trefoil
BR	Bromegrass
CWG	Crested Wheatgrass
RC	Red Clover

Scale and chute used for weighing the cattle.

had hoped for. However, we do not think we supplied the quality and the quantity of forage during the summer months to allow the steers to reach their potential. We also banded the steers fairly late at a 650 lb average which may have caused the steers' leaner growth and with less fat.

We plan to ultrasound some cattle again next year. Some will have similar genetics to this year's steers so we will see how they do under next year's management. After two years of results the farmer participants are pleased with the rate of gain on their animals and are learning how to promote steady gains by matching forage quality with the growth stage of the cattle. They see the value of having high RFQ in the forages for achieving improved rate of gain in the animals.

Management Tips

1. Forage testing at each cutting or grazing is crucial for managing to achieve good rate of gain on the animals.

2. Band or castrate bull calves at a young age so they do not produce too much lean growth.

3. The use of the electronic scale is a must to keep track of the cattle and allows us to easily access information on each animal.

4. Raising high quality forage is a lot like raising high quality beef. You need to start with genetics that have the potential for what you want to produce, then you have to see to it that the forage gets the nutrients it needs to maximize its potential.

Cooperators

Richard Handeen, Grazier, Montevideo, MN
Luverne Forbord, Grazier, Starbuck, MN
Mark Erickson, Grazier, Donnelly, MN
Dennis Johnson, Dairy Scientist, WCROC, Morris, MN
Margot Rudstrom, Agricultural Economist, WCROC, Morris, MN
Doug Gunnink, Grazing Consultant, Gaylord, MN

Project Location

For specific locations, call Don Struxness at 320-734-4877 or email at dbstruxness@fedteldirect.net

Other Resources

Blanchet, K., H. Moechnig, and J. DeJong-Hughes. 2000. Grazing systems planning guide. MN Publication No. BU-07606-S. University of Minnesota Extension Service, St. Paul, MN, 612-625-8173 or 800-876-8636.

Dairyland Laboratories, Inc., Dan Moscho, Lab Manager, PO Box 580, St. Cloud, MN 56302-9900, 320-240-1737.

Graze. PO Box 48, Beltsville, WI 53508, 608-455-3311, graze@mhtc.net. Newspaper devoted to grazing. Published ten times per year.

Jeranyama, P., and A. Garcia. 2004. Understanding Relative Feed Value (RFV) and Relative Feed Quality (RFQ). SD Publication N. ExEx8149. South Dakota State University Cooperative Extension Service. Access at: agbiopubs.sdstate.edu/articles/ExEx8149.pdf

Jung, G.A., A.J.P. Van Wijk, W.F. Hunt, and C.E. Watson. In L.E. Moser et al. (ed.). Cool-season forage grasses. Agron. Mongr. 34, pp. 605-641. ASA, CSSA, SSSA, Madison, WI.

Midwestern Bio-Ag, PO Box 160, Blue Mounds, WI 53517, 800-327-6012. Access at: www.midwesternbioag.com/homepage.html. A biologically-based agriculture consulting company. Also publishes a quarterly newsletter BIO-NEWS.

Peterson, Paul. March 16, 2006. Seeding Grasses with Alfalfa: This "Old" Idea Makes Cent$ Today. Minnesota Crop eNews. University of Minnesota Extension Service. Access at: www.extension.umn.edu/cropenews

The Stockman Grass Farmer. PO Box 2300, Ridgeland, MS 39158-2300, 800-748-9808. Monthly publication devoted to grazing.

New Demonstration Grant Projects - 2008

Alternative Markets and Specialty Crops

Growing the Goji Berry in Minnesota

Koua Vang and Cingie Kong
7862 – 465th St.
Harris, MN 55032
651-387-9246
tuajncigntuj@yahoo.com
Chisago County
Award amount: . . . . . $21,117 for 3 years

The goal of this project is to design a production system to cultivate the Goji berry in Minnesota. The Goji berry is very new to the United States. We would like to be one of the first growers to produce the Goji berry on a commercial scale. We would like to be able to produce enough fresh and dried Goji berries and juice to sell at a profit.

Cropping Systems and Soil Fertility

Increasing the Profitability of Raising Livestock: An Evaluation of Two Methods to Extend the Grazing Season

Jeff Duchene
Fillmore SWCD
900 Washington St. NW, Box A
Preston, MN 55965
507-765-3878
Jeff.duchene@mn.nacdnet.net
Fillmore County
Award amount: . . . . . $18,176 for 3 years

This project involves grazing the last crop of hay and aerial seeding winter rye into cropland to extend the grazing season and lower the costs of producing beef cattle.

Utilizing Warm Season Grasses in Forage Production in a Changing Climate

Jerry Tourtillott
34843 Cty. Rd. 133
Salol, MN 56756
218-463-1177
Roseau County
Award amount: . . . . . $17,400 for 3 years

This demonstration project will compare the benefits of integrating warm season grasses into forage farming systems that currently rely on cool season grasses for production and profitability. We will determine if warm season grasses increase production and profitability of forage production over cool season species used alone. We will compare conventional and organic fertilizer requirements among species treatments. The project will monitor forage quality such as crude protein and relative feed value. Rainfall and local weather data will be monitored as well.

Fruits and Vegetables

Using Solar Energy to Heat the Soil and Extend the Growing Season in High Tunnel Vegetable Production

Dallas Flynn
48677 Rice Lake Rd.
Frazee, MN 56544-8908
218-841-6380
drusadal@hotmail.com
Otter Tail County
Award amount: . . . . . $17,692 for 3 years

This project will evaluate a unique way of heating high tunnels. I will heat the soil with solar heat that is stored in the ground using fans to move the heat into the soil. The warm soil can store heat during the day and radiate the heat out at night, warming the air temperatures and the plants. By warming the soil, I hope to warm the tunnel enough to plant seeds in early February, giving me an extra 2 months of growing season in the spring. I will compare air temperature, soil temperature, and crop productivity in this high tunnel heated with a nearby high tunnel without heated soil.

Looseleaf: Lettuce Growing Experiment

Michael Hamp
32251 Bunny Hill Rd.
Sebeka, MN 56477
218-472-3395
calico@wcta.net
Wadena County
Award amount: . . . . . $4,557 for 3 years

This project plans to use shade cloth and water misters over lettuce and herb beds to lower air temperatures in midsummer – extending the growing season and, in turn, providing more farm income.

Enhancing the Marketing of Strawberries through Season Extension

Sam Kedem
12414 – 191st St. E.
Hastings, MN 55033
651-437-7516
info@kedemroses.com
Dakota County
Award amount: . . . . . $13,695 for 3 years

The goal of this project is to extend the market season for organic strawberries. We want to develop a protocol for organically grown day neutral strawberries in Minnesota and compare the costs and benefits of these to June-bearing strawberries. Additional objectives for the project are reducing dependency on transportation energy and evaluating a crop rotation program (green manure) as a sustainable option for weed suppression and nitrogen fixation.

Winter Plant Protection of Blueberries in Northern Minnesota

Al Ringer
1765 Jackpine Rd.
Brimson, MN 55602
218-848-2475
aringer@frontiernet.net
St. Louis County
Award amount: . . . . . $6,265 for 3 years

This project will investigate different types of winter protection for blueberries. Some of the methods they will compare include traditional plant coverings and non-traditional plant coverings as well as investigating the feasibility of making snow for winter protection on a small agricultural scale.

Winter Harvest of Hardy Crops under Unheated Protection

Kelly Smith
165 Korby Rd.
Esko, MN 55733
218-879-3829
kellythegreenman@yahoo.com
Carlton County
Award amount: . . . . . $10,589 for 3 years

The project will research and demonstrate growing hardy greens under unheated hoop house and floating row cover protection for fall-winter-spring harvest. Cages of meat rabbits will add winter heat in the hoop house.

Livestock

Diversified Harvest of Integrated Species

Joe Bowman and Michelle Gransee-Bowman
1100 South St. W.
Belle Plaine, MN 56011
952-873-3998
gransee.bowman@gmail.com
Scott County
Award amount: . . . . . $13,939 for 3 years

This project focuses on integrating multiple species for effectively grazing pasture. We will monitor the impacts this has on the animals, pasture, and surrounding ecosystems. They will research and demonstrate strategies for managed rotational grazing by cattle, sheep, and poultry to benefit the health of the ecosystems and the animals while providing a diverse harvest of marketable products for farm enterprises.

Methods to Establish Grazing of Annual Forages for Beef Cows on Winter Feeding Areas

Ryon S. Walker
550 Bunker Lake Blvd. NW
Andover, MN 55304
763-767-3847
Walke375@umn.edu
Itasca and Carlton Counties
Award amount: . . . . . $24,959 for 3 years

The project will compare conventional seeding, no-till inter-seeding, and broadcasting of annual cool and warm season grasses in pastures used as winter feeding areas. The project will determine the effectiveness and efficiency of each pasture renovation method by measuring stand establishment, forage yield, and number of grazing days using cow/calf pairs in a traditional rotational grazing system to provide additional grazing days through the growing season.

Completed Grant Projects...

Final Greenbook Article	Title of Project	Grantee

Alternative Markets and Speciality Crops

2007	Developing a Saskatoon Berry Market in the Upper Midwest	Patricia Altrichter/Judy Heiling
2005	Creating Public Recognition of and Demand for "Grass-Fed" Dairy Products Through the Development of Brand Standards and Promotion of These Standards to the Public	Dan French
2004	Collaborative Character Wood Production and Marketing Project	Cooperative Development Services/Isaac Nadeau
	Creating Consumer Demand for Sustainable Squash with Labels and Education	Gary Pahl
	Integrated Demonstration of Native Forb Seed Production Systems and Prairie Land Restoration	Michael Reese
	Pride of the Prairie: Charting the Course from Sustainable Farms to Local Dinner Plates	Kathleen Fernholz
2003	Demonstrating the Market Potential for Sustainable Pork	Prairie Farmers Co-op/Dennis Timmerman
	Evaluating the Benefits of Compost Teas to the Small Market Grower	Pat Bailey
	Flour Corn as an Alternative Crop	Lynda Converse
2002	Increasing Red Clover Seed Production by Saturation of Pollinators	Leland Buchholz
	Propagation of Native Grasses and Wildflowers for Seed Production	Joshua Zeithamer
2001	Establishing Agroforestry Demonstration Sites in Minnesota	Erik Streed/CINRAM
	Managed Production of Woods-grown and Simulated Wild Ginseng	Willis Runck
	Midwest Food Connection: Children Monitor on Farms	Midwest Food Connection
	Phosphorus Mobilization and Weed Suppression by Buckwheat	Curt Petrich
2000	Converting a Whole Farm Cash Crop System to Keeping an Eye on Quality of Life and the Bottom Line in Sustainable Agriculture by Using Key Farm Economic Ratios to Aid in Decision Making	Red Cardinal Farm
	Dry Edible Beans as an Alternative Crop in a Direct Marketing Operation	Bruce & Diane Milan
	Native Minnesota Medicinal Plant Production	Renne Soberg
1999	An Alternative Management System in an Organic, Community Supported Market	Candace Mullen
	Cultural and Management Techniques for Buckwheat Production and Marketing	Tom Bilek
	Pond Production of Yellow Perch	John Reynolds

Final Greenbook Article	Title of Project	Grantee
1998	Establishing and Maintaining Warm Season Grasses (Native Grasses)	Pope County SWCD
	On-farm Forest Utilization and Processing Demonstrations	Hiawatha Valley RC&D
1995	Cash Crop Windbreak Demonstration/Development	Phil Rutter
	Cutter Bee Propagation under Humid Conditions	Theodore L. Rolling
	Red Deer Farming as an Alternative Income	Peter Bingham
	Wildflower Seeds as a Low-input Perennial Crop	Grace Tinderholt/Frank Kutka
1992	Alternative Mulch Systems for Intensive Specialty Crop Production	Ron Roller/Lindentree Farm
	Benefits of Crop Rotation in Reducing Chemical Inputs and Increasing Profits in Wild Rice Production	George Shetka
	Benefits of Weeder Geese and Composted Manures in Commercial Strawberry Production	Joan Weyandt-Fulton
	Common Harvest Community Farm	Dan Guenthner
	Mechanical Mulching of Tree Seedlings	Timothy & Susan Gossman
	Minnesota Integrated Pest Management Apple Project	John Jacobson

Cropping Systems and Soil Fertility

2007	Field Windbreak/Living Snow Fence Yield Assessment	Gary Wyatt
2006	Gardening with the Three Sisters: Sustainable Production of Traditional Foods	Winona LaDuke
2005	Chickling Vetch—A New Green Manure Crop and Organic Control of Canada Thistle in Northwest Minnesota	Dan Juneau
	Feasibility of Winter Wheat Following Soybeans in Northwest Minnesota	Jochum Wiersma
	Treating Field Runoff through Storage and Gravity-fed Drip Irrigation System for Grape and Hardwood Production	Tim Gieseke
	Use of Rye as a Cover Crop Prior to Soybean	Paul Porter
2004	Development of Eastern Gamagrass Production	Nathan Converse
	In-field Winter Drying and Storage of Corn: An Economic Analysis of Costs and Returns	Marvin Jensen
	Mechanical Tillage to Promote Aeration, Improve Water Infiltration, and Rejuvenate Pasture and Hay Land	Robert Schelhaas
	Native Perennial Grass – Illinois Bundleflower Mixtures for Forage and Biofuel	Craig Sheaffer
	Northwest Minnesota Compost Demonstration	John Schmidt/Russ Severson
	Potassium Rate Trial on an Established Grass/Legume Pasture: Determining Economic Rates for Grazing/Haying Systems	Dan & Cara Miller
	Woolly Cupgrass Research	Leo Seykora
	Yield and Feeding Value of Annual Crops Planted for Emergency Forage	Marcia Endres
2003	Aerial Seeding of Winter Rye into No-till Corn and Soybeans	Ray Rauenhorst
	Dairy Manure Application Methods and Nutrient Loss from Alfalfa	Neil C. Hansen

Final Greenbook Article	Title of Project	Grantee
2003	Manure Spreader Calibration Demonstration and Nutrient Management	Jim Straskowski
	Replacing Open Tile Intakes with Rock Inlets in Faribault County	Faribault County SWCD/Shane Johnson
	Soil Conservation of Canning Crop Fields	Andy Hart
	Using Liquid Hog Manure as Starter Fertilizer and Maximizing Nutrients from Heavily Bedded Swine Manure	Dakota County SWCD/Brad Becker
2002	Agricultural Use of Rock Fines as a Sustainable Soil Amendment	Carl Rosen
	A Low-cost Mechanism for Inter-seeding Cover Crops in Corn	Tony Thompson
	Annual Medic as a Protein Source in Grazing Corn and Weed Suppressant in Soybeans	Joseph Rolling
	Evaluation of Dairy Manure Application Methods and Nutrient Loss from Alfalfa	Stearns County SWCD
	Increased Forage Production through Control of Water Runoff and Nutrient Recycling	James Sovell
	Land Application of Mortality Compost to Improve Soil and Water Quality	Neil C. Hansen
	Turkey Litter: More is Not Always Better	Meierhofer Farms
2001	Applying Manure to Corn at Agronomic Rates	Tim Becket/Jeremy Geske/Dakota County Extension/SWCD
	Cereal Rye for Reduced Input Pasture Establishment and Early Grazing	Greg Cuomo
	Establishing a Rotational Grazing System in a Semi-wooded Ecosystem: Frost Seeding vs. Impaction Seeding on CRP Land and Wooded Hillsides Using Sheep	James Scaife
	Living Snow Fences for Improved Pasture Production	Mike Hansen
	Managing Dairy Manure Nutrients in a Recycling Compost Program	Norman & Sallie Volkmann
	Reducing Chemical Usage by Using Soy Oil on Corn and Soybean	Donald Wheeler
	Techniques for More Efficient Utilization of a Vetch Cover Crop for Corn Production	Carmen Fernholz
	Using Nutrient Balances to Benefit Farmers and the Environment	Mark Muller/IATP
2000	Forage Mixture Performance	Itasca County SWCD
	Inter-seeding Hairy Vetch in Sunflower and Corn	Red Lake County Extension
	Growing Corn with Companion Crop Legumes for High Protein Silage	Stanley Smith
	Legume Cover Crops Inter-seeded in Corn as a Source of Nitrogen	Alan Olness/Dian Lopez
	Surface Application of Liming Materials	Jane Grimsbo Jewett
	The Introduction of Feed Peas and Feed Barley into Whole Farm Planning	Ken Winsel
1999	CRP in a Crop Rotation Program	Jaime DeRosier
	Evaluating Kura Clover for Long-term Persistence	Bob & Patty Durovec
	The Winona Farm Compost Strategies	Richard J. Gallien
	Timing Cultivation to Reduce Herbicide Use in Ridge-till Soybeans	Ed Huseby

Final Greenbook Article	Title of Project	Grantee
1998	An Evaluation of Variable Rate Fertility Use on Ridged Corn and Soybeans	Howard Kittleson
	Farming Practices for Improving Soil Quality	Sustainable Farming Association of SC MN
	Sustainable Agriculture in Schools	Toivola-Meadowlands School/Jim Postance
1997	Converting from a Corn-Soybean to a Corn-Soybean-Oat-Alfalfa Rotation	Eugene Bakko
	Manure Application on Ridge-till: Fall vs. Spring	Dwight Ault
1996	Biological vs. Conventional Crop Systems Demonstration	Gary Wyatt
	Building Soil Humus without Animal Manures	Gerry Wass
	Controlled Microbial Composting to Improve Soil Fertility	Howard & Mable Brelje
	Living Mulches in West Central Minnesota Wheat Production	Dave Birong
	Making the Transition to Certified Organic Production	Craig Murphy
	No-till Barley and Field Peas into Corn Stalks, Developing Pastures on These Bare Acres	Jerry Wiebusch
	Weed Control and Fertility Benefits of Several Mulches and Winter Rye Cover Crop	Gary & Maureen Vosejpka
1995	Annual Medics: Cover Crops for Nitrogen Sources	Craig Sheaffer
	Integration of Nutrient Management Strategies with Conservation Tillage Systems for Protection of Highly Eroded Land and Lakes in West Otter Tail County	Harold Stanislawski
	Manure Management/Utilization Demonstration	Timothy Arlt
	Reducing Soil Insecticide Use on Corn through Integrated Pest Management	Ken Ostlie
	Taconite as a Soil Amendment	Donald E. Anderson
1994	Biological Weed Control in Field Windbreaks	Tim Finseth
	Energy Conserving Strip Cropping Systems	Gyles Randall
	Fine-tuning Low-input Weed Control	David Baird
	Flame Weeding of Corn to Reduce Herbicide Reliance	Mille Lacs County Extension
1993	Chemical Free Double-cropping	Jeff Mueller
	Cooperative Manure Composting Demonstration and Experiment	Rich Vander Ziel
	Early Tall Oat and Soybean Double Crop	Charles D. Weber
	NITRO Alfalfa, Hog Manure, and Urea as Nitrogen Sources in a Small Grain, Corn, Soybean Crop Rotation	Carmen Fernholz
	Nitrogen Utilization from Legume Residue in Western Minnesota	Arvid Johnson
1992	Demonstration of Land Stewardship Techniques in the Red River Valley	Donald H. Ogaard
	Demonstration of Tillage Effects on Utilization of Dairy and Hog Manure in Southeast Minnesota	John Moncrief
	Economically and Environmentally Sound Management of Livestock Waste	Fred G. Bergsrud
	Herbicide Ban? Could You Adapt on a Budget?	David Michaelson
	Improving Groundwater Quality and Agricultural Profitability in East Central Minnesota	Steven Grosland/Kathy Zeman
	Modified Ridge-till System for Sugar Beet Production	Alan Brutlag

Final Greenbook Article	Title of Project	Grantee
	Soil Building and Maintenance	Larry H. Olson
	Strip-cropping Legumes with Specialty Crops for Low-cost Mulching and Reduced Fertilizer/Herbicide Inputs	Mark Zumwinkle
	Using Nitro Alfalfa in a No-till Corn and Soybean Rotation	Jeff Johnson
1991	Alternative Methods of Weed Control in Corn	Sr. Esther Nickel
	Hairy Vetch and Winter Rye as Cover Crops	Mark Ackland

Energy

2007	Testing the Potential of Hybrid Willow as a Sustainable Biomass Energy Alternative in Northern Minnesota	Dean Current

Fruits and Vegetables

2007	Apple Scab Control Project	Rick Kluzak
2005	Organic Strawberry Production in Minnesota	Brian Wilson/Laura Kangas
2003	Research and Demonstration Gardens for New Immigrant Farmers	Nigatu Tadesse
	Root Cellaring and Computer-controlled Ventilation for Efficient Storage of Organic Vegetables in a Northern Market	John Fisher-Merritt
	Viability of Wine Quality Grapes as an Alternative Crop for the Family Farm	Donald Reding
2002	Development and Continuation of a Community Based Sustainable Organic Grower's Cooperative and Marketing System	Patty Dease
	Flame Burning for Weed Control and Renovation with Strawberries	David Wildung
	Integrating Livestock Profitably into a Fruit and Vegetable Operation	David & Lise Abazs
	Soil Ecology and Managed Soil Surfaces	Peter Seim/Bruce Bacon
	Value Adding to Small Farms through Processing Excess Production	Jeffrey & Mary Adelmann
2001	Bio-based Weed Control in Strawberries Using Sheep Wool Mulch, Canola Mulch and Canola Green Manure	Emily Hoover
	Biological Control of Alfalfa Blotch Leafminer	George Heimpel
	Cover Crops and Living Mulch for Strawberry Establishment	Joe Riehle
	Sustainable Weed Control in a Commercial Vineyard	Catherine Friend/Melissa Peteler
1999	Development of Mating Disruption and Mass Trapping Strategy for Apple Leafminer	Bernard & Rosanne Buehler
1998	Alternative Point Sources of Water	Joseph & Mary Routh
	Comparison of Alternative and Conventional Management of Carrot Aster Leafhoppers	MN Fruit & Vegetable Growers Association
	Jessenland Organic Fruits Project	MN New Country School
	Propane Flame Weeding Vegetable Crops	Jean Peterson/Al Sterner

Final Greenbook Article	Title of Project	Grantee
	Soil Quality Factors Affecting Garlic Production	Tim King
	Wine Quality Grapes in Otter Tail County	Michael & Vicki Burke
1997	Community Shared Agriculture and Season Extension for Northern Minnesota	John Fisher-Merritt
	Living Mulch, Organic Mulch, Bare Ground Comparison	Dan & Gilda Gieske

Livestock

2007	Comparing Alternative Laying Hen Breeds	Suzanne Peterson
2006	Composting Bedded Pack Barns for Dairy Cows	Marcia Endres
	Managing Hoops and Bedding and Sorting without Extra Labor	Steve Stassen
2005	Performance Comparison of Hoop Barns vs. Slatted Barns	Kent Dornink
	Raising Cattle and Timber for Profit: Making Informed Decisions about Woodland Grazing	Michael Demchik
	Using a 24' x 48' Deep Bedded Hoop Barn for Nursery Age Pigs	Trent & Jennifer Nelson
2004	Comparing Performance of Hoop Buildings to an Older Conventional Building for Finishing Hogs	Kevin Connolly
	High Value Pork Production for Niman Ranch Using a Modified Swedish System	David & Diane Serfling
	Low Cost Fall Grazing and Wintering Systems for Cattle	Ralph Lentz
2003	Can New Perennial Grasses Extend Minnesota's Grazing Season	Paul Peterson
	Enhancement of On-farm Alfalfa Grazing for Beef and Dairy Heifer Production	Dennis Johnson
	Farrowing Crates vs. Pens vs. Nest Boxes	Steve Stassen
	Forage Production to Maintain One Mature Animal Per Acre for 12 Months	Ralph Stelling
	High Quality – Low Input Forages for Winter Feeding Lactating Dairy Cows	Mark Simon
	Pasture Aeration and its Effects on Productivity Using a Variety of Inputs	Carlton County Extension
	Potential of Medicinal Plants for Rotational Grazing	Management Intensive Grazing Groups/Dave Minar
	Programmatic Approach to Pasture Renovation for Cell Grazing	Daniel Persons
2002	Adding Value for the Small Producers via Natural Production Methods and Direct Marketing	Pete Schilling
	Grazing Beef Cattle as a Sustainable Agriculture Product in Riparian Areas	Frank & Cathy Schiefelbein
	Improvement of Pastures for Horses through Management Practices	Wright County Extension
	Increasing Quality and Quantity of Pasture Forage with Management Intensive Grazing as an Alternative to the Grazing of Wooded Land	Michael Harmon
	Supplement Feeding Dairy Cattle on Pasture with Automated Concentrate Feeder	Northwest MN Grazing Group

Final Greenbook Article	Title of Project	Grantee
	Viability of Strip Grazing Corn Inter-seeded with a Grass/Legume Mixture	Stephen & Patricia Dingels
2001	Annual Medic as a Protein Source in Grazing Corn	Joseph Rolling
	First and Second year Grazers in a Year Round Pasture Setting Served by a Frost Free Water System	Don & Dan Struxness
	Low Input Conversion of CRP Land to a High Profitability Management Intensive Grazing and Haying System	Dan & Cara Miller
	Reviving and Enhancing Soils for Maximizing Performance of Pastures and Livestock	Doug Rathke/Connie Karstens
	Whole System Management vs. Enterprise Management	Dennis Rabe
	Working Prairie – Roots of the Past Sustaining the Future	John & Leila Arndt
2000	Converting a Whole Farm Cash System to Sustainable Livestock Production with Intensive Rotational Grazing	Edgar Persons
	Dairy Steers and Replacement Heifers Raised on Pastures	Melissa Nelson
	Establishing Pasture Forages by Feeding Seed to Cattle	Art Thicke
	Grass-and Forage-based Finishing of Beef, with Consumer Testing	Lake Superior Meats Cooperative
	Learning Advanced Management Intensive Grazing through Mentoring	West Otter Tail SWCD
	Low Cost Sow Gestation in Hoop Structure	Steve Stassen
1999	Deep Straw Bedding Swine Finishing System Utilizing Hoop Buildings	Mark & Nancy Moulton
	Extending the Grazing Season with the Use of Forage Brassicas, Grazing Corn and Silage Clamps	Jon Luhman
	Home on the Range Chicken Collaborative Project	Sustainable Farming Association of SE MN
	Hoop Houses and Pastures for Mainstream Hog Producers	Josh & Cindy Van Der Pol
	Management Intensive Grazing Groups	Dave Stish
	Renovation of River Bottom Pasture	Jon Peterson
	The Values Added Graziers: Building Relationships, Community and Soil	Values Added Graziers
1998	Buffalo: Animal from the Past, Key to the Future	Richard & Carolyn Brobjorg
	Marketing Development - Small Farm Strategies Project	Sustainable Farming Association of NE MN
	Pastured Poultry Production and Riparian Area Management	Todd Lein
1997	Butcher Hogs on Pasture	Michael & Linda Noble
	Developing Pastures Using Various Low-input Practices	Ralph Lentz
	Grass Based Farming in an Intensive Row Crop Community	Douglas Fuller
	Grazing Hogs on Standing Grain and Pasture	Michael & Jason Hartmann
	Grazing Sows on Pasture	Byron Bartz
	Low Input Systems for Feeding Beef Cattle or Sheep	Dennis Schentzel

Final Greenbook Article	Title of Project	Grantee
	Raising Animals for Fiber	Patty Dease
	Rotational Grazing Improves Pastures	MISA Monitoring Team
	Seasonal Dairying and Value-added Enterprises in Southwest Minnesota	Robert & Sherril Van Maasdam
	Swedish Style Swine Facility	Nolan & Susan Jungclaus
1996	Dairy Waste Management through Intensive Cell Grazing of Dairy Cattle	Scott Gaudette
	Establishing Trees in Paddocks	Dave/Diane Serfling
	Evaluating Pasture Quality and Quantity to Improve Management Skills	Land Stewardship Project
	Expanding into Outdoor Hog Production	James Van Der Pol
	Grazing Length: Season Length and Productivity	Doug/Ann Balow
1995	Evaluating Diatomaceous Earth as a Wormer for Sheep and Cattle	David Deutschlander
	Intensive Controlled Grazing and Pasture Rejuvenation on Fragile Land	Lyle/Nancy Gunderson
	Intensive Rotational Grazing on Warm Season Grasses	Jim Sherwood
	Rotational Top-grazing as a Method of Increasing Profitability with a High-producing Dairy Herd	Alton Hanson
1994	Economics of Rotational Grazing vs. Row Crops	Harold Tilstra
1993	A Comparison Study of Intensive Rotational Grazing vs.Dry-lot Feeding of Sheep	R & K Shepherds
	Controlled Grazing of Ewes on Improved Pastures and Lambing on Birdsfoot Trefoil	Leatrice McEvilly
	Improving Permanent Pastures for Beef in Southwest Minnesota	David Larsen
	Intensive Rotational Grazing	Chad Hasbargen
	Research and Demonstration of Rotational Grazing Techniques for Dairy Farmers in Central Minnesota	Stearns County Extension
	Winter Grazing Study	Janet McNally/Brooke Rodgerson
1992	A Demonstration of an Intensive Rotational Grazing System for Dairy Cattle	Ken Tschumper
	Intensive Rotational Grazing in Sheep Production	James M. Robertson
	Using Sheep and Goats for Brush Control in a Pasture	Alan & Janice Ringer

The Effect of Pastures on Water Quality in SE Minnesota

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Project Description

Fecal coliform levels are exceeding accepted thresholds in many Minnesota streams and rivers. It is often assumed that animal agriculture is a primary source of fecal coliform loading to surface waters. Our objective in this study is to monitor how different grazing and row crop systems affect fecal coliform, sediment, and nutrient transport during storm events. Can pasture management improve the ecological integrity of riparian areas and streams? Our hypothesis is that improved pasture management leads to reduced fecal coliform loading in streams.

The project addresses this question using rain simulations and water quality analysis in the driftless area of southeast Minnesota. The study sites are located in the Root River and Whitewater watersheds. All study areas are located on silt loam soils. These soils are highly productive but prone to erosion. We applied simulated rainfall events to conventional pastures, managed pastures, manured row crops, and newly established alfalfa.

The study was intended to be a comparison of rotational vs. continuous grazing. However, due to the actual differences in animal stocking rates, the study more correctly reflects the comparison of high vs. low stocking rates than the effects of rotational vs. continuous grazing.

Specifically, the study sites can be characterized as follows:

- The August, 2005 and 2007 data were derived from a high stocking rate rotationally grazed beef pasture (1.69 animal units/acre), a low stocking rate continuously grazed beef pasture (0.44 animal units/acre), and an alfalfa field established in 2005.
- The June, 2006 data were derived from a low stocking rate rotationally grazed dairy pasture, an overgrazed continuous pasture, and a manured row crop site (soybeans).

Background

Fecal coliform bacteria numbers decline after they leave the gut of the animal and are deposited on the landscape in manure. They continue to decline in numbers as long as they stay on the upland landscape. This is due primarily to the fact that they are preyed upon by aerobic organisms. Once they enter the stream, their survival time increases due to reduced predation and cool water temperatures.

Escherichia coli (*E. coli*) is currently used as an indicator organism for overall fecal coliform bacteria levels in surface and ground water. *E. coli* is a facultative anaerobe (prefers low oxygen environments but will survive under aerobic conditions). The warm, moist, food rich, low oxygen conditions found in the gut of warm blooded animals provides an ideal environment for replication of *E. coli* and other fecal coliforms. *E. coli* can multiply after it is outside the gut but this has been shown to be an insignificant consideration in temperate ecosystems. The main pathway by which fecal coliforms reach streams and lakes is through surface water runoff. Movement through the soil profile is far less important. Soil is an effective filter of *E. coli* except in karst or soils with extensive macropores. The ultraviolet (uv) light in solar radiation is a primary cause of inactivation of *E. coli.* However, *E. coli* remains unaffected by UV light at a depth of 0.4" in soil or manure. The result is that inactivation is more related to temperate than ultraviolet exposure in soil. Once below the soil surface, predation by aerobic soil organisms dramatically reduces *E. coli* populations, particularly when soil temperates are warm. Upland landscapes have been shown to become free of fecal pollution within months after fecal inputs are removed.

The UV light in solar radiation is a primary cause of inactivation of *E. coli* in water. This becomes an important factor once the organisms have reached the streams. Stream sediment can act as a transient reservoir for

fecal pollution, absorbing these microbes during periods of low flow (deposition) and releasing them (microbes) during periods of high flow (scour and resuspension). This can lead to false positive readings for agriculturally related fecal coliform when a farm field is not inputting into the stream, but instead the organisms are being resuspended from the stream bottom.

In summary, fecal coliform bacteria that have been deposited on the landscape will be degraded by ultraviolet light or predation as long as they remain in biologically active, aerobic soils. In order to minimize fecal coliform pressure in streams, farming systems need to be designed to maximize the time that rainfall and runoff water are held in the upland landscape. Improved water infiltration on farms can minimize the transportation of *E.coli* to streams. Increased infiltration reduces overland flow of water and lowers the energy available for resuspension of fecal coliform.

Table 1. Steady State Infiltration Rates (in/hr)

2005 (2"/hr rain event) in Root River Watershed	**(in/hr)**
Rotational Pastures *(high stocking rate)* Immediately after Grazing	1.47
Rotational Pastures *(high stocking rate)* 1 Week after Grazing	1.73
Rotational Pastures *(high stocking rate)* 2 Weeks after Grazing	1.50
Continuous Grazing *(low stocking rate)*	1.91
Alfalfa – Establishment Year	1.22
2006 (2"/hr rain event) in Whitewater Watershed	**(in/hr)**
Rotational Grazing	1.97
Continuous Grazing	1.90
Soybean	1.48
2007 (3"/hr rain event) in Root River Watershed	**(in/hr)**
Rotational Pastures *(high stocking rate)* Immediately after Grazing	1.89
Rotational Pastures *(high stocking rate)* 1 Week after Grazing	2.42
Continuous Grazing *(low stocking rate)*	2.61
Alfalfa – Mature Stand	2.53

Table 2. Cumulative Runoff after Applying 2" of Rainfall (Average of Events from 2005 and 2007)

	Gallons
Rotational Pastures *(high stocking rate)* Immediately after Grazing	33
Rotational Pastures *(high stocking rate)* 1 Week after Grazing	13
Continuous Grazing *(low stocking rate)*	8
Alfalfa	21

Methods

Simulated rainfall was used to generate runoff over time for the upland position in the landscape, documenting the onset of overland flow of water for all farming systems. Storm events were applied at 2"/hr in 2005 and 2006 and were raised to a rate of 3"/hr in 2007 to ensure sufficient runoff for water quantity and quality analysis. Runoff was collected from plots 24' long up and down the slope and 45" wide. Plot borders were delineated by tin barriers pounded into the soil.

A timed runoff water sample was taken at the onset of runoff and every ten minutes thereafter until steady-state infiltration was achieved. Steady-state infiltration was determined by measuring three continuous samples without a significant increase in flow of runoff. Rain simulations were replicated two times on each farm in the Root River watershed from 2005 to 2007 and were replicated three times on each farm in the Whitewater watershed in 2006. We documented the change in *E. coli* populations over time in the rotational pasture by performing rainfall events immediately after a controlled grazing event and again one and two weeks later.

The samples were placed on ice and immediately transported to the Minnesota Department of Agriculture Lab where they were analyzed within 24 hours for *E. coli*, ammonia (NH4), nitrate (NO3), ortho phosphorus (a major form of bioavailable phosphorus), total phosphorus (ortho phosphorus plus sediment bound phosphorus), and sediment.

Results

In 2005 and 2007, sufficient natural rainfall and soil profile moisture led to appreciable runoff in the simulated rainfall plots (Figures 1, 6, and 11). Figures 1, 6, and 11 express the rate of runoff over time. Figures 2-5, 7-10, and 12-15

show the cumulative deposition of a specific water quality measurement over time. All grazing systems provided reduced runoff and improved water quality when compared to soybeans or newly established alfalfa.

Runoff and Infiltration Rate. Overall, the grass-based systems had higher infiltration rates than soybeans and the newly established alfalfa. In both years, the rotational (high stocking rate) pasture had dramatically more runoff than the continuous (low stocking rate) pasture (Figures 1, 6, and 11) immediately after removal of animal pressure.

The infiltration capacity of the rotational pasture recovered within 2 weeks to nearly that of the continuous pasture (Table 1). This was observed in both 2005 and 2007. The high stocking rate in the rotational system was most problematic immediately after removal of animals both with respect to runoff and water quality. Under dry antecedent (background) soil moisture conditions in 2005 and 2006, the farming systems with the highest steady state infiltration rate also had the longest time to the onset of runoff. The highest cumulative runoff per plot was 33 gallons in rotational grazing immediately after grazing. The lowest was 8 gallons in continuous grazing (Table 2). The cumulative runoff and infiltration rate in the rotational system did not fully recover to the low level found in the continuous pasture.

A high rate of runoff in alfalfa occurred in the establishment year. Cumulative runoff in establishment year alfalfa was similar to rotational grazing immediately after grazing in 2005. After the establishment year, alfalfa had little or no runoff. There continued to be sites of water ponding in the alfalfa in 2006 but did not result in overland flow. In 2007, alfalfa had a high infiltration rate equal to that of continuous grazing.

Water Quality. There was a dramatic reduction in overland transport of most water quality measurements (sediment, total phosphorus, ortho phosphorus, NO3, and NH4) under both rotational and continuous pastures compared to soybean production (Tables 3-5). The exception was *E. coli* which was released in significant quantities by manured row crop land, continuous grazing, and rotational grazing once overland flow commenced. Rotational pasture did not improve water quality beyond that found in continuous pasture.

E. coli. Early in the storm event, *E. coli* was held in check in pastures by the high water infiltration rate provided by the sod. An intense short duration event of one half hour showed little input from the pasture to the stream and much less than from soybean ground. An intense event of one hour found pastures contributing *E. coli* loading similar to row crop ground.

E. coli loading was consistently lower in continuous pastures than in rotational pastures in both watersheds (Figures 2, 7, and 12). This result holds true across both rotational systems investigated including high and low stocking rate systems. *E. coli* loading was highest in rotational grazing immediately after grazing, manured alfalfa, and manured row crops.

In several rain simulation plots, we documented the presence and absence of cow pies and the distance water had to travel from the cow pie to the water catchment. The results showed that the cow pies were the primary source of *E. coli* measured in the runoff, not the *E. coli* residing in the surrounding grass (Table 6, Figures 16 and 17).

Conclusions

This study provides continued support for maintaining acreage in pasture. We have shown the potential for pasture systems to reduce runoff and contribute dramatically to water quality improvements in sensitive agricultural watersheds. All pasture and hay systems provided a dramatic water quality benefit compared to row crops and newly established alfalfa. The pastures in this study slowed the rate of runoff, increased water infiltration, and reduced the transport of sediment, phosphorus, and nitrogen. However, *E. coli* appears to be a special case and is released in significant quantities by manured row crop land, continuous grazing, and rotational grazing systems once overland flow commences. Rotational pastures with high animal numbers did not improve water quality (including *E. coli* loading) beyond that of continuous pastures.

The high relative contribution of the freshly deposited cow pies to *E. coli* in runoff provides support for timed grazing in riparian areas when least prone to runoff. Flash grazing, strategically timed in midsummer, can maximize forage harvest and minimize negative water quality impacts. Grazing immediately adjacent to the stream in midsummer should occur when there is sufficient biomass, sufficient room in the soil profile for water and warm air temperatures with high evapotranspiration. Further study is needed to understand how greater storm intensities will affect the release of *E. coli* from pastures.

This study has shown that runoff and water quality can be manipulated by management through increasing the infiltration capacity of these silt loam soils. We have options: optimizing stocking rates; improving timing in rotational pastures; and overall support for grass-based systems.

Table 3a. Runoff Water Quality on Farms in Root River Watershed: Cumulative Deposition 60 min into a 2″/hr Storm Event (August, 2005)

Farming System	Sediment	Total P	Ortho P	NO3	NH4	*E. coli*
	- - - (lbs/A) - - -					(counts/A)
Rotational Grazing *(high stocking rate)* Immediately after Grazing	8.01	0.08	0.04	0.06	0.15	1.42E+10
Rotational Grazing *(high stocking rate)* 1 Week after Grazing	0.21	0	0	0	0	1.22E+08
Rotational Grazing *(high stocking rate)* 2 Weeks after Grazing	1.58	0.02	0.02	0.01	0.01	6.92E+08
Continuous Grazing	0	0	0	0	0	0
Alfalfa – Establishment Year	406.26	0.67	0.09	0.79	0.11	2.75E+10

Table 3b. Reduction in Pollutant Loading by Pasture Systems in Root River Watershed 60 min into a 2″/hr Storm Event* (August, 2005)

Farming System	Sediment	Total P	Ortho P	NO3	NH4	*E. coli*
	- - - - - (% reduction) - - - - -					
Alfalfa – Establishment Year	0	0	0	0	0	0
Rotational Grazing *(high stocking rate)* Immediately after Grazing	98.03	87.76	52.30	91.96	-45.56	48.53
Rotational Grazing *(high stocking rate)* 1 Week after Grazing	99.95	99.50	97.39	100	99.17	99.56
Rotational Grazing *(high stocking rate)* 2 Weeks after Grazing	99.61	96.64	81.08	98.44	86.57	97.49
Continuous Grazing *(low stocking rate)*	100	100	100	100	100	100

**Presented as % reduction compared to alfalfa water quality parameter yield.*

Table 4a. Runoff Water Quality on Farms in Whitewater Watershed: Cumulative Deposition 60 min into a 2″/hr Storm Event (June, 2006)

Farming System	Sediment	Total P	Ortho P	NO3	NH4	*E. coli*
	- - - (lbs/A) - - -					(counts/A)
Rotational Grazing	0.67	0	0	0	0	6.22E+06
Continuous Grazing	1.00	0	0	0.02	0	2.27E+06
Soybeans	330.35	0.40	0.02	0.08	0.02	3.91E+06

Table 4b. Reduction in Pollutant Loading by Pasture Systems in Whitewater Watershed 60 min into a 2″/hr Storm Event* (June, 2006)

Farming System	Sediment	Total P	Ortho P	NO3	NH4	*E. coli*
	- - - - - (% reduction) - - - - -					
Soybeans	0	0	0	0	0	0
Rotational Grazing	99.8	99.25	95.2	98.8	98.1	159.1
Continuous Grazing	99.7	99	90.5	80.9	92.4	58.1

**Presented as % reduction compared to soybean water quality parameter yield.*

Table 5a. Runoff Water Quality on Farms in Root River Watershed: Cumulative Deposition 40 min into a 3″/hr Storm Event (September, 2007)

Farming System	Sediment	Total P	Ortho P	NO3*	NH4	*E. coli*
	- - - (lbs/A) - - -					(counts/A)
Rotational Grazing *(high stocking rate)* Immediately after Grazing	96.12	0.22	0.03	ND	0.09	3.63E+10
Rotational Grazing *(high stocking rate)* 1 Week after Grazing	13.84	0.05	0.02	ND	0.01	2.12E+08
Continuous Grazing *(low stocking rate)*	41.71	0.08	0.01	ND	0.01	2.32E+09
Alfalfa – Mature Stand	22.96	0.04	0.01	ND	0	8.66E+05

**Below detection limit.*

Table 5b. Reduction in Pollutant Loading by Pasture Systems in Root River Watershed after 40 minutes into a 3″/hr Storm Event[1] (September, 2007)

Farming System	Sediment	Total P	Ortho P	NO3[2]	NH4	*E. coli*
	- - - - - (% reduction) - - - - -					
Rotational Grazing *(high stocking rate)* Immediately after Grazing	0	0	0	ND	0	0
Rotational Grazing *(high stocking rate)* 1 Week after Grazing	85.6	78.7	38.24	ND	87.5	99.42
Continuous Grazing *(low stocking rate)*	56.61	64.81	82.35	ND	85.23	93.61
Alfalfa – Mature Stand	76.11	81.94	79.41	ND	96.59	100

[1]Presented as % reduction compared to rotational grazing (immediately after grazing) water quality parameter yield.
[2]Below detection limit.

Table 6. Relative Contribution of Cow Pies and Ambient Grass to *E. coli* Loading in Selected Rain Simulation Plots

	Ambient Grass (counts/A)	Cow Pie in Grass (counts/A)	% Contribution from Cow Pies
Rotational Grazing (high stocking rate) Immediately after Grazing (2005)	2.83E+09	4.41E+10	93.97
Continuous Grazing (2006)	1.55E+08	3.90E+08	71.57

References

Guan, T.Y., and R.A. Holley. 2003. Pathogen Survival in Swine Manure Environments and Transmission of Human Enteric Illness – A Review. J. Environ. Qual. 32:383-392.

Kudva, I.T., K. Blanch, and C.J. Hovde. 1998. Analysis of *Escherichia coli* 0157:H7 Survival in Ovine or Bovine Manure and Manure Slurry. Applied and Env. Microbiology. 64:3166-3174.

Mubiru, D.N., M.S. Coyne, and J.H. Grove. 2000. Mortality of *E. coli* 0157:H7 in Two Soils with Different Physical and Chemical Properties. J. Environ. Qual. 29:1821-1825.

Tian, Y.Q., P. Gong, J.D. Radke, and J. Scarborough. 2002. Spatial and Temporal Modeling of Microbial Contaminants on Grazing Farmlands. J. Environ. Qual. 31:860-869.

Wang, G., and M.P. Doyle. 1998. Survival of Enterohemorrhagic *Escherichia coli* 0157:H7 in Water. J. Food Production. 61:662-667.

Wang, G., T. Zhao, and M.P. Doyle. 1996. Fate of Enterohemorrhagic *Escherichia coli* 0157:H7 in Bovine Feces. Applied and Env. Microbiology. 62:2567-2570.

Winfield, M.D., and E.A. Groisman. 2003. Mini-review: Role of Non-host Environments in the Lifestyle of Salmonella and *Escherichia coli*. Applied and Env. Microbiology. 69:3687-3694.

Figure 1. Effect of Pasture and Hay Systems on Runoff from Simulated 2"/hr Storm (August, 2005)

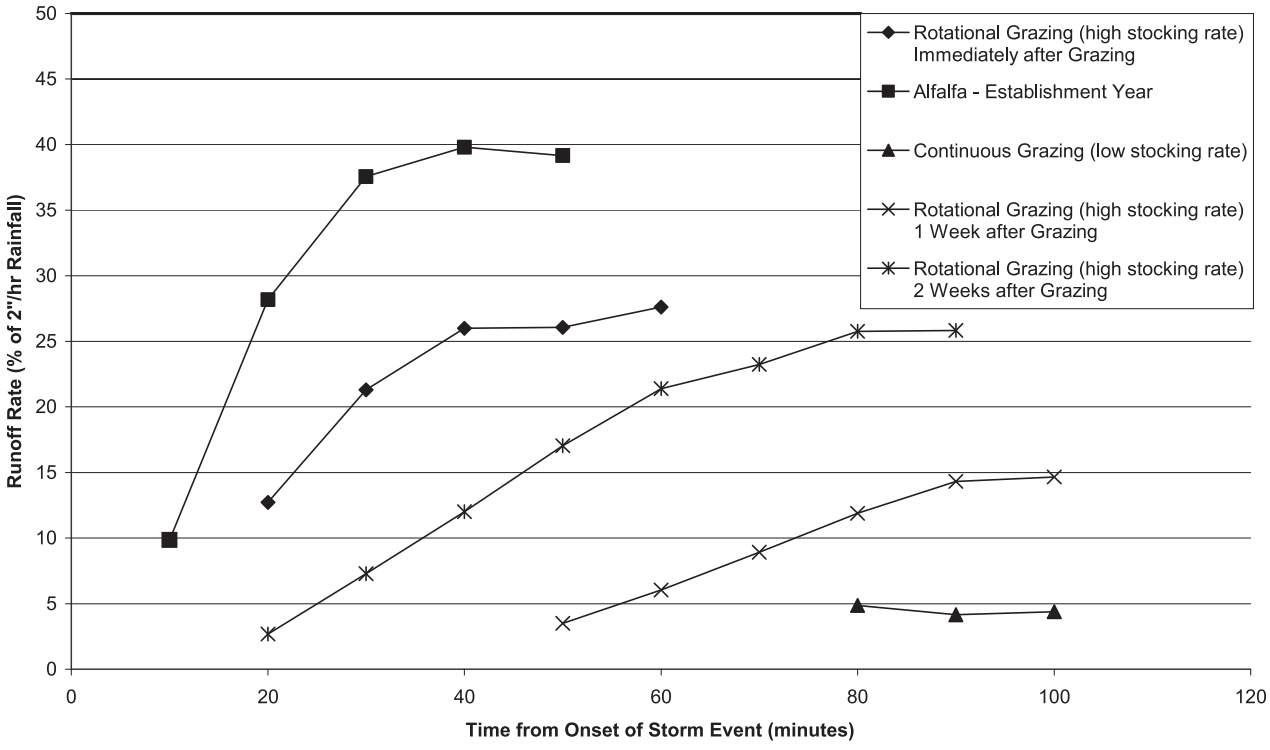


Figure 2. Cumulative *E. Coli* Removal from Pasture and Hay Systems During a Simulated 2"/hr Storm (August, 2005)

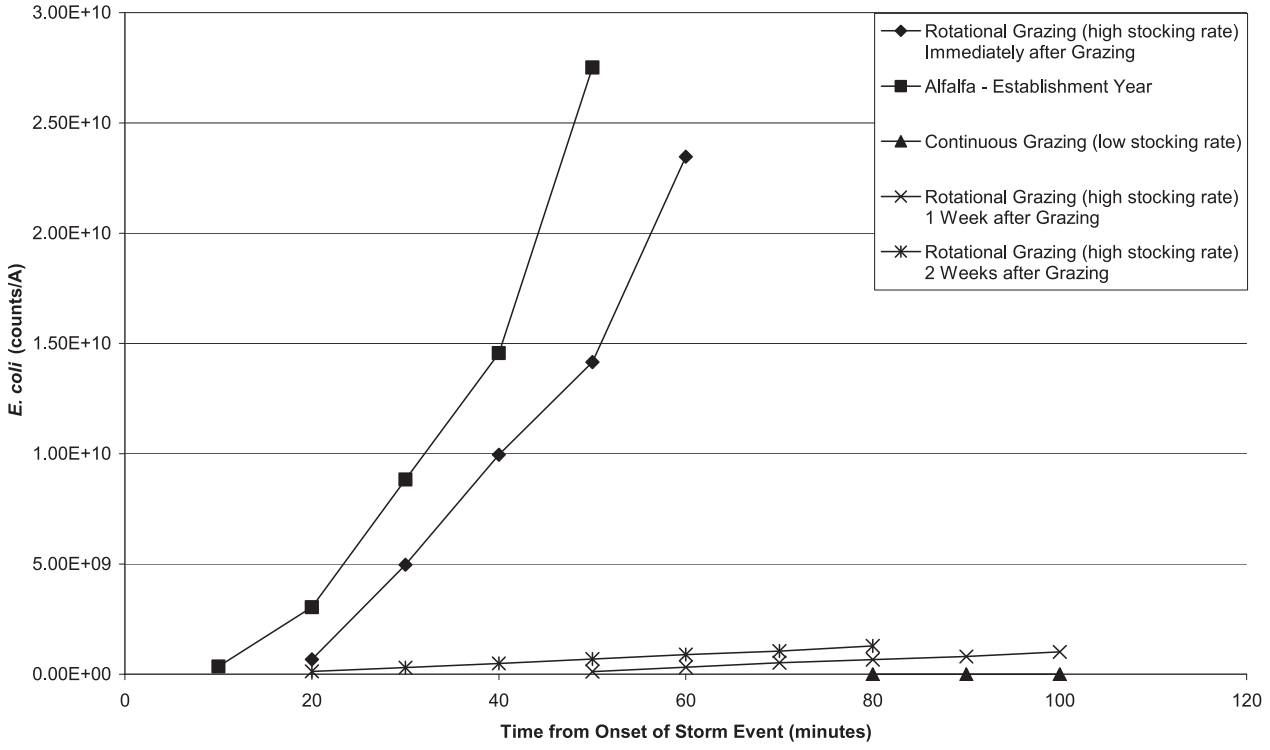


Figure 3. Cumulative Sediment Removal from Pasture and Hay Systems During a Simulated 2"/hr Storm (August, 2005)

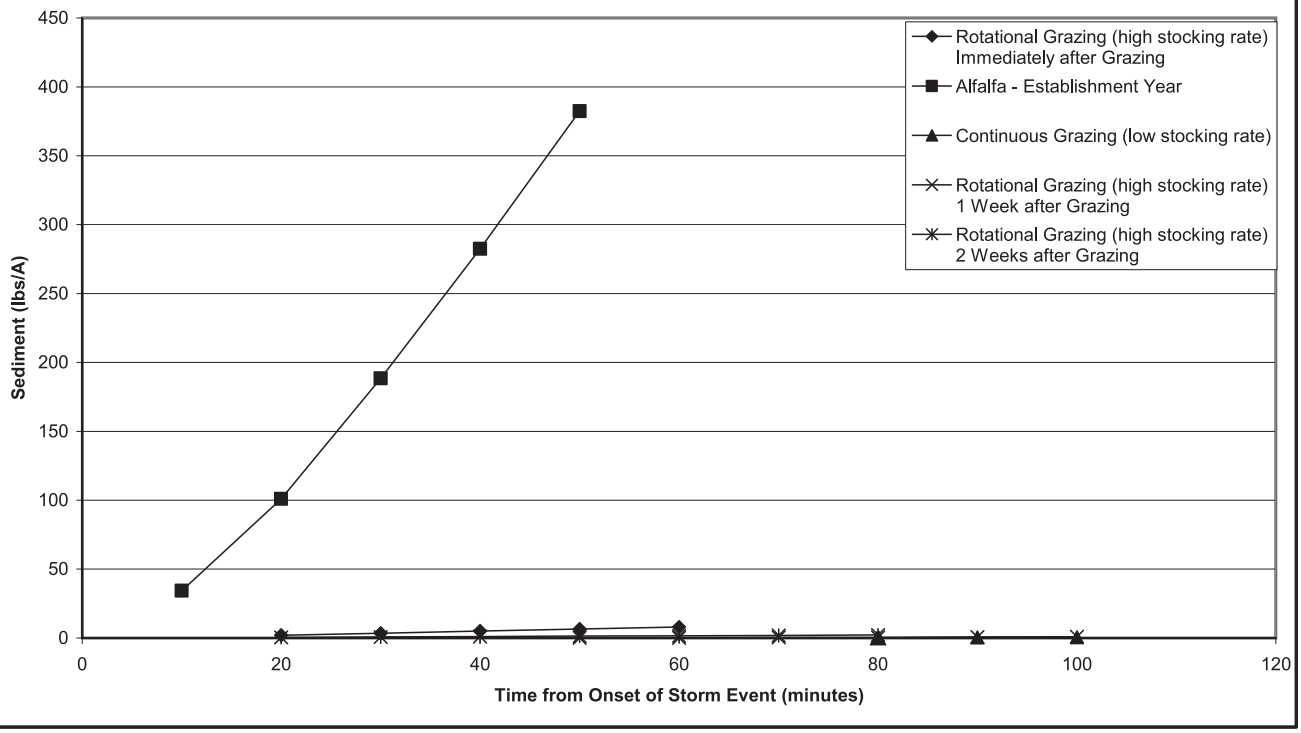


Figure 4. Cumulative Total Phosphorus Removal from Pasture and Hay Systems During a Simulated 2"/hr Storm (August, 2005)

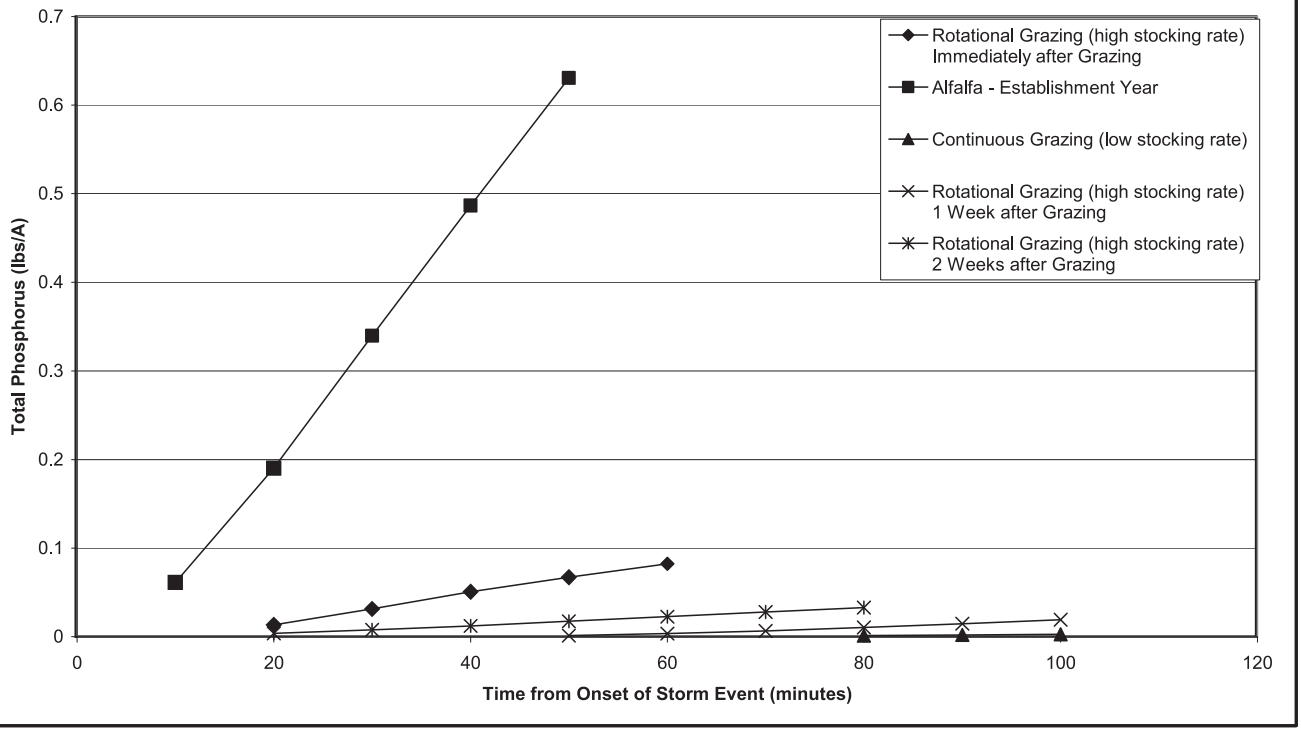


Figure 5. Cumulative Ortho Phosphorus Removal from Pasture and Hay Systems During a Simulated 2"/hr Storm (August, 2005)

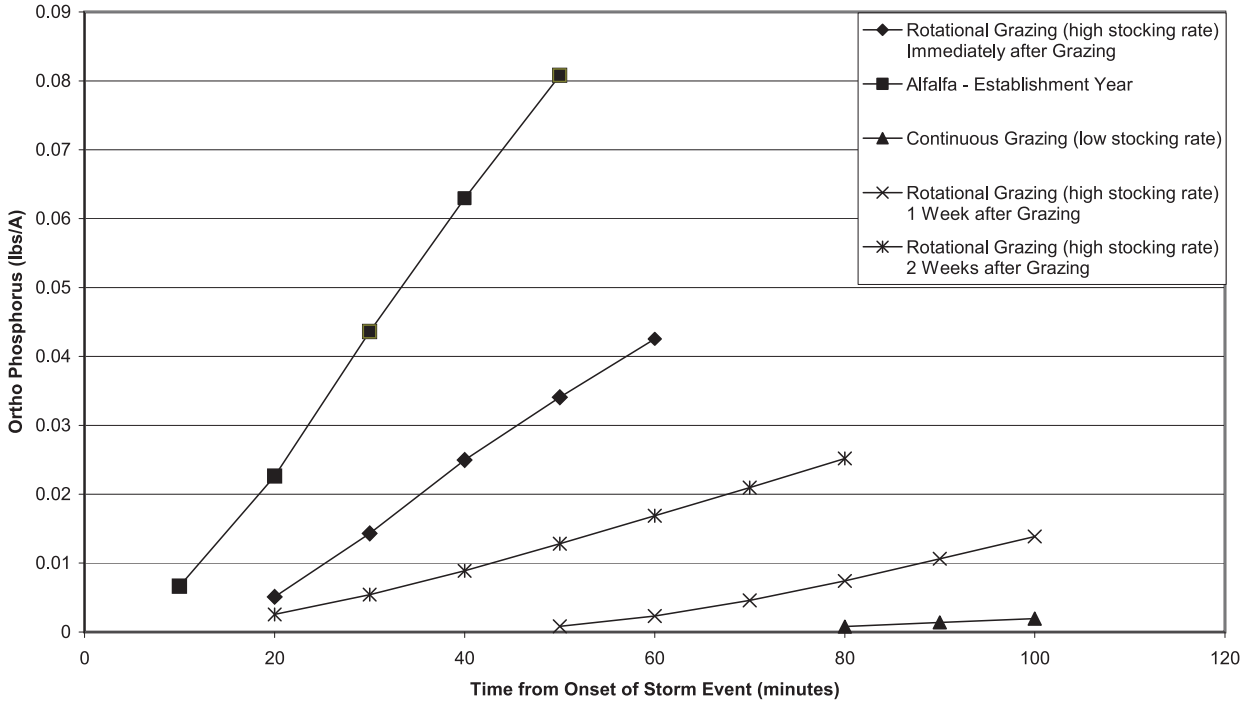


Figure 6. Effect of Pasture and Row Crop Systems on Runoff from Simulated 2"/hr Storm (June, 2006)

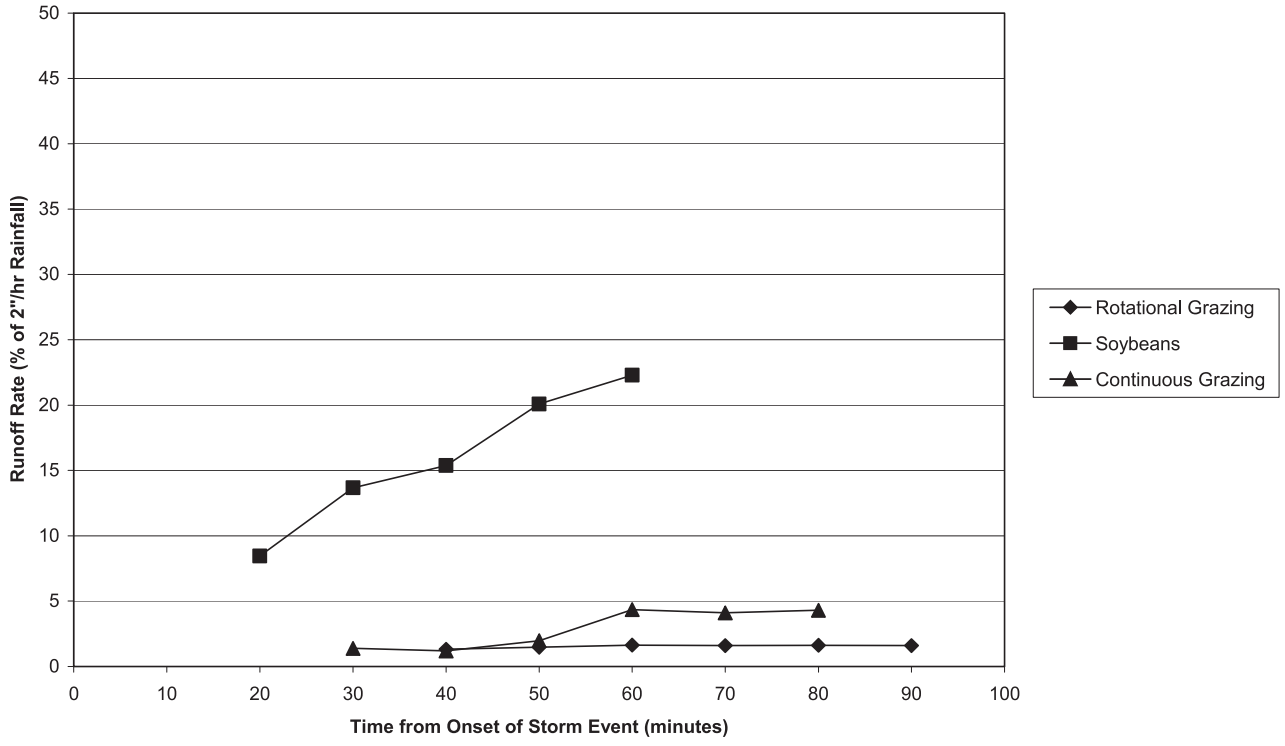


Figure 7. Cumulative *E. Coli* Removal from Pasture and Row Crop Systems During a Simulated 2"/hr Storm (June, 2006)

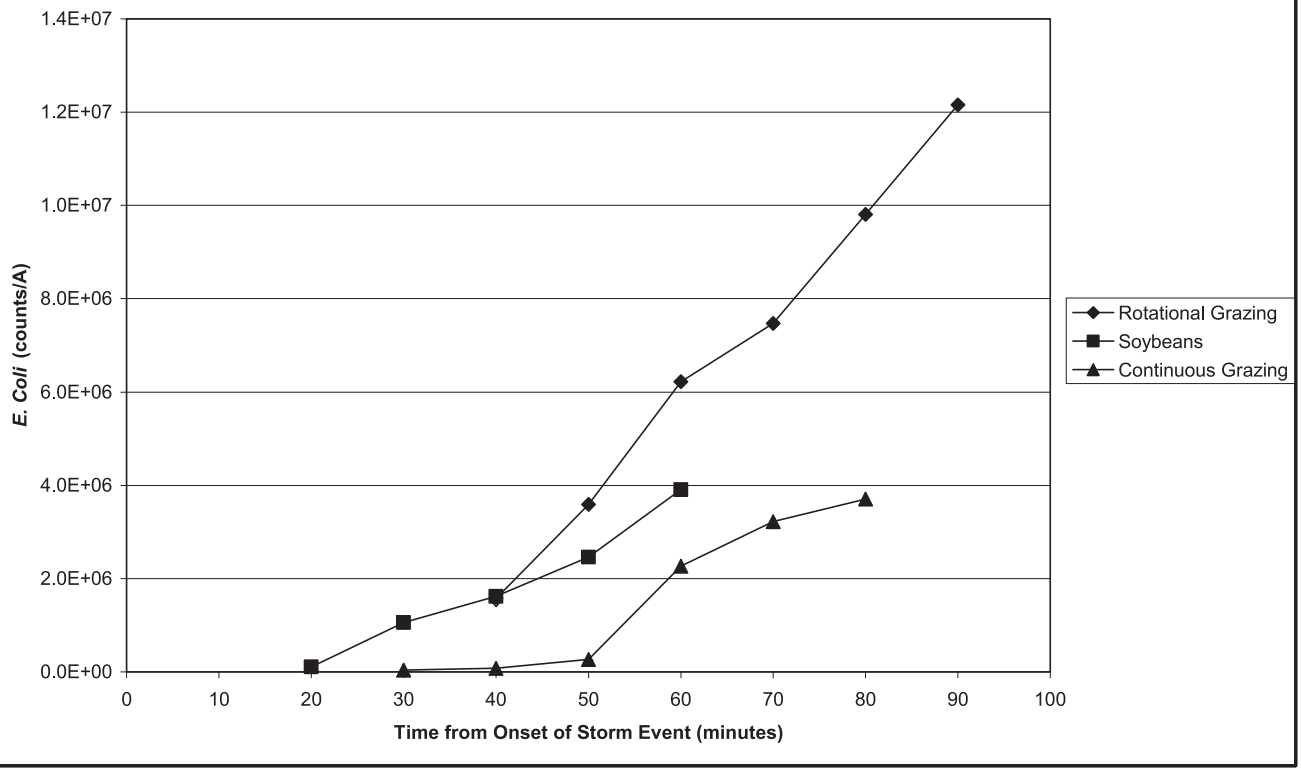


Figure 8. Cumulative Sediment Removal Pasture and Row Crop Systems During a Simulated 2"/hr Storm (June, 2006)

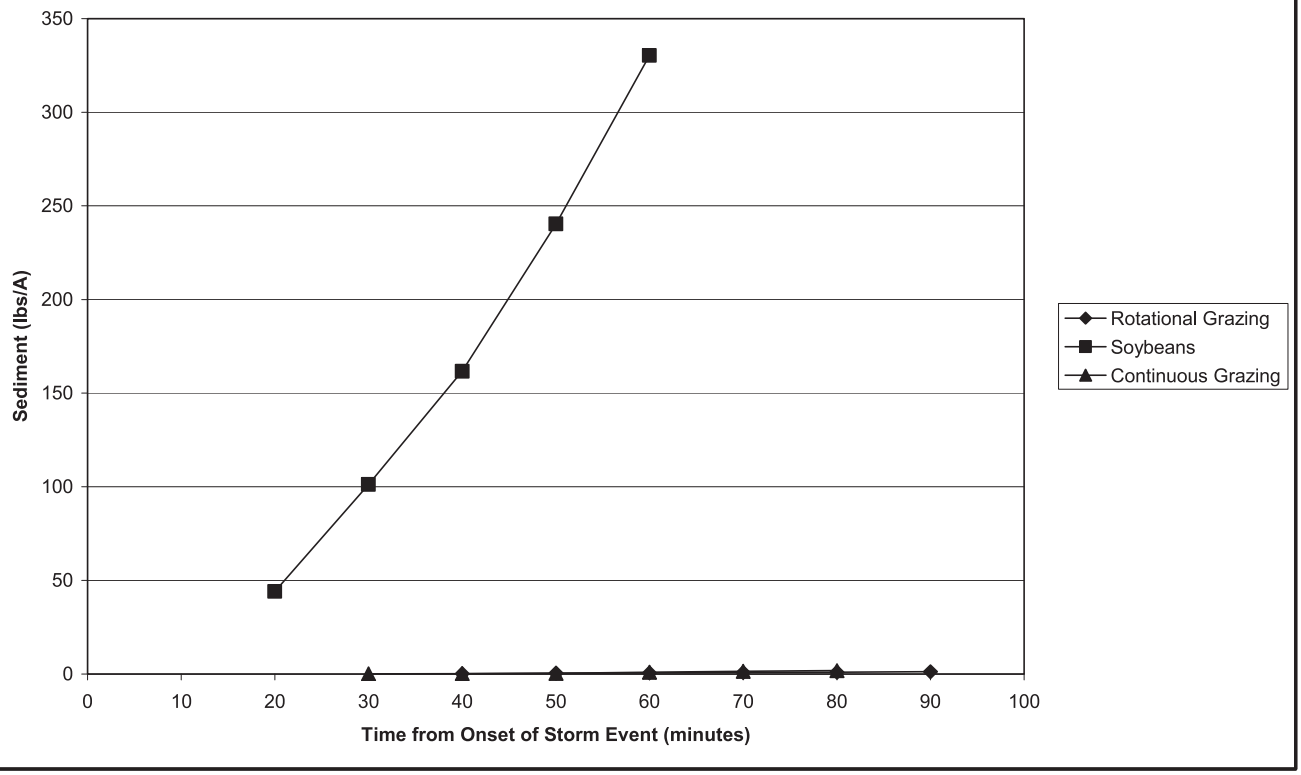


Figure 9. Cumulative Total Phosphorus Removal from Pasture and Row Crop Systems During a Simulated 2"/hr Storm (June, 2006)

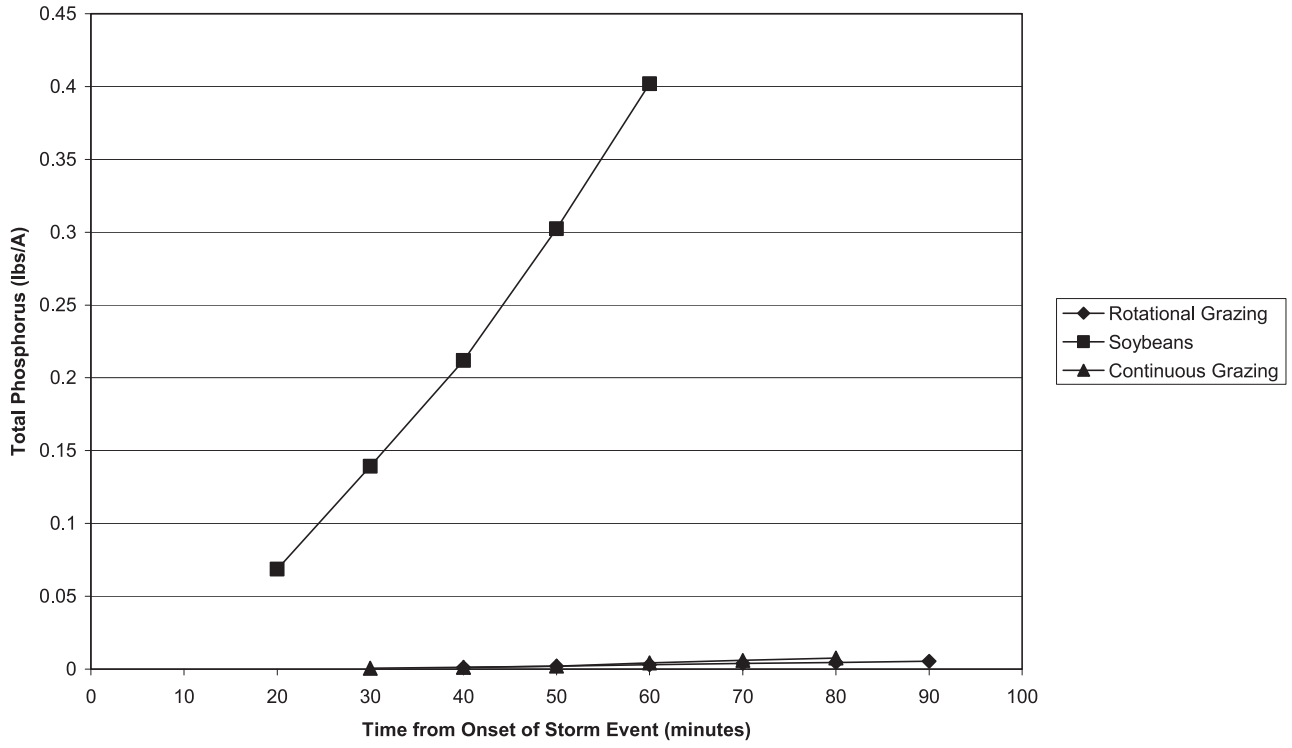


Figure 10. Cumulative Ortho Phosphorus Removal from Pasture and Row Crop Systems During a Simulated 2"/hr Storm (June, 2006)

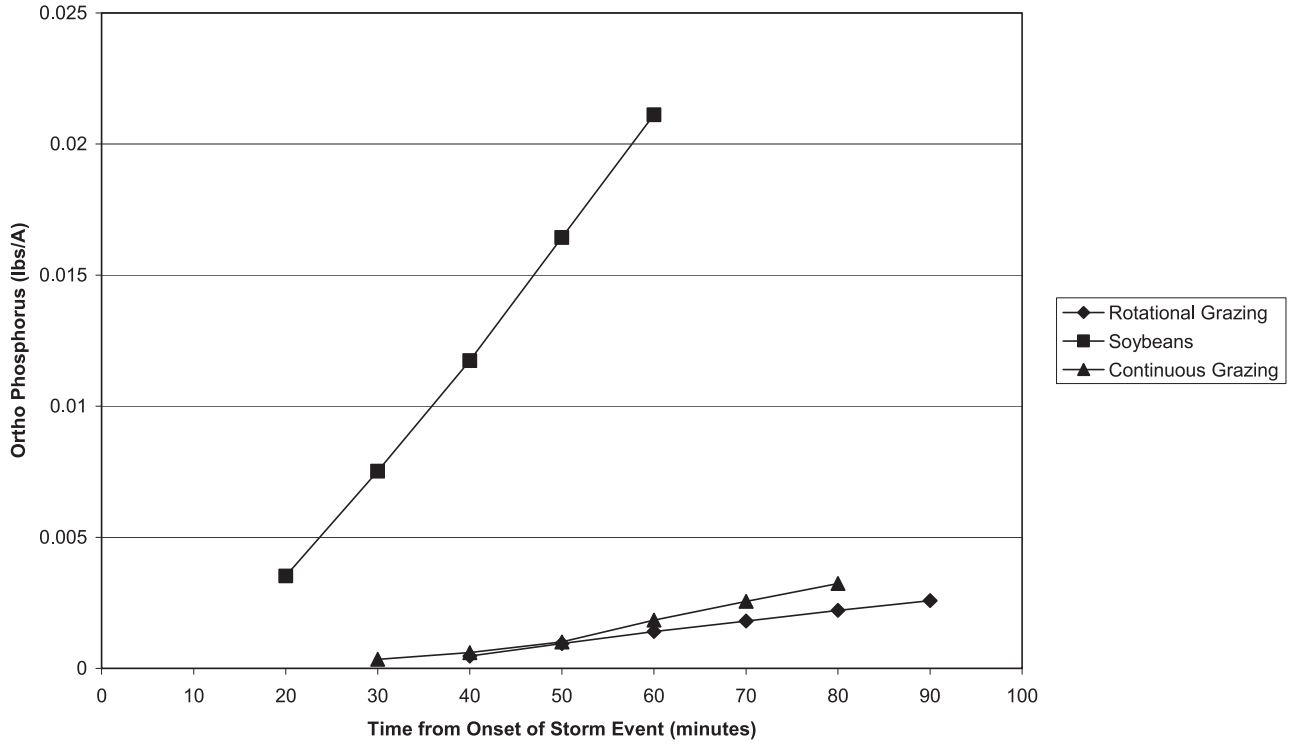


Figure 11. Effect of Pasture and Hay Systems on Runoff from Simulated 3"/hr Storm (September, 2007)

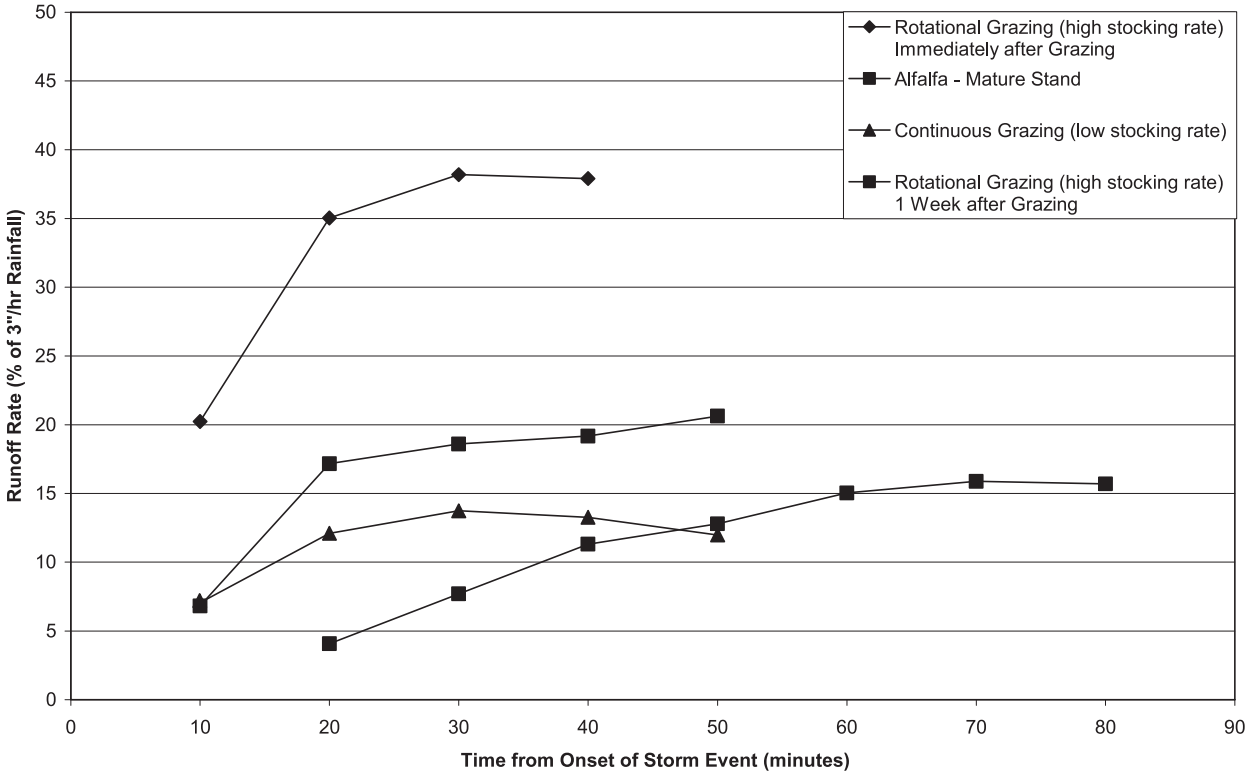


Figure 12. Cumulative *E. Coli* Removal from Pasture and Hay Systems During a Simulated 3"/hr Storm (September, 2007)

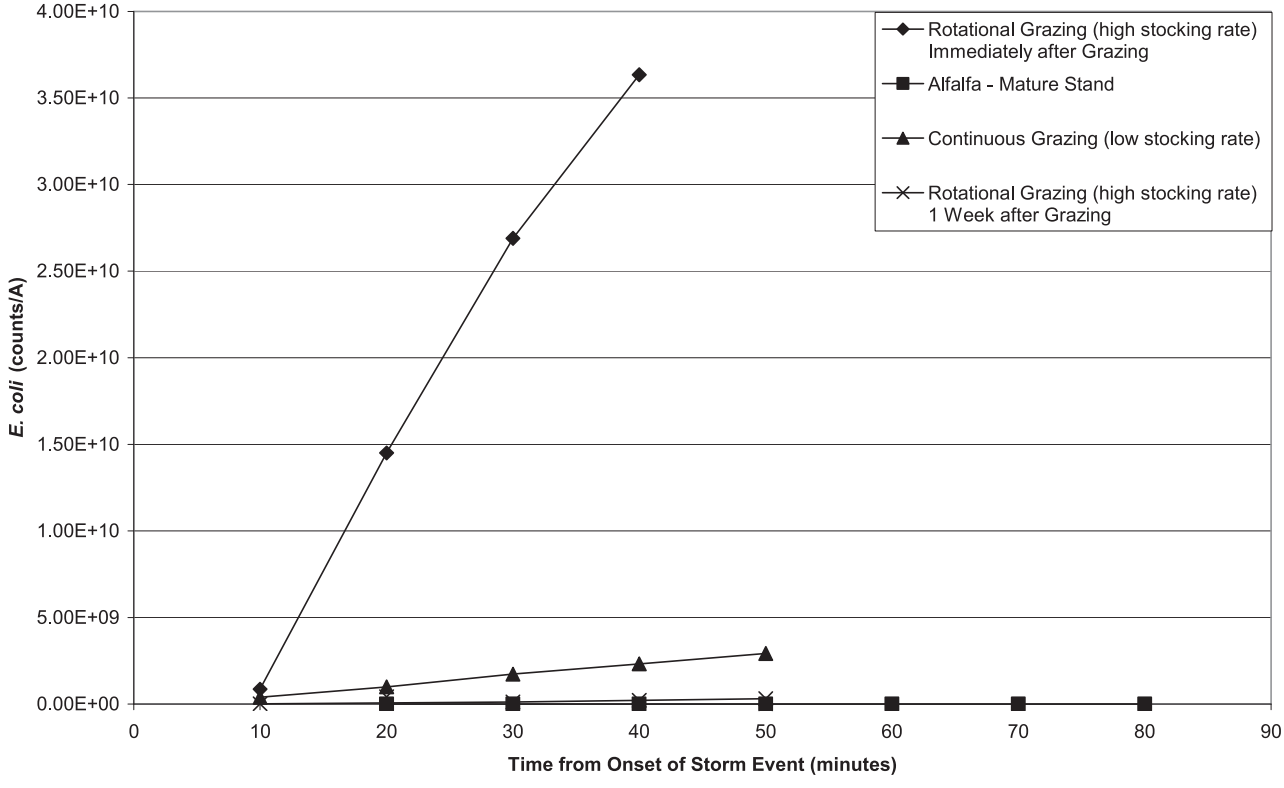


Figure 13. Cumulative Sediment Removal from Pasture and Hay Systems During a Simulated 3"/hr Storm (September, 2007)

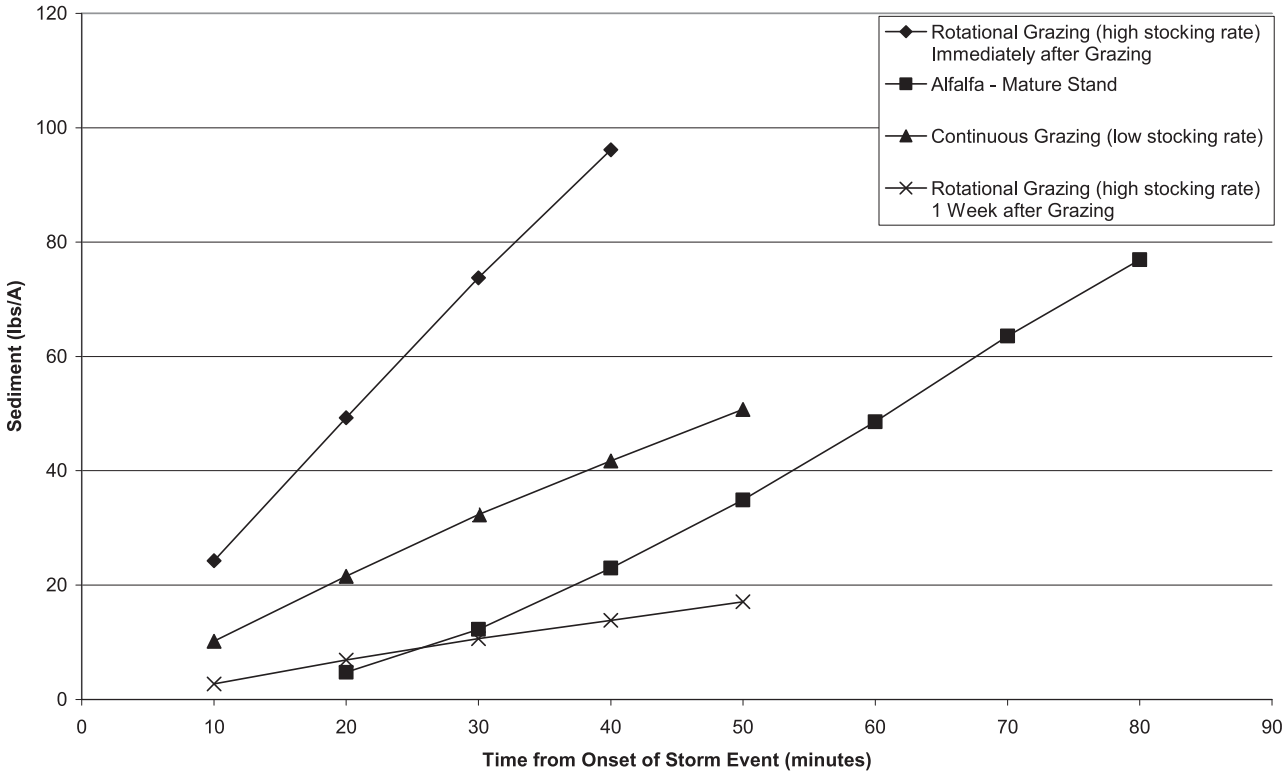


Figure 14. Cumulative Total Phosphorus Removal from Pasture and Hay Systems During a Simulated 3"/hr Storm (September, 2007)

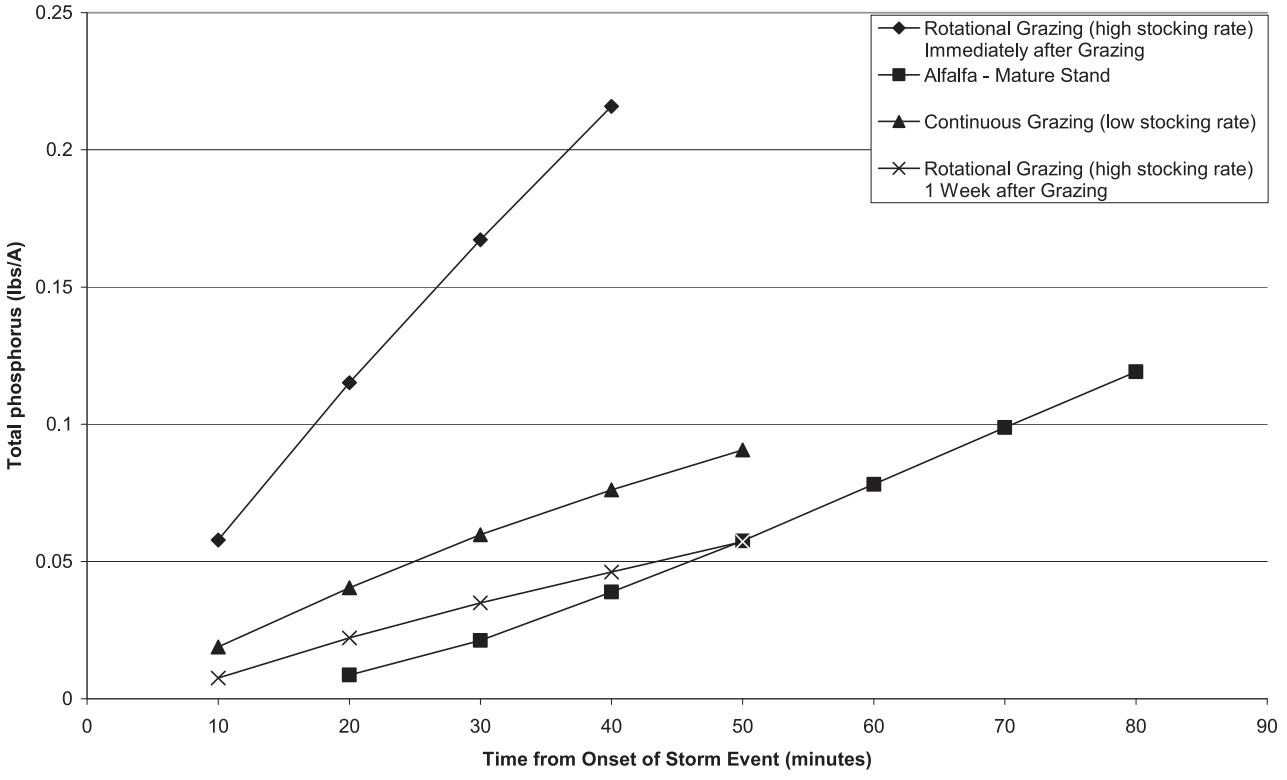


Figure 15. Cumulative Ortho Phosphorus Removal from Pasture and Hay Systems During a Simulated 3"/hr Storm (September, 2007)

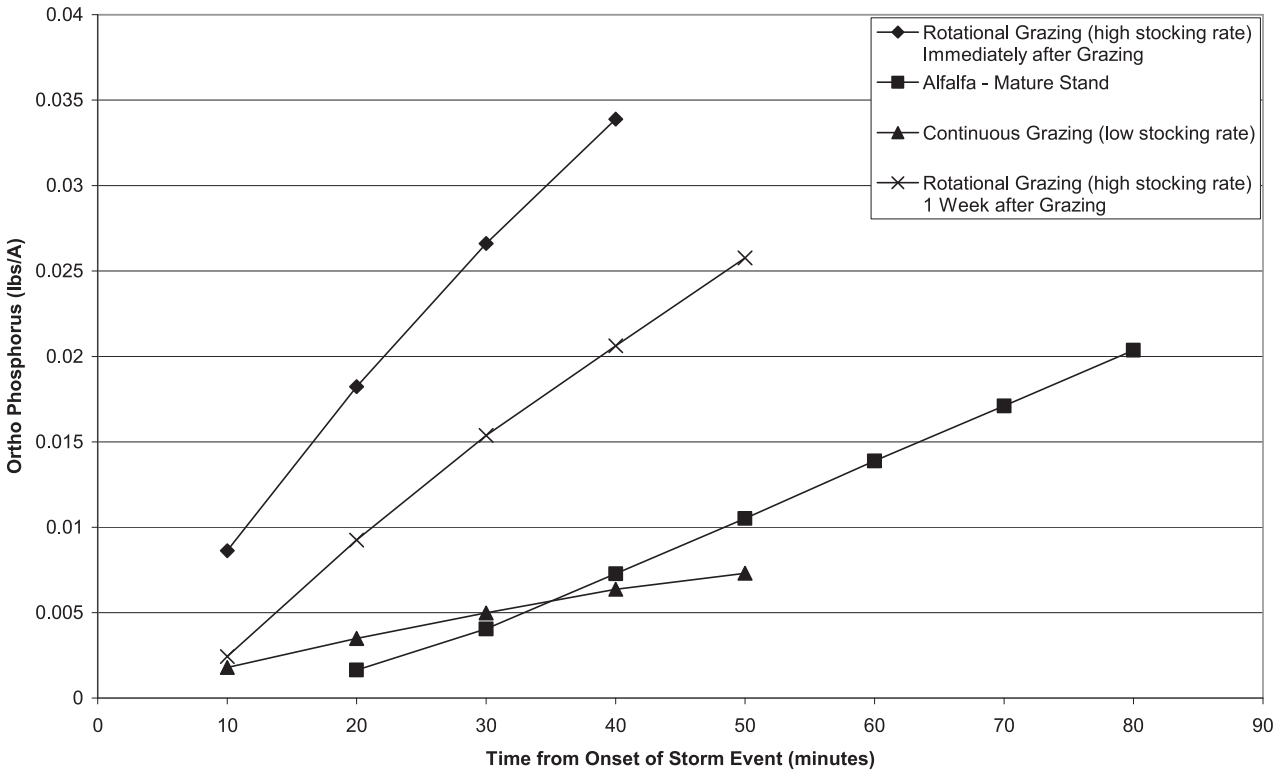


Figure 16. Effect of Cow Pies on *E. coli* in Runoff Water in Rotational Pasture (August, 2005)

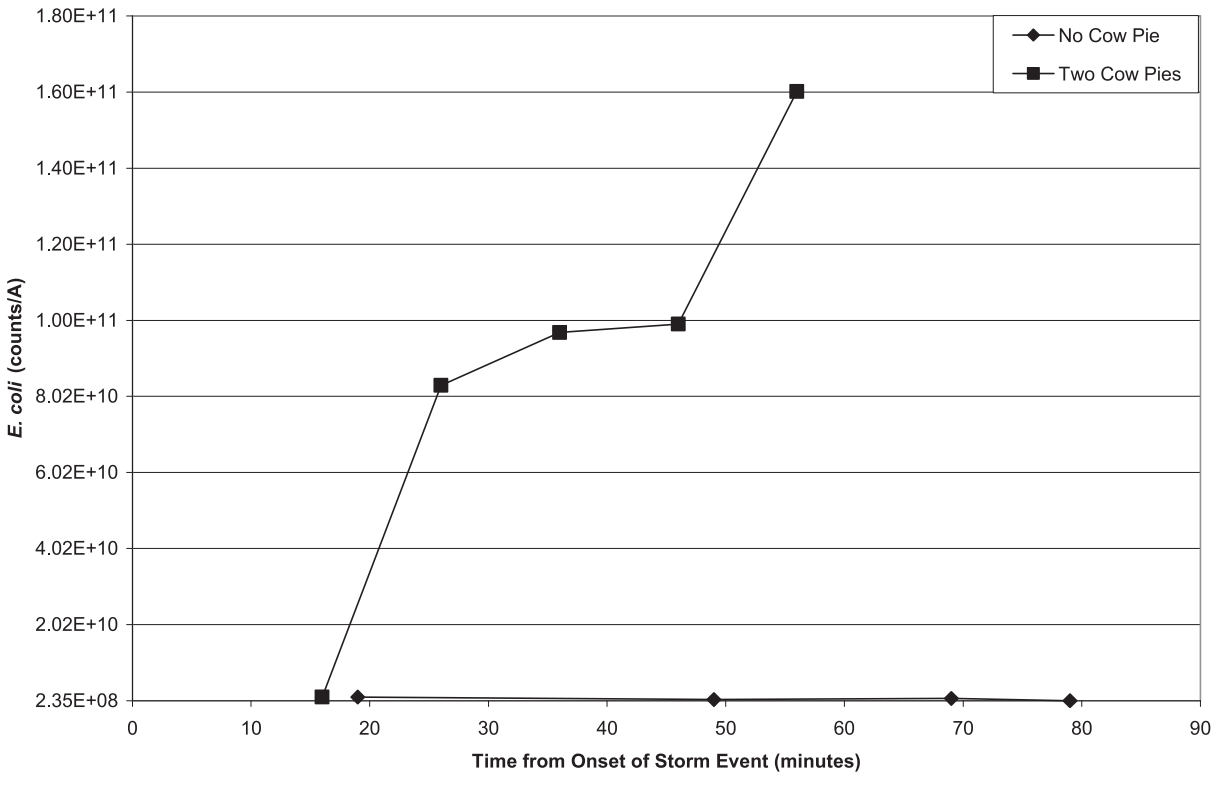
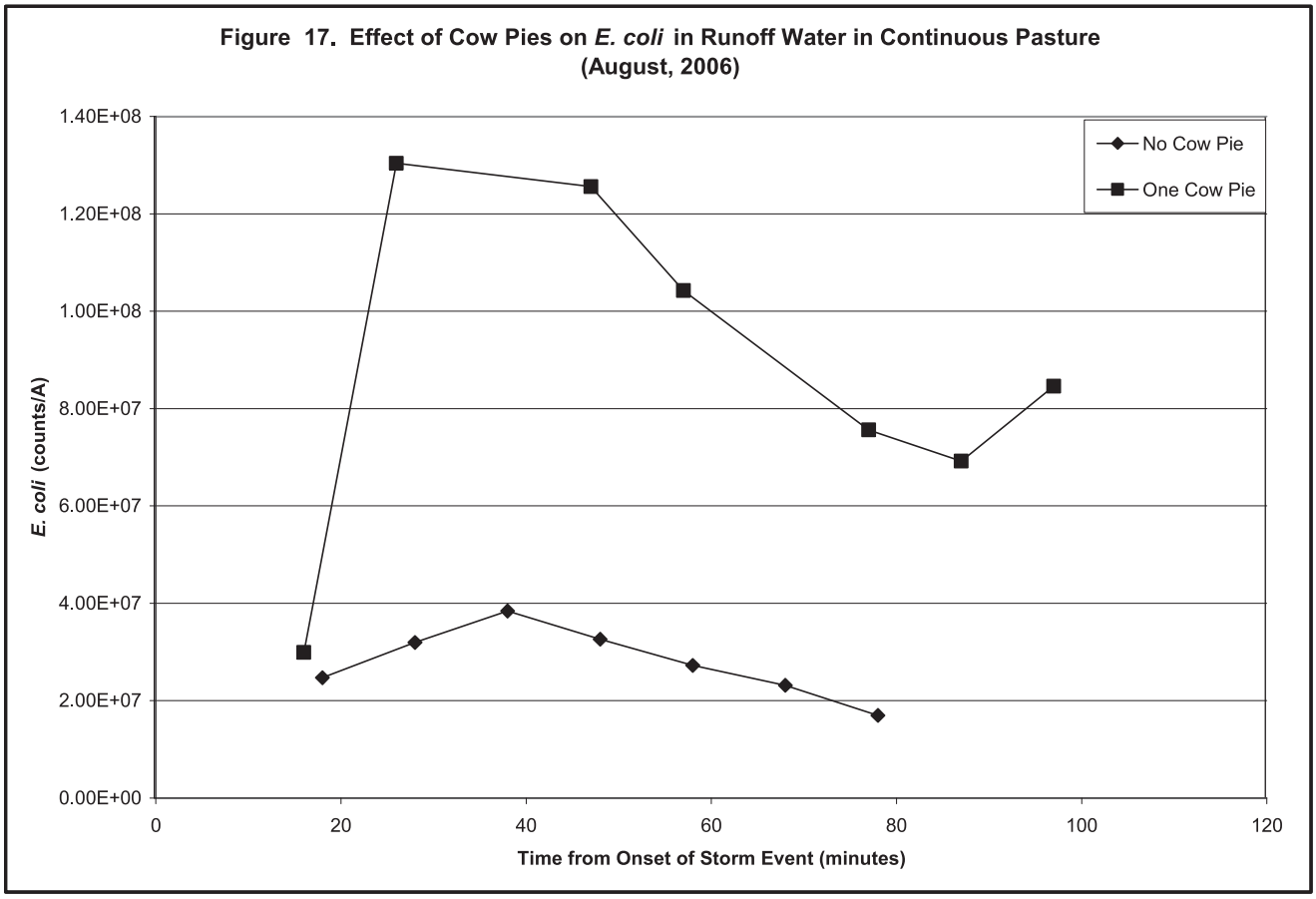


Figure 17. Effect of Cow Pies on *E. coli* in Runoff Water in Continuous Pasture (August, 2006)



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Integrated Pest Management (IPM) Program

Integrated Pest Management (IPM) Program

The term "Integrated Pest Management" or "IPM" is used to describe a set of cultural, physical, and biological management practices coupled with the cautious use of pesticides to control unwanted "pests" including insects, diseases, weeds, and/or wildlife problems. Integrated pest management uses knowledge of the pest and its life cycle to determine the most appropriate management practices to keep pests and/or the damage they cause at or below an acceptable level. IPM is not a repetitious method but a dynamic decision-making process that requires the user to look at the situation before taking action. IPM can have many positive benefits including reduced pesticide resistance, less disruption of natural biological control, less hazardous to human health, and in the long-term, most likely to produce effective pest suppression and be cost-effective.

FRUIT AND VEGETABLE IPM

The *Minnesota Fruit and Vegetable IPM News* is produced in cooperation with Dr. William Hutchison at the University of Minnesota (U of MN), Entomology Department. Partial funding for the newsletter was provided through partnership agreements with the Minnesota Fruit and Vegetable Growers Association and the United States Department of Agriculture – Risk Management Agency (RMA).

The Newsletter's primary aim is to alert growers and processors about pest outbreaks, and provide timely management recommendations that also reduce environmental and economic risks to growers. When relevant, we also provide newsworthy topics related to biotechnology and specialty crops, emerging pests, invasive species, impacts of the Food Quality Protection Act (FQPA), produce marketing, and articles of broad interest concerning the benefits of IPM and sustainable agricultural practices. The newsletter is published May through August and is posted on the U of MN and Minnesota Department of Agriculture (MDA) web sites on Fridays.

The MDA has produced four insect manuals including: *Field Guide for Identification of Pest Insects, Diseases, and Beneficial Organisms in MN Apple Orchard; Integrated Pest Management Manual for MN Apple Orchard; Field Guide for Identification of Pest Insects, Diseases, and Beneficial Organisms in MN Strawberry Fields; and, Integrated Pest Management Manual for MN Strawberry Fields.*

HOMEOWNER'S IPM

The MDA developed and is conducting a state-wide workshop for homeowners titled "Managing Pests in Landscapes and Homes." The project is funded by the US EPA, Region 5, and is based upon the MDA book "Managing Pests in Landscapes and Homes: A Homeowner's Guide to IPM in MN."

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IPM newsletter web site:
www.mda.state.mn.us/plants/pestmanagement/ipm/ipmnews.htm

IPM manuals and other fruit IPM information web site: www.mda.state.mn.us/plants/pestmanagement/ipm/fandvipm.htm
Homeowner's Guide web site: www.mda.state.mn.us/plants/pestmanagement/ipm/homeipmguide.htm

Insect Biological Control Program

We are in the process of establishing and rearing soybean aphid parasitoid colonies, and eventually mass rearing them for the first implementation of biological control of soybean aphid with these parasitoids in the U.S. *Binodoxys communis* is the first species approved for release from the Minnesota Agricultural Experiment Station/Minnesota Department of Agriculture High Security

Containment Facility ("Quarantine Facility") located at the University of Minnesota, St. Paul campus. The first experimental releases of the parasitoids occurred in 2007.

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Weed IPM Program

The MDA Weed IPM program (WIPM) was formed to assist landowners and managers in developing practical IPM strategies for dealing with nuisance plant species throughout Minnesota. The WIPM is responsible for the statewide coordination and implementation of the following activities:

1. Establishing and evaluating biological control for terrestrial weed species.

2. Developing procedures for mass rearing potential weed biological control agents.

3. Conducting and coordinating annual surveys for nuisance and invasive weed species.

4. Developing research and demonstration projects to evaluate weed IPM methodologies.

5. Providing education, training, and outreach for professional and private land managers.

The WIPM has active biological control programs for leafy spurge and spotted knapweed. These programs are cooperator-based and depend upon the commitment of local entities to monitor for weed infestations, request biological control agents for releases in their area, and monitor sites following releases to determine establishment of agents and biological control success. The WIPM coordinates statewide collection and redistribution efforts for biological control agents and annually collects cooperator information pertaining to agent releases and site monitoring data that aids in tracking the distribution and impacts of these bioagents over time.

The WIPM is currently involved in the development of biological control for common tansy, an invasive weed of upland terrestrial landscapes. Exploration for potential biological control agents will occur in tansy's native range by European partners. This project is an international effort driven by a consortium of U.S. and Canadian agencies and organizations. Coordination of funding and dissemination of information will occur through the Alberta Invasive Plant Council in Canada and the MDA's WIPM. Research activities include overseas exploration and host-specificity testing of potential bioagents.

The WIPM is also involved with several weed biological control agent rearing projects in 2008. Using our state-of-the-art laboratory facility located in St. Paul, work continues with three projects:

1. A mass rearing protocol for the spotted knapweed biocontrol agent *Cyphocleonus achates* is being investigated to determine if these weevils can be reared on an artificial diet. Initial diet protocols have been provided to the MDA under a cooperative agreement with the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service, Center for Plant Health Science and Technology. Since the diet was initially created to rear a purple loosestrife biocontrol weevil, *Hylobius transversovittatus*, USDA is making diet modifications to better suit the needs of *C. achates*. If successful, lab-reared *C. achates* will supplement our field-collected populations, increasing total numbers of the weevil in the field.

2. *Hylobius transversovittatus*, a purple loosestrife biocontrol agent, is being reared using the same protocols used to rear *Cyphocleonus achates*. We will be providing approximately 1,000 of these weevils to the Minnesota Department of Natural Resources for release in the summer of 2008.

3. Garlic mustard biocontrol agents at the MAES/MDA High Security Containment Facility are undergoing final host-specificity testing. The projected date for release from quarantine of one of these agents, a small weevil, *Ceutorhynchus scrobicollis*, is approaching. MDA is cooperating with researchers at the University of Minnesota and the Minnesota Department of Natural Resources to develop mass rearing strategies for future field releases.

One important tool for any IPM program is the use of surveys to identify pest thresholds and management needs. To improve the methodologies for tracking and recording weed distributions, emergence, and shifts in weed types over time, the WIPM developed a mobile global positioning system/geographic information system (GPS/GIS) for mapping important weeds throughout the state. Over the past 6 years, the WIPM's weed survey data has allowed land managers and policy makers to make more informed decisions concerning invasive, exotic, and noxious weed management in Minnesota. This survey methodology is also being incorporated by several Cooperative Weed Management Areas currently being developed throughout the state.

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WIPM web site: www.mda.state.mn.us/plants/weedcontrol

The Biological Control Teaching Greenhouse and Laboratory
Greenhouse, Garden, Yard, and Indoor Plantscape Biological Control

Biological Control Greenhouse
The Biological Control Teaching Greenhouse serves a unique role as a multipurpose space for demonstrating insect life cycles and insect and plant relationships, and as a center for public outreach about insects and their relationship to urban and rural agriculture.

Between January, 2007 and May, 2008, the Biological Control Greenhouse hosted 28 groups on-site and provided living materials for over 50 off-site presentations that include students ranging from grade school ages to postsecondary students, private growers, garden clubs, community garden groups, and summer youth gardening organizations. Presentations include demonstrations of biological control agent releases, samples of biological control agents reared at the greenhouse, and plants grown at the greenhouse.

Presentations offered include *The Jobs that Insects Do* (for young learners), *The Biological Imagination* (for middle school learners), and *Introduction to Biological Control* for secondary and postsecondary students, and professionals. All of these presentations are offered free on an appointment basis throughout the year and can be customized and tailored for the needs of any audience age, background, and/or interest level.

This year, we collaborated with Dan Miller, IPM Specialist with the University of Minnesota Landscape Arboretum, by contributing insects and insect rearing techniques for an exhibit called the *IPM Home Exhibit*. Our relationship involved providing cabbage butterfly eggs and caterpillars, green lacewing larvae, and soldier bugs to the exhibit – part of which attempted to demonstrate the feeding powers of beneficial insects. Biocontrol Program staff also presented their unique use of living organisms for public outreach in a presentation titled *The Biological Imagination* at the American Horticultural Society's Childrens' Gardening Symposium in July and at the Spring Community Gardening Resource Fair in March, *Developing Biological Control Strategies* at a JR Johnson vendor expo in August, and *Introduction to Biological Control* for members of the Gesneriad Society in March, 2008.

With the invitation of Al Withers' Ag in the Classroom Program, we re-created (for the third year in a row) a popular display titled *Little Beasts, Big Feasts: The Things Bugs Eat* that exposed an estimated 5,000 State Fair goers to insect biology and biological control principles. Margot Monson, an environmental educator with the University of Minnesota, played a key role in staffing the display.

The Biological Control Greenhouse is located on the Metropolitan State University's main St. Paul campus overlooking downtown St. Paul. Tours and off-site presentations are free and available by appointment.

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Greenhouse
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(Greenhouse tours and publications)

Dr. John Luhman, 651-201-6163
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(Insect identification and school talks)

Web site: www.mda.state.mn.us/plants/insects/plantscape/biofacility.htm
(Biological Control Facility - Teaching Greenhouse)

Biological Control Laboratory
The Biological Control Laboratory also supports the Biological Control programs. It contains environmental chambers used for rearing insects and growing plants needed to feed colonies. The lab's primary activities involve maintaining insect colonies for beneficial releases, research, educational projects, insect identification, and preservation. The laboratory also works on developing or modifying mass rearing systems and diets for pests and beneficial insects, field collection and distribution of biological control agents, and monitoring the establishment and success of released agents. The laboratory houses the MDA's Insect Reference Collection which currently contains close to 20,000, mostly pinned, insect specimens and is cared for by Dr. John Luhman. Insect rearing procedures are available at: www.mda.state.mn.us/plants/pestmanagement/greenhouse.htm

Laboratory
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MDA Quarantine Facility

The MDA-U of MN quarantine facility is located within the current greenhouse complex of the U of MN, St. Paul Campus. It is a biological control research facility and plant disease quarantine facility licensed by USDA. Current University of Minnesota research includes screening biocontrol agents of soybean aphid and garlic mustard. In the near future, the plant pathology portion of the facility will house research on soybean rust and other economically important pathogens.

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Quarantine Facility web site:
www.mda.state.mn.us/plants/quarantine

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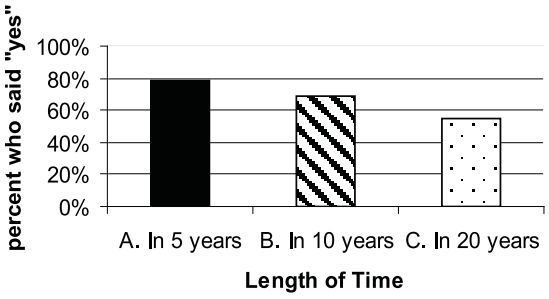
Overview: Experiences and Outlook of Minnesota Organic Farmers – 2007

In Spring 2007, the Minnesota Department of Agriculture (MDA) mailed a 4-page, postage-paid[1] survey to approximately 532 Minnesota organic farmers. The survey asked questions about their experiences with and opinions regarding organic agriculture. The response rate was 39%. A total of 217 surveys was returned; 209 were determined to be usable surveys from certified organic operations.

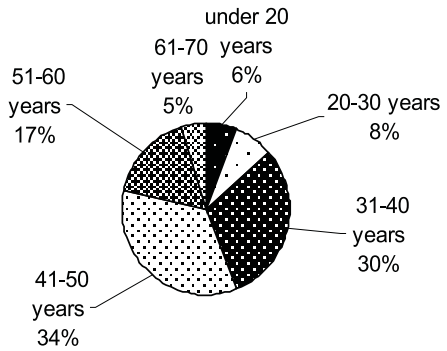
Preliminary Conclusions

Organic farmers in Minnesota are diverse in age, scale, and type of operation. Most find organic to be a profitable enterprise and are optimistic about the future of their farms. Weed control remains their biggest challenge, and they see a need for research particularly in weed management and soil topics. The state's Organic Certification Cost Share program is well used, and organic farmers find value in a number of other services provided by MDA's Agricultural Development and Financial Assistance Division and the Minnesota Grown program. International marketing services are used little by organic farmers. The MDA might consider developing a system to register exempt operations and creating a directory of organic buyers. There is lukewarm support for an organic land registry; before the idea is pursued or abandoned, this question could be posed to applicators and others to determine whether they see a need for this kind of resource. There is not strong support for the idea of an organic checkoff at this time. The next survey of organic farms should include questions about services organic farmers want and need, but may not be receiving.

14. Thinks he/she or a family member will be farming . . .



1. What is your age range?

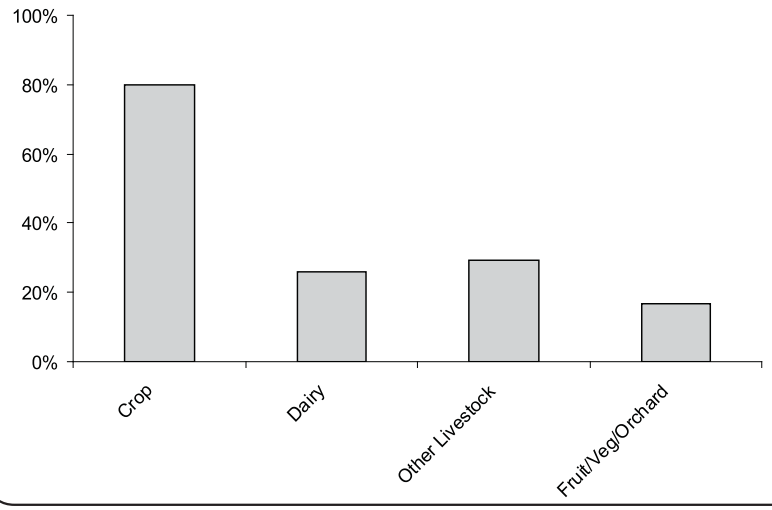


Specific Findings

Respondents represented all age groups, and about 44% of respondents were age 50 or younger (1). By and large, these organic farmers were optimistic about the future of their farming operations. Almost 80% thought they or another family member will be farming in 10 years. More than half thought this would be true in 20 years (14).

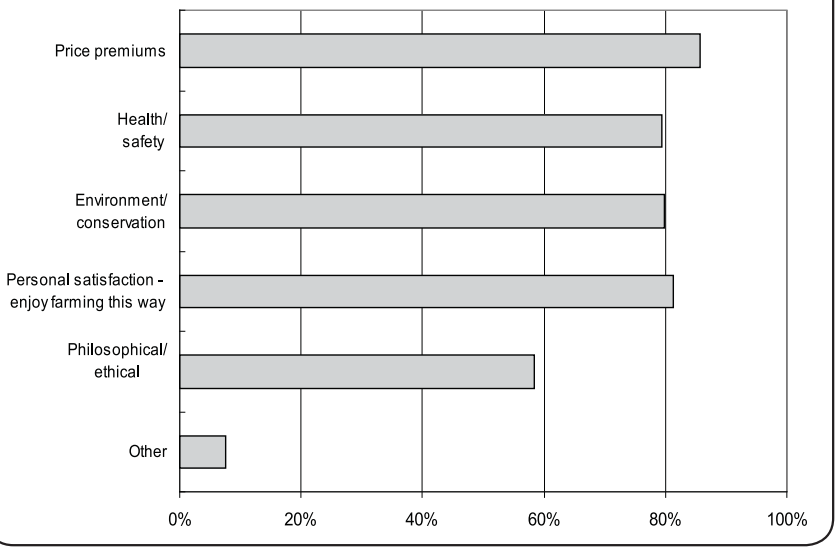
[1] *Postage paid return envelopes were contributed by the University of Minnesota College of Food, Agricultural and Natural Resource Sciences.*

2. What kind of farm enterprise(s) do you have?



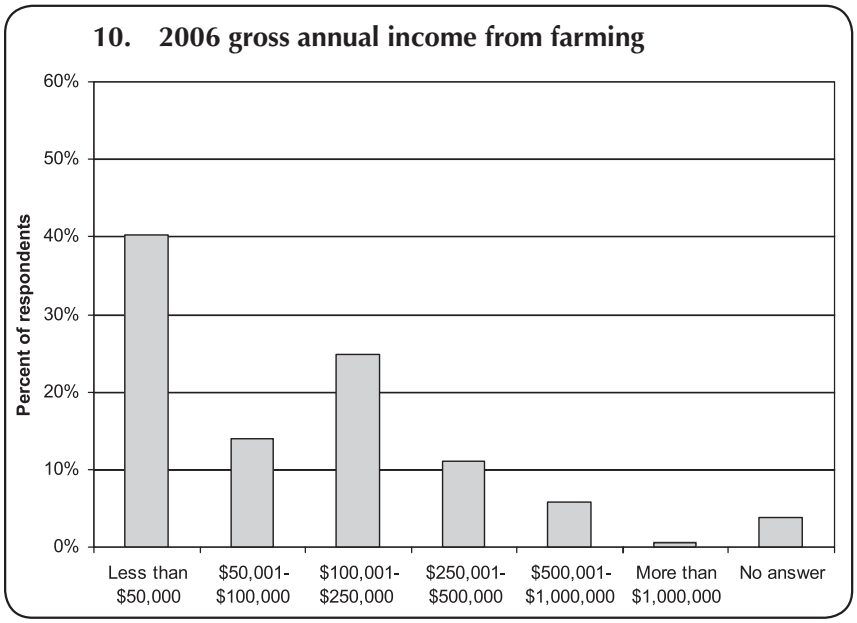
← Most respondents (80%) reported having crop operations. About one quarter were dairy farmers. Just over 29% had organic livestock other than dairy. About 17% reported growing fruit and/or vegetables (2). It was not uncommon for respondents to have diversified operations, reporting more than one type of enterprise.

5. Why are you certified organic?



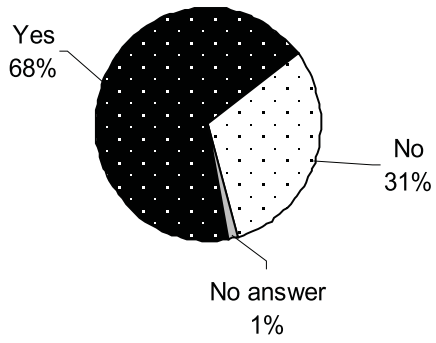
← Most respondents also noted multiple reasons for their choice to farm certified organic. More than three out of four cited price premiums, health/safety, conservation, and personal satisfaction – these reasons were all within seven points of each other. Fewer respondents, although still a majority (59%), cited philosophical or ethical reasons. An "other" category included comments like "buyers or market requires it" (5).

10. 2006 gross annual income from farming



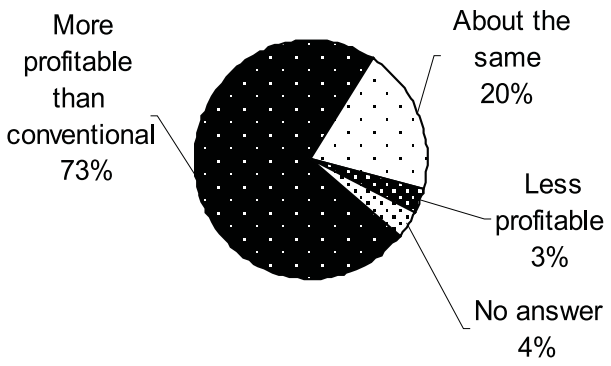
We know that organic farms in Minnesota range from a few acres to 3,000 or more. About 42% of survey respondents reported grossing more than $100,000 a year from farming. A little over 17% reported gross annual income of $250,000 or greater. (Note, this is a difficult question to formulate. Although the question asked about gross income from farming, there is no way to be sure those are the responses we are getting—that respondents didn't report "net" or "all household income" instead) (10).

12. In 2006, did any adult in your household earn off-farm income?



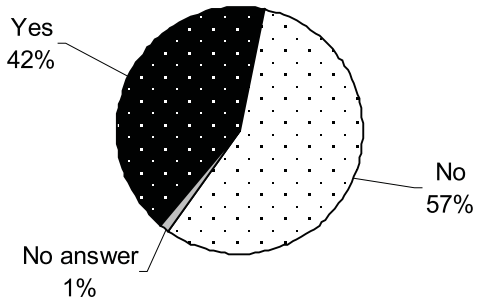
More than two-thirds also reported having off-farm income in 2006 (12).

13a. Profitablity of organic compared to conventional



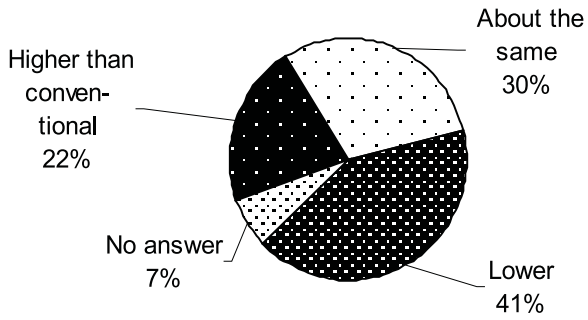
Most (73%), but not all, respondents said they thought organic farming was more profitable than conventional. About one in five said they thought profitability of conventional and organic were about the same. Only seven of 209 survey respondents said they thought organic was less profitable (13a).

8. Do you buy crop insurance for your organic production



While 42% reported buying crop insurance for their organic production (8), many survey responses included comments about their dissatisfaction with the availability and inequitability of crop insurance offered to organic farmers (30; see page 130). They are charged a premium for organic insurance, while claims are paid at conventional prices.

13b. How do you think organic production costs compare to conventional?



Their opinion about production cost is even more interesting. Organic has a reputation as a "low input" and "low tech" farming approach. However, 52% of respondents said they thought production costs were about the same or higher than in conventional farming. About 42% thought organic production costs were lower than conventional (13b).

When asked to rate the problems they faced in 2006 from "no problem" to "big problem," the most frequently commonly cited "big " and "medium" problems were: weed control, public confusion about what "organic" is, competition from organic imports, availability of organic seed, and soybean aphid (15). Many of these issues are also reflected by open-response comments to question 30, which also asked about areas of concern.

15. In 2006, how big a challenge to your organic operation were the following?

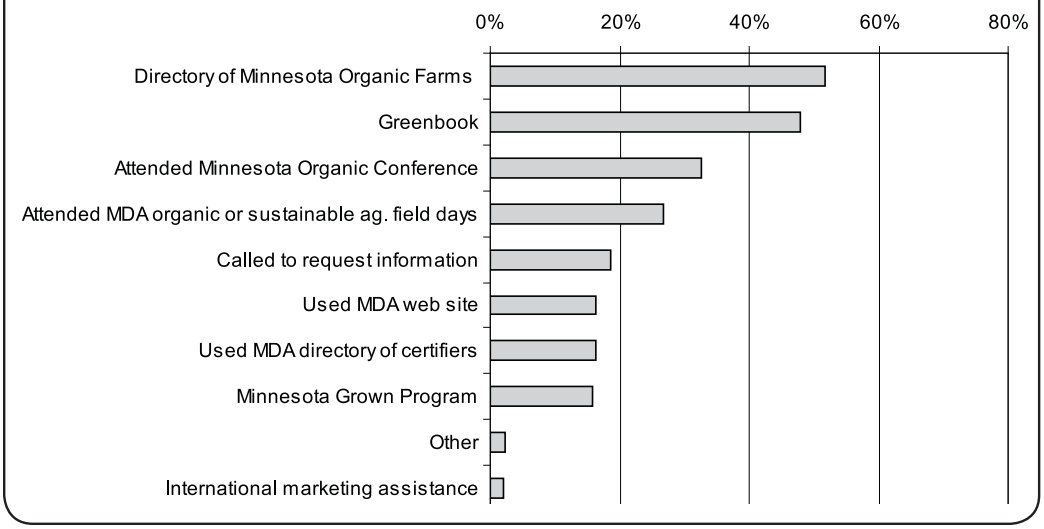
	% saying "big" or "medium" problem
Weed control	58.9%
Public confusion about what "organic" is	39.2%
Competition from organic imports	36.8%
Availability of organic seed	29.7%
Soybean aphid	28.2%
Production volume (i.e., didn't have volume required by buyer)	27.8%
GMO contamination	24.4%
Labor (availability, cost, etc.)	24.4%
Herbicide/pesticide drift	22.5%
Poor crop quality	15.8%
Enforcement of national organic standards	15.8%
Availability of organic processing (meat)	14.4%
Lack of marketing knowledge/confidence	14.4%
Insect pest management (other than soybean aphid)	13.9%
Lack of price transparency	13.9%
Availability of organic processing (other than meat)	13.4%
Immature markets (difficult to find buyers)	12.4%
Price of organic feed	11.5%
Availability of financing	10.5%
Availability of organic feed	7.7%
Availability of transportation	7.7%
Difficult relationships with neighbors	4.8%

Respondents listed weed management, soil fertility, soil health and biology, and nutritional studies about organic foods as the research areas of greatest need (16).

16. In your opinion, which FOUR research areas are most important to organic agriculture in Minnesota?

	Percent rating area in top 4
Weed management	57.4%
Soil fertility	45.5%
Soil health/biology	42.6%
Nutritional studies on organic foods	33.0%
Insect pests	30.1%
Food quality/safety studies on organic foods	24.9%
Yields	23.0%
Economics of organic farming	22.5%
Crop breeding/variety selections	22.0%
Organic variety trials	19.6%
Marketing	19.1%
Livestock health management	18.2%
Other	12.0%
Plant diseases	8.6%
Milk quality	5.7%
Composting	4.3%
Irrigation	1.9%
Storage	1.4%

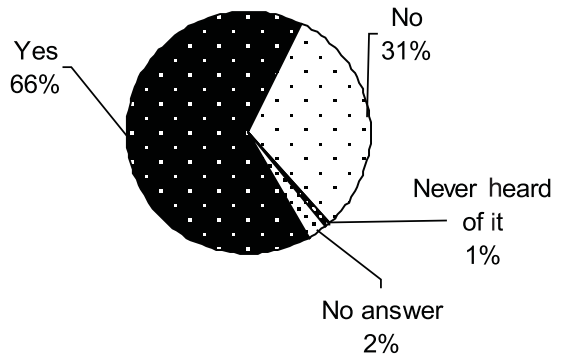
20. Which other MDA services have you used in the past year?



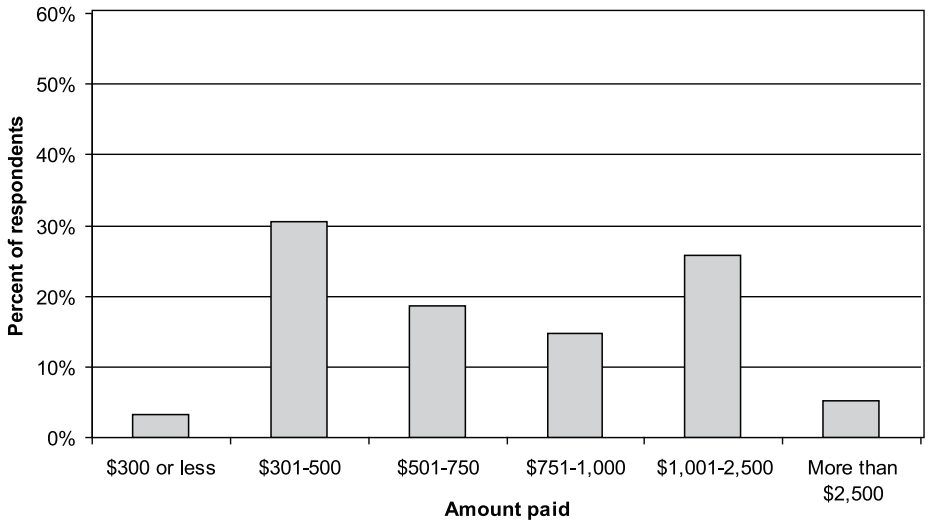
← MDA programs and services were used by many of these farmers. About 83% said they used one or more other services provided by the MDA during the last year (20). Note: this question did not provide insight into which services they thought were most important (other than effectively rating by frequency of use), nor does it help the MDA identify services respondents want, but are not receiving, from the state.

Two-thirds of respondents said they applied to the Organic Certification Cost Share Program in 2006 (19). Since the survey was distributed along with the 2005-06 organic certification cost share application form, this high level of awareness is not surprising. We don't know why a full third did not apply for cost share in 2006 but suspect many did not bother to submit applications because the program notified growers when funds ran out. →

19. Did you apply to the MDA for organic certification cost share in 2006?



17. About how much did you pay for organic certification in 2006?

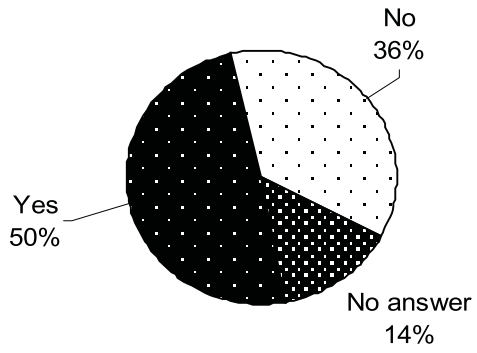


← More than 95% reported paying $300 or more for certification in 2006 (17). Almost two-thirds paid $500 or more.

The survey confirmed that the Organic Certification Cost Share Program administered by the MDA is popular with the state's organic farmers. The survey also asked about three additional projects that have been proposed by the Minnesota Organic Advisory Task Force (OATF) and others:

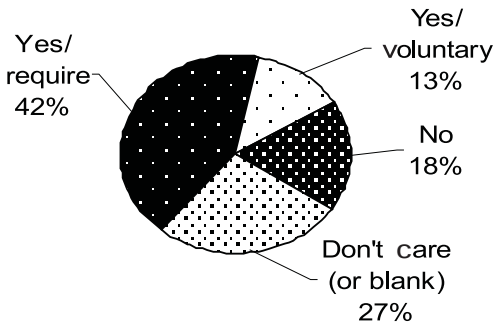
1) A checkoff on organic commodity sales to be used for organic research and promotion.
2) An organic farm registry (something like the Kansas "Sensitive Crops" registry – a resource that pesticide applicators and others could consult to identify the location of certified organic land).
3) Require those organic operations that are exempt from certification (under federal law) to register with the state.

27. Voluntary organic checkoff for organic research and promotion?



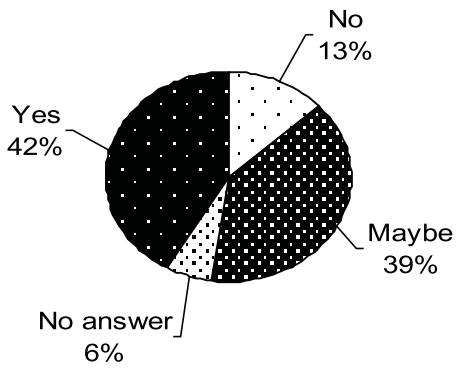
Only about 50% supported the checkoff, indicating there is not enough support to make pursuing the idea worthwhile at this time (27).

29. State registration for exempt operations?



Of the three efforts proposed, the third received the most interest: more than half of respondents said that registration for exempt operations should be required or voluntary, while 18% did not support the idea of state registration (29).

28. Public organic land registry (for notification and use by custom sprayers, road commissions, etc.)?



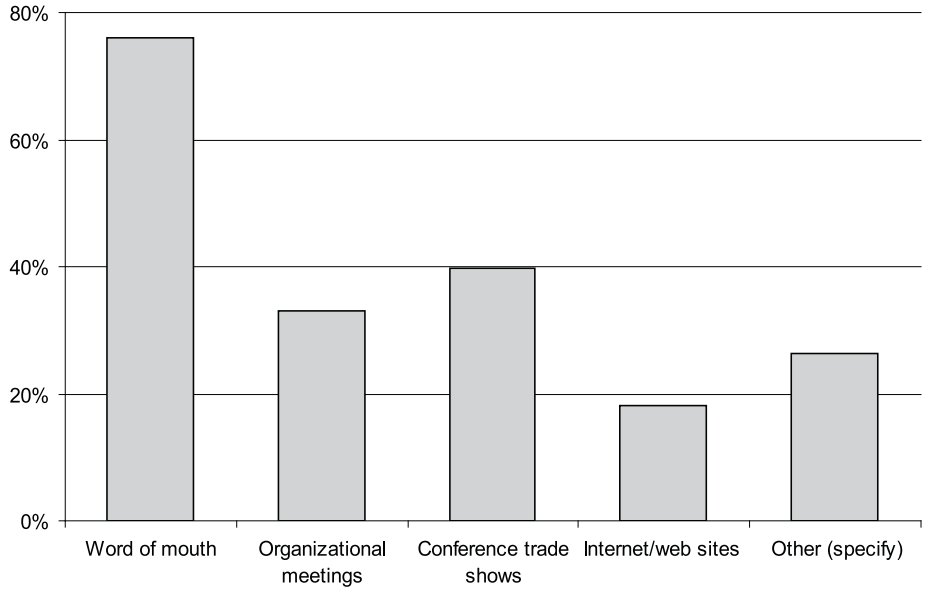
← About 42% supported, and 39% were undecided about, the organic land registry idea. About 13% opposed the idea of such a registry (28).

Marketing

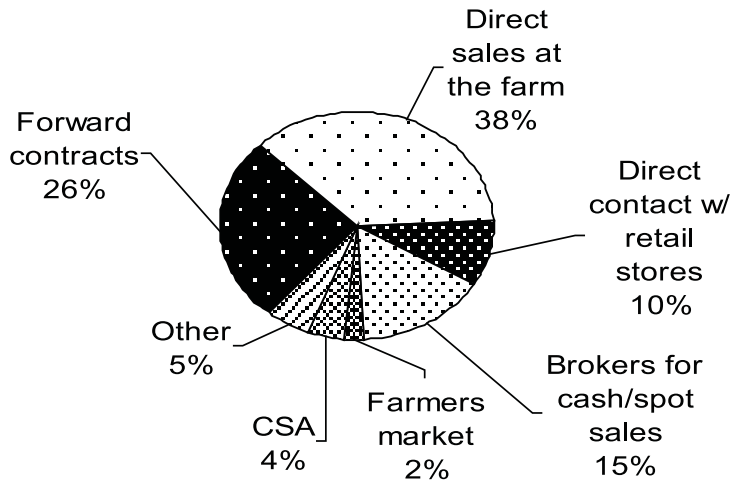
A visiting fellow at the University of Minnesota asked the MDA to include a special group of marketing questions on the survey. She used the data from these questions to prepare an analysis, which is available at: www.misa.umn.edu/vd/Organic_Marketing_Report_208.pdf

Marketing channels for organic products are still developing. Organic farmers use a number of methods (many use more than one) to locate buyers (24). Word of mouth is still the most popular. The "Other" category included publications and newsletters, cold calls, and "they contact me."

24. How do you find organic buyers now?



25a. Which ONE marketing channel would you prefer to use in the future?



← There is similarly a diversity of opinion about marketing methods that respondents would prefer to use (25a). The high response rate of "direct sales at the farm," even among cropping operations, indicates the wording of this question may have been poor. While the question meant farm stands, the respondents may have interpreted this as "buyer provides transportation—picks up cash grains at the farm."

25b. Which ONE marketing channel would you prefer to use in the future?

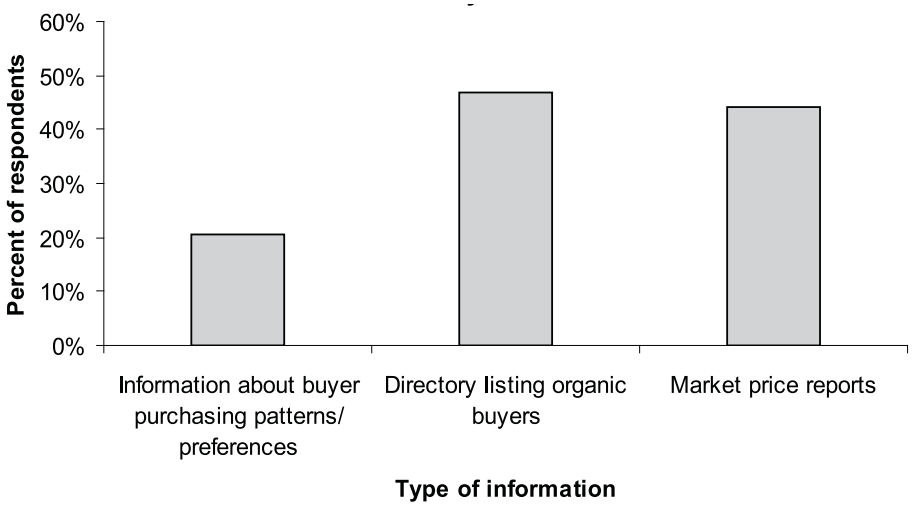
Note: Some groups exceed 100% due to multiple answers.

	Crop ONLY (n=79)	Fruit & Veg ONLY (n=19)	Dairy* (n=43)
Forward contracts	47.2%	0.0%	9.3%
Direct sales	33.3%	33.3%	32.6%
Direct retail	5.6%	55.6%	4.7%
Brokers	26.4%	0.0%	4.7%
Farmers market	1.4%	5.6%	4.7%
CSA	1.4%	22.2%	2.3%
Other	1.4%	5.6%	2.3%

**includes farms that marked "crop" and "dairy" (28) as well as those who marked only "dairy" (15).*

← The question about preferred marketing channel is more informative when answers are examined by type of operation. Crop farmers are most interested in forward contracts, while fruit and vegetable growers would prefer direct retail sales, and dairy farmers prefer direct sales (several noted the name of the company or cooperative to which they presently ship milk).

26. What type of marketing information would be most helpful to you?



← When asked what kind of marketing information they wanted, respondents expressed interest in a directory of organic buyers (also a recommendation of the MN OATF) and in market price reports (26). Since the time this survey was conducted, the USDA Grain and Livestock Market News has begun to publish an organic grain, oilseed, and feedstuff market report on a bi-weekly basis (see www.ams.usda.gov/mnreports/nw_gr113.txt).

Additional Respondent Interests and Concerns

Finally, open comments by respondents are illustrative, offering insight into what is on farmers' minds that the survey didn't necessarily ask about (30). A total of 139 respondents wrote comments that clustered as follows (many commented on more than one topic, and all concerns were categorized and counted). The topics that appeared most frequently were competition from imports (particularly China), increasing corporatization and concentration in organic farming and processing, dissatisfaction with organic crop insurance programs, the need for consumer education regarding organic food and production methods, and the high cost of land. On the production side, pollen drift and GMO contamination weed and insect control, were the areas of greatest concern.

30. What challenges are Minnesota organic farmers currently facing?

Comment Topic	Frequency
PRODUCTION	***84***
Weed management	16
Insect pest management - especially soybean aphid	14
Pollen drift and GMO contamination	13
Seed—availability and variety selection of organic seed, cost	8
Soil—quality, health, and fertility	7
Spray drift	6
Inputs—cost, allowability, availability of, etc. (including fertilizer)	6
Poor growing conditions, drought	6
Opportunity cost of green manures	3
Production—yields, inability to meet demand, etc.	3
Labor—high cost of	2
MARKET AND INDUSTRY STRUCTURE	***50***
Imports—price undercutting, doubts regarding import compliance with standards, and concerns about negative effect imports will have on consumer confidence. Support for COOL.	23
Corporatization—at both farm and processor levels. Influence of big business—both on markets and political.	14
Finding markets and marketing avenues, market saturation	9
Industry/infrastructure that favor conventional and large scale production	4
POLICY AND REGULATION	***25***
Efforts to dilute standards	8
Farm program structure, "cheap food policy"	5
Government—too much interference by State and Feds, or lack of support from MDA	5
Organic paperwork and other requirements (also export requirements that exceed NOP)	4
Violations, lack of enforcement, misuse of "organic" claim, inconsistent oversight by certifiers and inspectors	3
OTHER ISSUES	***24***
Land—high prices (and rents) and limited availability	9
Farmer shortage and lack of young people getting into farming	6
Hostility from non-organic community (smear campaigns, etc.)	5
Isolation—need for more farmer-to-farmer networking (information and marketing)	3
Health insurance—lack of affordable health insurance for farm families	1
CONSUMER EDUCATION	**12**
Public awareness of what organic is, how it is produced. Need for consumer education	12
RESEARCH	***8***
Research—need for credible research in areas like food quality, economics, environmental impacts. Also research into water conservation, cover cropping, companion planting, soils, etc.	8
PROCESSING AND TRANSPORTATION	***6***
Infrastructure—lack of infrastructure, distance to, cost of transportation	6
ENERGY	***4***
Energy costs—high cost of fuel, need to develop alternative sources	4

** 136 of 209 respondents wrote in comments for this question.*

Sustainable Agriculture Loan Program

Loan Technical Review Panel for 2007

Gregg Bongard
Ag Lender

Robin Brekken
Farmer

Ralph Lentz
Farmer

Thaddeus McCamant
Farm Management Specialist

Bob Mueller
Farmer

Ray Rauenhorst
Farmer

Keith Schoenfeld
Ag Lender

Chuck Schwartau
Extension Educator

Program Purpose

The Sustainable Agriculture Loan Program was created to accelerate the adoption of sustainable farming information and technology in Minnesota. Loans of up to $25,000 per farmer or up to $100,000 for joint projects are made at a fixed 3% interest rate for a term of up to 7 years. These low-interest loans are made to farmers for purchasing new or used equipment or building improvements that help make the farming system more sustainable.

Background

When this program began in 1988, the concepts of sustainable agriculture were less understood and less accepted by farmers and lenders than they are today. Many farmers had difficulty obtaining the capital necessary to refocus their farm operations since lenders were reluctant to finance changes during the volatile economy of the 1980s. The state chose to assist these farmers through direct lending.

The initial $1 million appropriation from the state legislature was set up as a revolving fund. As loans are repaid, the funds are pooled and redistributed to other farmers in the form of new loans. Many farmers will benefit from this continuing program with no additional cost to the state.

Evaluation Criteria

Applications for the Loan Program are accepted throughout the year and are competitively evaluated. A review panel representing a cross-section of agricultural professionals from various regions of the state determines which loan projects to recommend to the Commissioner of Agriculture for funding.

The loan proposals are evaluated based on the following criteria:

a) **Long-term Plans for the Farm:** How does this investment fit the long-term plans for the farm?
b) **Effect on the Farming System:** How will this investment lead to a more sustainable farm system?
c) **Environmental Impact:** Is there an environmental benefit to the proposed project?
d) **Farm Income:** What is the added return to the farming operation from the proposed project?
e) **Input Reduction:** Does the project reduce or make more efficient use of inputs?

Each proposal is judged on its relative merits. A farming method considered to be highly innovative in one region of the state may be commonplace in another region.

Impact of Program

The loans have given Minnesota farmers added incentive to make changes toward more efficient use of inputs while enhancing profitability and protecting the environment. More than 330 farmers have borrowed over $3.5 million from the Sustainable Agriculture Loan Program.

As loans are repaid and the funds redistributed, approximately $250,000 is available each year for new loans. When farmers implement innovative changes, their neighbors have an opportunity to observe and decide whether to adapt changes to their farming system. In this way, the farmers are demonstrating new, innovative, and alternative ways of farming and are serving to accelerate the rate of adoption of sustainable agriculture in Minnesota.

Project Categories

Loan projects typically fall into six categories: energy savings and production, livestock management, conservation tillage, weed and nutrient management, on-farm processing, and alternative crops. Almost one-half of loans have been made for livestock management and this category continues to be the most common. Projects have included fencing, livestock handling equipment, milk parlor upgrades, and building improvements. Conservation tillage and weed management projects have accounted for about one-fourth of the loans and include the purchase of rotary hoes, flame cultivators, and ridge tillage equipment. Energy production and on-farm processing and handling equipment projects have been increasing in the past few years.

About the Staff…..

The Greenbook staff brings a broad range and many years of experience in sustainable agriculture areas. Each staff person focuses on individual topic areas where they have expertise and interest.

Linda Bougie – Office Manager, has been working for the program since it began in 1988. Linda provides administrative clerical support to the staff and the program.

Jean Ciborowski - Integrated Pest Management (IPM) Program Coordinator, has been part of the staff since 1997. During her tenure at the MDA, she has coordinated the Biological Control Laboratory (1989-91) and the Exotic Pest Program (1991-97). Jean works on development and implementation of statewide strategies for increasing the use of IPM on private and state managed lands.

Alison Fish - Secretary, does desktop publishing and word processing for the program, helps design program brochures, handles mail requests, and maintains the Sustainable Agriculture Loan and Grant files.

Mary Hanks - Program Supervisor, works with staff to develop project goals and implementation strategies. Mary's training is in plant pathology with a research focus. She came to the MDA in 1990 from private industry.

Wayne Monsen - Alternative Livestock Systems Specialist, provides rotational grazing planning services for livestock producers (in cooperation with NRCS), and cooperates with local, state and federal agencies on livestock and non-point source pollution issues. He began working for MDA in 1992 after farming for 12 years near St. James, MN.

Meg Moynihan - Organic and Diversification Specialist, joined the Minnesota Department of Agriculture in 2002. She helps farmers and rural communities learn about crop, livestock, management and marketing options, including organic. She has also worked professionally as an educator and evaluator, and as a community development extension specialist with the U.S. Peace Corps in northern Thailand.

Mark Zumwinkle - Sustainable Agriculture Specialist, provides hands-on experience to farmers working on soil quality and acts as a liaison with university researchers and farmers coordinating the use of the rainfall simulator. Mark uses soil and cropping system health as focal points for farmers exploring management issues and options and provides the non-farm community with access to soil health information. Mark is a vegetable grower from North Central MN with research experience in living mulches and plant nutrition. Mark joined the ESAP staff in 1993.

Staff Resource Directory

	Jean Ciborowski	Mary Hanks	Wayne Monsen	Meg Moynihan	Mark Zumwinkle
Agroforestry			•		
Alternative Crops & Livestock			•	•	•
Community Supported Agriculture (CSA)		•		•	
Composting		•			•
ESAP Grants	•	•			
ESAP Loans		•			
Farming Systems/Tillage, Weed Control, Crop Rotation	•		•		•
Integrated Pest Management (IPM)	•	•			
Livestock Production			•		
Living Mulch					•
Manure Management					•
Organic Production/Livestock,Vegetables, Grain, Fruit				•	•
Organic Rules and Certification		•		•	
Plant Diseases/Insects	•	•			
Managed Rotational Grazing Planning		•	•		
Soil Quality and Soil Fertility, Composting					•
Vegetable Production					•