Greenbook 2004

Sustainable Energy from Agriculture

The Greenbook is dedicated to the farming families of Minnesota. Their innovation, cooperation, and persistence are creating a more sustainable agriculture.

Sustainable Energy from Agriculture

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

FROM THE FARM TO YOUR FAMILY

July 2004

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Introduction to the Greenbook 2004

I am pleased to introduce the 15th edition of the *Greenbook*, a publication of the Minnesota Department of Agriculture's Agricultural Resources Management and Development Division (ARMD). It highlights the project results of creative and innovative farmers and researchers involved with the Sustainable Agriculture On-farm Demonstration Grant Program.

Sustainable agriculture focuses on farming practices that reduce inputs and protect the environment. It also includes diversification of crops and alternative livestock systems, and it gives farmers increased access to alternative markets.

Greenbook 2004 contains articles that highlight 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 profitable and environmentally friendly. Feel free to give them a call about their projects.

Our essays this year include: "Bioenergy: An Overview," reprinted with permission from a U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy Reference brief. It discusses the different types of renewable energy sources available around the country. Our second essay is, "Empowering the Countryside with Renewable Energy" by Greg Cuomo at the University of Minnesota Renewable Energy Research and Demonstration Center in Morris. Greg discusses the role the University plays in fostering renewable energy. And finally, Charles and Karen Knierim's, "Homegrown Energy: A Tour of Wildrose Farm" looks at energy use from a Minnesota farmer's viewpoint. I think you will find them informative and interesting.

The *Greenbook* also includes updates on other ARMD projects such as activities at Big Woods Dairy at Nerstrand – Big Woods State Park, organics in Minnesota, integrated pest management, and a special section titled "Diversification Compass: A Guide to Choosing New Directions for Your Farm."

I hope you find *Greenbook 2004* interesting and full of new and useful ideas.

Gene Hugoson, Commissioner
Minnesota Department of Agriculture

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Bioenergy: An Overview

Excerpt from a U.S. Department of Energy Reference Brief, reprinted with permission of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. This and other articles about bioenergy can be found at www.eere.energy.gov .

The energy stored in biomass (organic matter) is called bioenergy. Bioenergy can be used to provide heat, make fuels, and generate electricity. Wood, which people have used to cook and keep warm for thousands of years, continues to be the largest biomass resource. Today there are also many other types of biomass we can use to produce energy. These biomass resources include residues from the agriculture and forest industries, landfill gas, aquatic plants, and wastes produced by cities and factories.

Because they come from organic matter, biomass resources are renewable. For example, many biomass resources are replenished through the cultivation of fast-growing trees and grasses. As these trees and grasses grow, they remove carbon dioxide—a major greenhouse gas—from the atmosphere. This is important because bioenergy, like fossil fuels, can produce carbon dioxide. However, the net emission of carbon dioxide from bioenergy will be zero as long as plants continue to be replenished.

Today, we depend on biomass to provide about 3 to 4% of our energy in the United States. And we continue to expand our use of bioenergy. We're even learning more about how to produce the same high-quality materials and chemicals from biomass, such as those that presently come from petroleum.

Biopower

Hundreds of U.S. power plants use biomass resources to generate about 65 billion kilowatt-hours of electricity each year. The wood and paper products industries generate and use about two-thirds of this power. Solid wastes from cities fuel most of the remaining biopower plants, providing enough electricity to meet the needs of nearly 7 million Americans.

Biopower plants come in all sizes. Today's biopower plants have a combined capacity of about 10.3 gigawatts, which is about 1.4% of our nation's total electrical generating capacity. However, with better technology and expanded use of biomass resources, the nation could generate as much as four-and-one-half times more biopower by 2020.

Of all the forms of renewable energy, only hydropower produces more electricity than bioenergy does. Like hydropower, biopower is available 24 hours a day, seven days a week. Other forms of renewable energy, such as solar or wind power, have lower availability since they are produced only when the sun shines or the wind blows.

Several types of biopower systems are currently in use or under development. These systems include direct combustion, cofiring, gasification, and small modular systems.

Direct Combustion. Direct combustion involves the burning of biomass in a boiler to produce steam. The pressure of the steam then turns a turbine attached to an electrical generator, which makes electricity. Coal-fired power plants employ similar technology but use fossil fuel in their boilers. Most of today's biopower plants use a direct combustion system. Researchers are evaluating other advanced processes that are even more efficient than direct combustion.

Cofiring. Cofiring systems can burn up to 15% biomass when mixed with coal in some boilers. Cofiring biomass with coal reduces emissions and produces fewer of the chemicals that cause acid rain. Many existing coal plants could use a cofiring system with only a few modifications. Therefore, this system has a significant potential for growth in the near future. To make cofiring biomass more attractive to power companies, researchers are investigating improvements to the cofiring process and better technologies for minimizing emissions.

Gasification. Engineers are developing new technologies to produce biogas from biomass. Biogas consists of methane (found in natural gas) together with hydrogen, and other gases. Researchers are learning how to produce higher quality biogas by studying coal gasification systems. Some new gasification technologies make biogas by heating wood chips or other biomass in an oxygen-starved environment.

A second method for making biogas is to let landfills do the work. As paper and other biomass decay inside a landfill, they naturally produce methane. Methane can be recovered from landfills by drilling wells into the landfill and piping the gas to a central processing facility for filtering and cleaning. Clean landfill gas is then ready to fuel a biopower plant or help heat a building.

Biogas can be burned (or cofired) in a boiler to produce steam for electricity generation. Biogas can also fuel gas turbines or combined-cycle generation systems. In a combined-cycle system, pressurized gas first turns a gas turbine to generate electricity. Then, the waste gas from the gas turbine is burned to make steam for additional power production.

Pyrolysis. Researchers are also investigating a smoky-colored, sticky liquid that forms when biomass is heated in the absence of oxygen. Called pyrolysis oil, this liquid can be burned like petroleum to generate electricity. Petroleum, however, is almost never used any more to generate electricity. There's a greater need to use petroleum as a source of gasoline, heating oil, and petrochemicals. Because pyrolysis oil can also be refined in ways similar to crude oil, it may also be more valuable as a source of biofuels and biobased products than for biopower generation. Unlike direct combustion, cofiring, and gasification, this technology is not yet in the marketplace.

Modular Systems. Researchers are particularly interested in improving small systems sized at 5 megawatts (MW) or less. These so-called modular biopower systems can use direct combustion, cofiring, or gasification for power generation. They are well suited for generating biopower from locally grown resources for small towns, rural industries, farms, and ranches.

Modular systems may be a good choice where power lines are not available. Clusters of modular biopower systems in rural areas may eradicate the need for power companies to build larger, more expensive power plants.

Biofuels for Transportation

Biomass is the only renewable source of transportation fuels. These renewable fuels, called biofuels, produce fewer emissions than petroleum fuels. Biofuels also can help us reduce our dependence on foreign sources of fossil fuels. We can open up foreign markets for U.S. products and technologies. And, we stimulate growth in industry and in rural areas, making farming and forestry more profitable.

Ethanol. Fuel ethanol is a form of the alcohol found in wine and spirits, but rendered unfit for drinking through the addition of a small amount of gasoline or other denaturant. Industry currently makes ethanol from the starch in grains - such as wheat, corn, or corn by-products - in a process similar to brewing beer. Each year, we blend more than 1.5 billion gallons of ethanol with gasoline to improve vehicle performance and reduce air pollution.

Most gasoline blends contain about 10% ethanol and 90% gasoline. This mixture works well in cars and trucks, those you see on the road everyday, designed to run on gasoline. In addition, fuel containing 85% ethanol is available, primarily in the Midwest. This fuel, called E85, can be used in flexible fuel vehicles. Flexible fuel vehicles can run on either E85, straight gasoline, or any mixture of the two. Each year, automobile manufacturers produce more than 700,000 flexible fuel vehicles.

Researchers are investigating technologies for making ethanol from the cellulose (fiber) component in biomass, like municipal solid wastes and agricultural residues left in the field after harvest. This type of ethanol is called bioethanol. Bioethanol reduces exhaust emissions from carbon monoxide and hydrocarbons. In addition, by displacing gasoline components such as sulfur, bioethanol helps reduce the emissions of toxic effluents from automobiles.

Biodiesel. Biodiesel can be made from vegetable oils, animal fats, or recycled grease. Industry produces about 20 million gallons of biodiesel from recycled cooking oils and soybean oil. Like ethanol, biodiesel is primarily used as a fuel blend. Diesel blends usually consist of 20% biodiesel with 80% petroleum diesel. This mixture runs well in a diesel engine and does not require engine modifications.

Biodiesel is not yet widely available to the general public. Some federal, state, and transit fleets, as well as tourist boats and launches, use blended biodiesel or pure biodiesel. Industry is currently looking at using biodiesel in circumstances where people are exposed to diesel exhaust, in aircraft to control pollution near airports, and in locomotives with unacceptably high emissions. Biodiesel may increase nitrogen oxide emissions but it reduces carbon monoxide, particulates, soot, hydrocarbons, and toxic emissions when compared to pure, petroleum diesel.

Biobased Products

Whatever products we can make with fossil fuels, we can make nearly identical or better ones from biomass. The difference between a chemical derived from plants and an identical chemical made from petroleum is simply their origin. This difference is important because plants are renewable and petroleum is not. Biobased products also often require less energy to produce than petroleum-based products. In addition, they can be made from "useless" wastes.

Our nation produces more than 300 billion pounds of biobased products each year, not counting food and feed. Biobased products include plastics, cleaning products, natural fibers, natural structural materials, and industrial chemicals made from biomass. Such chemicals are sometimes referred to as "green" chemicals because they are derived from a renewable resource.

Biobased products are so varied it's unlikely that industries in the future will limit themselves to making just one of them. Rather, biorefineries could become commonplace.

Biomass Resources

Biomass resources are plentiful and varied throughout the country. They are primarily wastes, food crops, and energy crops. In the Pacific Northwest and the Southeast, for example, the forest products industry uses its wastes and residues to make electricity and heat for its own operations. Instead of filling up a landfill, sawdust, bark, paper pulp, wood shavings, scrap lumber, wood dust, and paper provide low-cost bioenergy. In Hawaii, a plant is using bagasse (a fibrous residue from sugar cane processing) to make particleboard.

In the Midwest, farmers grow corn and soybeans for ethanol fuels and bioproducts. A South Dakota firm sells truck bed liners made from soybeans. A Minnesota firm makes shrink wrap, clothing, candy wrappers, cups, food containers, home and office furnishings, and other biodegradable products from a chemical building block derived from corn starch. A consortium of farmers, businesses, and utilities in Iowa is growing 4,000 acres of switchgrass as an energy crop for cofiring with coal in utility boilers. A similar consortium in the Northeast is growing hybrid willow trees as energy crops, also for cofiring with coal. A number of cities in the Northeast generate electricity from their biomass-rich solid wastes instead of burying them in landfills. A utility in Vermont is experimenting with a new system to make biogas from wood chips.

The use of these resources is laying the foundation for future bioenergy use. However, if we want to increase our bioenergy resources and lower the costs of producing them, we must rely more on energy crops and less on food crops. As our understanding of agricultural science grows, we'll be able to grow more and better energy crops. Potential energy crops include poplars, willows, switchgrass, alfalfa stems, and sweet sorghum.

Compared to conventional farming, energy crops require less fertilizer and fewer chemicals to control weeds and insect pests. With sustainable farming practices, we can use energy crops to prevent erosion, and to protect water supplies and quality. Researchers are developing perennial grass and tree crops with life expectancies of 7 to 10 years after planting. Research has shown that soil carbon, one indicator of soil quality, increases measurably under energy crops in as few as 3 to 5 years. These crops can potentially restore the cultivation and water-holding capacity of soil degraded by intensive crop production. In all these ways, energy crop farming helps us preserve our cropland for future generations.

What Lies Ahead

No one can predict the future, but with bioenergy, there are intriguing possibilities. Researchers believe they can significantly improve the technologies for making electricity, heat, and fuels from biomass. They are investigating advanced gasification systems, fuel cells, and combination technologies that produce heat and electricity. Advanced technologies should be able to produce bioenergy more efficiently and at lower costs than today.

Another interesting possibility researchers are investigating is meshing the development of bioenergy with fossil-fuel energy. For instance, it should be possible to process biogas to pipeline quality. Pipeline quality biogas would increase natural gas supplies for home heating and electrical power generation. Cofiring biomass directly with coal for power generation is a strong possibility for the future.

Looking ahead, some analysts have begun to talk about a "carbohydrate economy," in which plants would be a major source of electricity and fuels, as well as construction materials, clothes, inks, paints, synthetic fibers, pharmaceuticals, and industrial chemicals. According to studies by the Shell International Petroleum Company and the Intergovernmental Panel on Climate Change, biomass could satisfy between one-quarter and one-half of the world's demand for energy by the middle of the 21st century. This projection implies a world full of biorefineries, where plants provide many of the materials we now obtain from coal, oil, and natural gas.

It is too soon to know whether the future holds thousands of locally owned biorefineries producing many different products from a locally grown energy crop. What we do know is that any future increases in the use of bioenergy will benefit farmers and rural communities. Each new biorefinery will make nearby farms more profitable. Farm income will rise because farmers will be able to sell both the food and energy they grow. Biorefineries will also boost regional employment and help reduce local energy costs.

Bioenergy holds great promise for the future. But to realize this promise, key challenges must be met. First, the cost of bioenergy needs to be lowered. As long as it costs less

to make electricity, transportation fuels, and products from fossil fuels than it does to make them from biomass, people will be reluctant to invest in bioenergy. We also must ensure that increasing our use of bioenergy will not adversely affect our environment. Finally, we must work together to facilitate the growth of an integrated bioenergy industry that links resources with the production of a variety of energy and material products.

Resources

The following web sites contain more information on renewable energy and related Minnesota activities.

Center for Biorefining, University of Minnesota, Dept. of Biosystems and Agricultural Engineering, 1390 Eckles Ave., St. Paul, MN 55108, 612-625-1710. Available at: biorefining.coafes.umn.edu

Initiative for Renewable Energy and the Environment, University of Minnesota, 612-625-2263. Available at: www1.umn.edu/iree

Minnesota Department of Agriculture, Biodiesel Program, 90 W. Plato Blvd., St. Paul, MN 55107, 651-297-2223. Available at: www.mda.state.mn.us/ams/biodiesel/default.htm

Minnesota Department of Agriculture, Ethanol Program, 90 W. Plato Blvd., St. Paul, MN 55107, 651-297-2223. Available at: www.mda.state.mn.us/ethanol

Minnesota Department of Commerce, 85 – 7th Place East, Ste. 500, St. Paul, MN 55101, 651-296-4026. Available at: www.commerce.state.mn.us

Minnesota Project, 1885 University Ave., Ste. 317, St. Paul, MN 55104, 651-645-6159. Available at: www.mnproject.org

Minnesotans for an Energy Efficient Economy, 46 E. Fourth St., Ste. 600, St. Paul, MN 55101, 651-225-0878. Available at: www.me3.org

Empowering the Countryside with Renewable Energy: University of Minnesota Renewable Energy Research and Demonstration Center at Morris

by: Greg Cuomo

Greg is the Head of the University of Minnesota's West Central Research and Outreach Center (WCROC) at Morris. Prior to becoming head at WCROC in 2000, he worked with an interdisciplinary forage-based livestock systems team at WCROC. He earned a Ph.D. in forages from the University of Nebraska and worked on forage systems for dairies in the Southeast US while on the faculty at Louisiana State University. Greg can be reached at cuomogj@umn.edu or at 320-589-1711. More information about the "Empowering the Countryside" program can be found at: wcroc.coafes.umn.edu

It is the role of public research institutions, like the West Central Research and Outreach Center (WCROC) and the University of Minnesota, to link with citizens, identify and understand challenges facing society, innovate to solve problems, and supply information for the public good. This is a lofty ideal and sets the bar high for the University, but it was this ideal that began the WCROC effort in renewable energy.

In the winter of 2001, the WCROC was addressing some tough questions: As an out-state unit of the University of Minnesota, what is the role and responsibility of the WCROC to the farmers, citizens, and communities of the region and the State? How can we connect and be a positive influence on producers and communities? How can we use the resources that are present in west central Minnesota and turn them into an advantage for the region?

As we watched the snow blow sideways, it dawned on us that west central Minnesota possesses the natural resources necessary for renewable energy production. In addition, Minnesota has been a leader in biofuels and wind energy and is, in many respects, the heart of renewable energy for the nation. With these facts in mind, the concept for the University of Minnesota Renewable Energy Research and Demonstration Center at Morris began.

What was it about renewable energy that attracted our attention? The natural resources that are necessary for a renewable energy industry, like wind, biomass (fibrous plant material), and biofuels (soy-diesel, vegetable oil, ethanol, etc.) are rural and agricultural resources. These resources can not only enhance economic prospects for rural areas, but also provide an opportunity to develop renewable energy systems that could diversify the nation's energy portfolio, and provide the environmental promise of clean air, clean water, and ultimately an improved quality of life.

We started with a vision. That vision was to develop a community scale, renewable energy research and demonstration center that focused on wind, biomass, biofuels, anaerobic digestion, and renewable hydrogen with two primary goals: 1) provide a model for rural communities and agricultural producers to integrate renewable energy systems into their economies, and 2) establish systems research that provides information to stimulate the renewable energy industry.

In terms of being a model, we want to be a place where communities, groups, or individuals can come for information and experience on how to develop renewable energy resources. How do you know what wind or biomass resources are available in your region? Where do you start? How do you approach utility companies? What about permitting? Developing a renewable energy resource is like doing a puzzle. Our goal is to provide as many pieces to the puzzle as possible. We will demonstrate different renewable energy applications as educational tools to help people make informed decisions about the potential to develop a renewable energy in their region.

What do we envision will be part of this Renewable Energy Center? We envision wind turbines on the ridge above the Pomme de Terre River in sequence with biofuel generators to provide a 100% renewable, dispatchable (energy on demand) energy system; wind-to-hydrogen demonstration and research; a biomass facility that provides heating and cooling to the University of Minnesota-Morris, to a new elementary school being built in Morris, and perhaps in the future

to the local hospital; a "Solar Smart Building" Renewable Energy Education Center; and working with the community of Morris to see how methane from local animal agriculture could help fuel the industrial park and ethanol plant in town.

This ability to demonstrate technologies and empower communities and individuals will be valuable; however, as a university we are a research institute. Our mission is to develop and provide unbiased research based information. As the Renewable Energy Center develops, it must be capable of facilitating and conducting innovative, cutting edge research well into the future.

So what is our research niche? We realized that one piece that is often missing from university research is the link between the terrific things that people discover in laboratories and bringing those innovations to commercial application. Our vision is that every system at the Renewable Energy Center will be able to facilitate "scale-up" research. We will take the most promising technologies and test them in a production setting. This will not only help refine technologies, but will also reduce the risks for those who implement renewable energy technologies. For example, if we develop a biofuel system that complements the intermittent nature of wind power, the biofuel generators need to have research capabilities to evaluate novel fuels and/or additives. What are the emissions, efficiencies, impact on engine components, and economics of those fuels or additives? These are questions that will need to be answered before a new technology can be used on a broad scale.

It is also important that we recognize that renewable energy is more than generation of power. For example, it is important to understand biomass cropping as a system, from potential impacts on water quality and carbon sequestration, through crop production, feedstock processing, biomass utilization, and consequential by-products and boiler emissions in a manner that is useful to a broader, nationwide biomass industry. This research can be conducted at the WCROC and the University of Minnesota. Renewable energy is a relatively young industry and the better the components of these energy systems are understood, the more sustainable they will be.

From the beginning, we realized that this was going to be a complicated project and that we had much to learn. We needed experts from many different disciplines to help, but we also needed people in the region interested in renewable energy to help provide input and guide us in our decision-making. We approached this through a public workshop. More than 200 people attended our first workshop. We invited all participants to be part of a Community Committee. The Community Committee has met irregularly when there is an update or items we need to discuss.

The next step was to develop funding to move the project from the theoretical stage to making it a reality. In retrospect, one of our key contacts early in the process was our local legislative representative, Torrey Westrom. When an opportunity came in the 2003 Legislative Session, Representative Westrom had the confidence to earmark some University of Minnesota funding to begin the Renewable Energy Center at Morris. This was really the break we needed to jump-start this project. In addition, from this funding, the Initiative for Renewable Energy and the Environment (IREE) was established. The IREE coordinates activities across the University of Minnesota into a cohesive force that will bring on-going research projects from many areas together to have the greatest impact on renewable energy and the State.

A total of three million dollars was dedicated to work at Morris. Of that, some has gone toward establishing about 2.0 MW of wind power at the WCROC, the rest of the funds were allocated to the University of Minnesota-Morris to begin work on a biomass heating and cooling facility.

Development of the Renewable Energy Center is underway, but we are only beginning to understand the potential and magnitude of what this Center could become and what it could do for Minnesota and the region. We have developed a set of objectives. They are:

1. Demonstrate the applicability of new and emerging technologies.

2. Provide a demonstration to empower individuals and communities to use renewable energy.

3. Link University of Minnesota research with citizens and industry.

4. Stimulate grassroots development of the emerging renewable energy industry.

5. Help establish the University of Minnesota, the region, and the State as national leaders in the economically and environmentally promising field of renewable energy.

So where are we now?

- We will be developing about 2.0 MW of nameplate wind power at the WCROC. We are currently developing a Power Purchase Agreement and working out logistical details. It is likely that the wind turbines will be operational late this year (2004).
- Funding for the University of Minnesota-Morris biomass heating and cooling facility is in the current legislative bonding request.
- There are several grant applications pending to develop the biofuel portion of the dispatchable wind/biofuel energy system.
- There is a grant application pending to develop a wind-to-hydrogen demonstration facility.
- We have funding to develop a pre-design for the "Solar Smart Building" Renewable Education Center. This proposal is earmarked for the 2006 Legislative Bonding Session.
- We have hired a coordinator (Mike Reese) for the project and have developed a series of "Assistantships, Fellowships, and Visiting Scientists" to attract researchers from throughout the University to conduct research around renewable energy systems.

Developing the infrastructure for a Renewable Energy Center will be exciting, but in itself will not make this project a success. For this project to be a success, it needs to provide value to the citizens of the region and the State. If the University of Minnesota renewable energy research and initiatives lead to new technologies, industries and businesses, quality jobs, stronger rural economies and communities, improved national security, and a more sustainable environment; then the Renewable Energy Center will be a success.

Homegrown Energy, a Tour of Wildrose Farm

by Charles and Karen Knierim

Charles, master carpenter and gourmet chef, is active in several sustainable farming and rural community development organizations. Karen sews. Wildrose Farm has won several awards for environmental and entrepreneurial leadership. They can be reached at info@wildrosefarm.com or at 218-562-4864. More information about Wildrose Farm can be found at www.wildrosefarm.com

Directions in hand, 150 miles north of the Twin Cities, today's drive takes us through the pine forests of northern Minnesota, around numerous lakes, over rolling hills, and to the wooden gates that mark the entrance to Wildrose Farm. The Knierim family, Chuck, Karen, and their three daughters have been living here, working with the land, and putting down roots for 30 years. Life has a rhythm that echoes the seasons, and energy supplies the beat.

Energy for heating is of foremost importance in this climate. Heat for the four bedroom house (office and warehouse included), Rosewood Studio, and the greenhouse is supplied with a wood burning boiler. The boiler, looking like a little smokehouse, and its adjoining woodshed are the first buildings we come across as we emerge from the wooded drive leading from the gate to the farmyard. Hot water from this outdoor boiler is pumped through buried piping enclosed in insulated channels into the house and greenhouse, and then on to the studio. The water returns to the boiler much cooler to warm and circulate again. A thermostat controls a fan in the boiler to keep the water temperature up. Two small electric pumps move the water through the house's hot water baseboards and a hot water tank in the studio. A third pump circulates the hot water from that tank through the pipes in the insulated cement slab floor of the studio.

But we're getting ahead of ourselves on this tour, as we haven't fueled the fire yet. A walk through the woods leads us down a trail that used to be the main road between the nearby city of Pequot Lakes and Breezy Point's Pelican Lake, back when traveling was done by horse and buggy. From the wagon tracks, we see several kinds of pine and a variety of hardwood trees that make up the inventory of Wildrose Farm's Registered Minnesota Tree Farm. Here, a sustained yield timber management plan consists of cutting mature trees for lumber, thinning stands where needed, and planning for the regrowth of the forest with seedlings. Success of this system is measured in its low impact on the environment. No clear cutting, no scars left by heavy machinery, and no interruption in the lives of the forest animals living there. In other words, the forest doesn't skip a beat. Wildlife habitat is always a consideration in working in harmony with nature in a well balanced plan. So, what about some firewood now? We will select a few dead trees, standing or recently fallen, but others we will let nature take care of. The woodpeckers and small animals will live in their shelter until the forest covers them in moss and finally reclaims their fertility.

Karen and Chuck on their farm.

Firewood is also supplied as a by-product of the periodic rhythm of lumber harvests. For one harvest, when Rosewood Studio was planned, a timber assessment was done based on construction needs. An area was chosen for its mature jack pine and a selective harvest was done. From an estimated 2.5 acre area, 14,000 board feet of building material was produced. A by-product was about 6.5 cords of firewood from crooked or dead trees, tops, and slab wood from milling the lumber. This area now, several years later, supports a good population of mature trees of various species, shading the younger trees and reseeding the future generations. And, if you look very closely over the rolling landscape and through the brush, you will see about 500 mostly pine seedlings that have been planted in that area. We'll give them a few years to establish themselves and then we'll check back and plant more in any spaces left by those that didn't survive. It's kind of like a tall perennial garden.

Well, as nice as it would be to spend all day in the forest, we have a lot more to see. The next stop on our tour is Rosewood Studio. The trees cut for this building were milled flat on three sides and left rounded on the fourth. This gives the log building a flat wall on the inside, and shows the natural round logs only on the outside. The fact that these walls are solid wood makes them great at holding out the elements and holding in the heat. As we know already, the heat is all in the floor. In this climate of quick changes of temperature, the Studio keeps a nice even temperature as it is slow to warm or cool. It stays very comfortable year round. The tall ceiling adds to that comfort, being well insulated and lending a nice light and airy atmosphere to the workplace. And a workplace it is! Wall-to-wall sewing machines and organic cotton fabric are stacked everywhere. A variety of clothing styles are designed and constructed here, revolving around jacket specialties and the march of seasons. Production of original styles is balanced between keeping orders from the web site filled, and staying ahead with enough inventory to exhibit at conferences and fairs. One machine in the middle of this swirl of activity is constantly piled high with the scraps from the cutting table. These are sewn into strips to be made into hand woven rugs of both naturally grown and hand dyed colors.

Our next stop is the barn and workshop. Starting at the back, we find the area for livestock production, mostly turkeys and chickens featuring pens made from barn wood recycled from an older barn. The front is the workshop, which has its own wood heating system. We find almost anything needed for equipment repair and maintenance, along with metal work, pottery and wood working tools. Ample lumber racks allow storage and air drying of lumber from the periodic lumber harvests. Once dried, lumber can be worked into usable items for the farm or into occasional items for sale. This has ranged from large items like a log home addition on down to furniture and small home accessories. It is a priority to always look for the most valuable end use of both harvested and recycled materials. All these parts work in harmony to provide a quality of living here always keeping in mind to conserve energy and work with nature.

Before we leave the workshop, what is that car parked there? It's the Endura, an electric car prototype from the late 70's, possibly the only one of its kind, being restored and improved. The plan is to charge it with a solar photovoltiac system, enabling it to run petroleum and pollution free anywhere within a 150 mile round trip.

On then to the farm house. This is not the typical house, as we come first through the office and warehouse. Feel the warmth that flows from the hot water system. Parts of this 2,800 sq. ft. house are over 100 years old and have, through the years and additions, had layers of insulation added along with new windows. The heating system is tied to the domestic electric hot water system with a closed loop heat exchanger. This enables domestic hot water to be heated from the wood heat source with a considerable savings of electricity. On the flip side of this, if one is delayed at returning to stoke the fire and the water cools, the electric tank will kick in as a back-up heat source. A unique gravity water system adds additional energy savings, as do the compact fluorescent bulbs in all the fixtures. A new attached four season solar greenhouse and solar hot water collectors for the roof are planned for the near future.

Do you need an excuse to come back for another visit? Come anytime of the year and perhaps lend a hand in picking some fresh produce in the new greenhouse. We'll have to have a ride in the electric car, too.

Sustainable Agriculture Grant Program

Summary of Grant Funding (1989-2004)

Year	Number of Grants Funded	Total Funding	Average Grant Size	Range
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	$10,000	$4,300 - 20,000
2003*	–	–	–	–
2004*	–	–	–	–
TOTAL	***226***	***$2,455,016***		

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

Program Purpose

The Grant Program provides a unique opportunity for farmers, non-profit 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 982 grant applications and has approved over $2.4 million in funding for 226 projects since the program began in 1989. Project categories include: Alternative Markets and Specialty Crops, Fruits and Vegetables, Cropping Systems and Soil Fertility, and Livestock. There are 24 grant projects throughout the state of Minnesota that are described in *Greenbook 2004*.

Grants provide a maximum of $25,000 for on-farm demonstrations that last up to three 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 over the last three years. To find out more details about these projects, contact the principal investigators directly through the listed telephone numbers, addresses, and email addresses.

Pride of the Prairie: Charting the Course from Sustainable Farms to Local Dinner Plates

Principal Investigator

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Madison, MN
56256
320-752-4700
Multiple Counties

Project Duration

2002 to 2003

ESAP Contact

Jean Ciborowski
651-297-3217

Keywords

identity preserved, locally grown, marketing

Project Summary

Pride of the Prairie is a collaborative effort of western Minnesota farmers, the Land Stewardship Project (LSP), the University of Minnesota at Morris, the West Central Regional Sustainable Development Board, Prairie Renaissance, the West Central Research and Outreach Center (WCROC), and citizens. Our purpose is to promote the production and consumption of locally grown food in our region. We are working to develop a sustainable and secure community-based food system in the Upper Minnesota River Valley that will provide good, safe, and nutritious food, nurture a healthy environment, and develop real economic opportunity for area citizens.

The farmers that began working on this are a blend of established farmers who have been raising and direct marketing food for many years and beginning farmers who are just formulating plans. We have organic vegetable growers, CSA's, an apple orchard, bison producers, goat producers, grain producers and millers, honey producers, as well as farmers who grow beef, pork, chicken, lamb, and eggs.

The Pride of the Prairie producer group's vision for their future, summarized by Mary Jo Forbord, describes the philosophy of the group:

We are a strong community at work to transform our landscape and redevelop our culture in the Upper Minnesota River Valley. The foods that we locally and sustainably produce and consume bring nutritional, environmental, social, economic, and spiritual benefits to our entire region. We are an inclusive and growing network of individuals and families who aim to live healthy, meaningful lives by producing, consuming and marketing the foods grown in our region. Through hard work, pricing transparency, and healthy communication, we will uphold the economic and spiritual advantages of cooperation. We value diversity and strive for economic justice. We celebrate our connection with the land and we dedicate our efforts to all future generations.

Project Description

The project began by connecting with established and beginning farmers in the region who were interested in producing food and marketing it directly to consumers, retail, and institutional food service establishments. Farmers' names were solicited at meetings and conferences and a press release was sent out locally encouraging farmers to call and participate. The response was overwhelming. During a six month period of time, over 150 farmers were interviewed about their farm products, distinguishing production characteristics, pricing and marketing strategies, future plans, the values they brought to their work, and marketing challenges for which they could use information and assistance.

During 2001, a series of workshops occurred in Granite Falls, MN on "Entrepreneurial Agriculture." Workshops were designed around the issues facing farmers who direct market. In addition, the workshops celebrated the foods of the Upper Minnesota River basin. Shortly after, some staff and students of the University of Minnesota at Morris expressed interest in bringing local food into their cafeteria. They were in the process of developing specifications for a new food service contract and knew the time was right to begin this work. Thus ***Pride of the Prairie*** was born.

There are many aspects to developing a local food system. The farmers involved strongly believe that raising food that is sold in the local areas is important for a variety of reasons:

1. It provides a market for a wider variety of crops. Biological diversity is of critical importance, especially here in western Minnesota.

2. It returns more of the economic value of the product to the farmer.

3. It provides economic opportunity for marketers, processors and transporters.

4. It reduces transportation and the use of fossil fuel.

5. It gives non-farm people who buy the food a better understanding of how it is grown and a reason to care about the land.

We recognize that in order to increase the marketing of locally produced food it needs to become easier for the food buyer and for the farmer marketers. Thus, while we continue to recognize the importance of farmers' markets and direct marketing, we want to take it to the next level -- to retailers and to institutions.

The farmer cooperators in this project quickly saw the advantage we could have by working together as a diverse group of farmers with the ability to market many different products. We began describing this farm/product mix as "market basket." The "market basket" of food products included bison, beef, chicken, pork, lamb, goat, eggs, honey, berries, flowers, grains, vegetables, and fruit. It is the group's intention to work together to supply retailers and institutions with diverse products with farm identity preserved.

Over the course of the fall, winter, and spring, a series of meetings and a number of events were sponsored or co-sponsored to begin to make this happen. We generated and tested ideas about how to source food and how to price food. We also held extensive discussions on production techniques and standards. In addition, we talked about how to develop regional food network groups. These events not only provided locally grown food but also provided excellent opportunities to learn more about how to do this, test ideas, and make improvements for the future.

Results

Several activities that directly demonstrate the philosophy and course of the Pride of the Prairie group have occurred. These activities included:

1. Pride of the Prairie provided food product for two University of Minnesota at Morris cafeteria meals during this period. This represents about 1,300 meals.

2. In addition to the University meals, we have provided food product at several major community events in the area. Including:

- Intergenerational Dialogue on the future of rural communities held in Milan, MN. We provided food for a noon meal for about 65 people.
- Alternative Swine Center Appreciation at the West Central Research and Outreach Center. We supplied food for about 125 meals.
- October 2002, Fall Harvest Fest at the University cafeteria. We supplied food for an evening meal for about 600 people.
- "A Taste of Branson" sponsored by the Lac qui Parle Community Education. This event provided the opportunity for Pride of the Prairie farmers to sell product to about 65 attendees.
- Farm Festival and Spring Brunch at the University of Minnesota at Morris. The Festival included a panel discussion of the evolution of agriculture in the area, a farmers' market, and a local foods meal on campus. There were over 500 meals served.

Additionally, we can now identify at least three times the number of restaurants and grocery stores that let the public know they carry locally grown foods. Some of this is the direct result of the work of this project and some is a "ripple effect" of the work through individual farmer participants. Also, we have begun exploring the possibilities for cooperation with two small, area distributors, a produce distributor, and a dairy distributor. Finally, we have laid sufficient groundwork to receive USDA (Cooperative State Research Education and Extension Service, Community Food Security) support to develop our local food distribution model for the next two years.

Management Tips

1. Even if members of the group feel an urgency to develop structure, it's important to move slowly, act together, and learn how to build trust. At the same time, a balance must be struck between process and structure. Keep moving forward on deciding how the group will be structured, but stay open to applying the lessons learned along the way.

2. Having different types of farmers helps to ensure that the product line is diverse.

3. Having a diverse product line puts the group in a position to offer convenience and variety to retail/institutional purchasers.

4. Getting local products into an area food system is a complex task. Farmers can team up with community groups promoting and organizing for a local food system to accomplish more.

Cooperators

Boettcher Vegetable Farm, Montevideo, MN
Moonstone Farm, Montevideo, MN
EarthRise Farm, Lewiston, MN
Stranlund Farm, Montevideo, MN
Red Tail Valley, Granite Falls, MN
Morning has Broken Farm, Granite Falls, MN
Pastures A'Plenty, Kerkhoven, MN
Chippewa Valley Bison, Benson, MN
Coyote Grange, Appleton, MN
CZ Pickins, Dawson, MN
Double D Natural Meats, Milan, MN
Dry Weather Creek Farm, Milan, MN
Easy Bean Farm, Milan, MN
Easy Blooms Flowers, Montevideo, MN
Paul's Prairie Honey, Montevideo, MN
Glacial Acres, Sunburg, MN
J & L Bison, Willmar, MN
Murphy's Organic Farm, Morris, MN
Prairie Horizons Farm, Starbuck, MN
Prairie Wind Farms, Bellingham, MN
Swenson Orchard, Montevideo, MN
University of Minnesota – West Central Research and Outreach Center, Morris, MN
Land Stewardship Project (LSP), Montevideo, MN
Food Alliance Midwest, St. Paul, MN
FoodRoutes, a local foods learning network, Millheim, PA

Project Location

Contact Terry VanDerPol, LSP, 320-269-2105.

Other Resources

Agricultural Marketing Resource Center, 1111 NSRIC, Iowa State University, Ames, IA 50011-3310, 866-277-5567, fax 515-294-9496, email: agmrc@iastate.edu, web site: www.agmrc.org

Appropriate Technology Transfer for Rural Areas (ATTRA) is a national sustainable agriculture information service providing information and other technical assistance to farmers, ranchers, Extension agents, educators, and others involved in sustainable agriculture in the United States. ATTRA's marketing and business web site: attra.ncat.org/marketing.html

FoodRoutes, a local foods learning network. Web site: www.foodroutes.org

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

Principal Investigator

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Dodge, Goodhue, and Wabasha Counties

Project Duration

2002 to 2004

ESAP Contact

Mary Hanks
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Keywords

animal health, antibiotic alternatives, brand standards, consumer education, direct marketing, grass-based dairy products, management intensive rotational grazing

Project Summary

The three member farms of the PastureLand cooperative are working to create public demand for dairy products produced on farms that use management intensive rotational grazing. It is our hope that this project will result in the development of stronger consumer recognition of and demand for dairy products that are made from the milk of grass-fed dairy herds, specifically those marketed under the brand name of the PastureLand dairy cooperative. The project includes three components: helping co-op members to comply with the cooperative's Production and Quality Standards related to limiting antibiotic use; development of a formal business plan for the cooperative with emphasis on marketing and sales strategies; and an intensive consumer education drive in the Twin Cities area.

Project Description

The PastureLand cooperative was incorporated in 1998 with the goal of creating a profitable marketing alternative for the milk of member farms. Each of the member farms of the cooperative uses management intensive rotational grazing. The members of PastureLand have watched commodity prices fluctuate and the dairy industry, both production and processing, become a big-business enterprise. The goal of the cooperative enterprise is to market the distinctive attributes of milk products from grass-fed herds in a way that enables it to return a high, stable pay price for milk to member farmers.

PastureLand hopes to create a market niche that can provide a profitable income for member farms and, in the long run, encourage more family farms to utilize management intensive rotational grazing. After the cooperative began to market cheese and butter in 2000, it became clear that "branding" dairy products from grass-fed cows would be among the biggest challenges in establishing a successful business. With the proliferation of organic and natural foods in the market, consumers are confused and skeptical about a new product that makes health and environmental claims.

This project is designed to help the cooperative address these challenges through three specific work areas:

- Part One of our project focuses on helping member farmers develop methods for complying with the

Roger and Michelle Benrud with daughter, Emily.

Quality and Production Standards established by the cooperative. Members need reliable, effective alternatives to antibiotic treatment for common illnesses in their herds.

- Part Two of this project involves working with a marketing expert to develop a more focused marketing and sales plan for our products, followed by market testing and development of products/ packaging to meet the demand of target markets.
- Part Three involves educating Twin Cities Natural Foods Co-op members and shoppers about products and production methods. As we work with customers face-to-face, we are learning about their buying preferences and reactions to our products. This part will be completed in cooperation with the Food Alliance Midwest.

Though the specific goals and outcome measures for each of these work areas are slightly different, the overall goal of the project is to increase the cooperative's expertise in the complex world of food marketing in order to make "grass-fed" an understood, positive association in the minds of consumers. Product sales will be the primary measurement of the cooperative's success in this endeavor, however, other measurement tools, discussed below, will be used, as well.

Results

Alternatives to Antibiotic Use. The first part of our project involves on-farm testing of alternatives to antibiotic use in PastureLand member herds. After a considerable amount of deliberation, PastureLand members adopted a policy strictly limiting the use of antibiotic treatments in member herds in early 2001. This policy is in direct response to negative consumer feedback about use of antibiotics in dairy animals. At the time the policy was adopted, the PastureLand cooperative also committed itself to assisting member farmers in meeting these standards.

Table 1. Dairy Herd Illness, Treatments and Treatment Outcomes on the Benrud Farm, 2002

Illness	Treatment	Outcome
Metritis (failure to clean after calving)	Tincture of garlic and homeopathic supplements containing caulophyllum and pulsatilla Tincture combined in some cases with an infusion of aloe and iodine into the uterus which shortened the course of treatment if the metritis was noticed immediately while the uterus was still open	Very high success rate Benruds intend to provide additional nutritional mineral supplements to first-calf heifers in the future to reduce this problem.
Static (non-cycling) cows	Tincture of comfrey and homeopathic supplements containing pulsatilla and sepia	Very high success rate
Pinkeye	Concentrated hydrogen peroxide wash in eye and application of garlic tincture 15 calves treated in 2003	Successful in isolated cases After an outbreak of pinkeye, veterinarian recommended vaccination for IBR. Benruds will work to control flies which seem to trigger the illness.
Pneumonia/croup in calves and heifers	Natural "respiratory purge" of wild cherry bark, mullein, horehound, and coltsfoot Tribiotic tincture of garlic, eucalyptus, and goldenseal Aloe pellets administered to clear up cough – less labor than other herbal compounds	Successfully treated one calf in spring of 2002. In the late fall, several calves developed a croupy cough and were treated with the same herbal compound. No significant croup or cough in 2003. Benruds attribute this to more gradual approach to weaning – calves fed 2 gal whole milk/day for 45 days and slowly weaned by 60 days.
Milk Fever	Changed mineral ration in feed early in 2002 to one that contains kelp, hemocell 100 (a probiotic), Redmond salt, GSM mineral, and Solmin Affected cows treated with IV calcium, magnesium, phosphorus, and potassium with calcium bolus administered upon calving the next year	No incidence of milk fever in 2002 and very low incidence in 2003. Benruds attribute this to good nutrition.
Foot Rot	Concentrated hydrogen peroxide foot bath with or without garlic	Very high success rate
Sinus Infection	Garlic tincture for infection and St. John's Wort for pain	Successful

Since early 2002, Roger and Michelle Benrud have kept illness and treatment records for each animal in their herd, with a specific emphasis on monitoring and recording the administration and outcomes of non-antibiotic treatments. Table 1 provides details about specific treatments and outcomes on the Benrud farm for 2002 and 2003.

PastureLand members feel that they have benefited from both the on-farm testing of alternative treatments and the information presented at workshops and field days. Successful utilization of alternatives has become even more important to PastureLand members as organic certification is becoming a reality or a distinct possibility on each farm. Selling milk on the organic market will enable individual members of the cooperative to maximize their family incomes during the period when PastureLand is building toward full utilization of members' output. As a cooperative board, the members are working to make a decision about the value of adding "organic" to the "pasture-fed" marketing approach that PastureLand has employed to date.

Business and Marketing Planning. PastureLand was able to make significant progress toward its goals of market analysis and business/marketing planning. In 2002, we secured the assistance of consultant Jeanne Quan, who designed a market analysis program and business planning process. By mid-year, much of the planning was complete, and late in 2002 we were working to secure new product placements and roll out new butter packaging as called for in the market analysis. John Seymour-Anderson, a graphic designer with a strong interest in sustainably produced products, worked as a team member to help conceptualize the images and language that will sell grass-fed products to customers. Our market research methods can be found in Table 2 of our 2003 Greenbook article. Plans were updated in 2003 and priority goals for marketing were determined.

Our goals for 2003 included:

- increasing sales of PastureLand branded products;
- creating product "buzz" by visiting food writers, chefs, and other food opinion leaders; and
- creating point-of-sale materials to promote brand recognition.

We project a doubling of product sales in 2003 to over $100,000 due to increased sales efforts, revised packaging/ marketing materials and consumer education. We met with or spoke to several opinion leaders to get feedback on our products. Many were unaware of our brand and we believe that this increased attention to this audience will help further increase sales. On the third goal, with the help of the Food Alliance Midwest, shelf talkers, rail strips, and cooler clings have been designed and are in use at the beginning of 2004.

Consumer Education. The third part of the PastureLand project was in the spring of 2003. We had initially proposed working with the Food Alliance Midwest to conduct a consumer education campaign in the Rochester, MN area. Because of staffing changes and other considerations, the location of this campaign was moved to the Twin Cities metro area, with an emphasis on shoppers at the Twin Cities Natural Food Cooperatives (TCNFC).

The focus of the consumer education campaign was threefold: 1) in-person product demonstrations in co-op stores; 2) placement of longer-format articles and other information about PastureLand in the newsletters of the food cooperatives; and 3) placement of advertisements or running product sales in order to attract attention and new consumers to our brand.

To the degree possible, we have tracked the sales outcomes of these efforts. In addition, we hope to conduct some in-store surveys with buyers and consumers early in 2004 to gauge how much of our grass-fed message and brand identity "stuck" with people who first encountered it in 2003.

Product demonstrations were conducted in 11 retail locations during 2003 (ten of these locations are natural foods cooperatives). As an example of the impact of product demos and other consumer education efforts, sales at one Twin Cities co-op increased from $375 for the period of January through March to $823 for April through June to $1,462 for July through September.

In general, we found that product demonstrations are essential to increasing brand recognition in the retail setting. This is true even in the smaller, more intimate setting of the food cooperative. There are enough brands of butter and premium cheese on the market that consumers rarely look past their favorite brand when shopping. We also found that our brand name is often confused with other brands with similar names or packaging. Demonstrations must be held on a regular, or at least cyclical basis, in order to remind shoppers of our presence and capture new consumers who might be unaware of our brand. This is a significant expense in either time or money and will need to be figured into our operation and promotional budgets in the future.

Long-format articles are much more effective in reaching out to new consumers than product advertisements. This could be because of a very weak history in product advertisements in most co-op newsletters, but it also speaks to the willingness of natural foods consumers to learn more about the foods they purchase and consume. These articles are particularly helpful when combined with product demos.

Finally, we have found that we achieved much more sustained sales success in Twin Cities food co-ops than in some of the suburban co-ops. We attribute this success to a longer history with these particular co-ops (we first placed product in some of the Minneapolis co-ops over two years ago) as well as a critical mass of shoppers and food cooperatives within the core cities. This larger customer base helps us a great deal by increasing word-of-mouth publicity and exposing customers to our logo, name, and products in multiple locations. Suburban co-op shoppers seem more price-conscious and less aware of the benefits of local agriculture. These stores also have a significantly larger product mark-up than many of the food co-ops in the central cities. As a result, our products can cost $.50 to $2.00 more per pound in these stores than in the co-ops located in Minneapolis and St. Paul.

Management Tips

1. It is essential that the "big picture" be considered when treating animals for illnesses that traditionally have responded to antibiotics. The animal's nutrition, health history, physical environment, and many other factors are important clues in determining a preventative approach to illness in dairy herds.

2. Thoughtful (and successful!) marketing efforts must rely on good record keeping. We have spent much of 2002-2003 refining our bookkeeping practices in order to better understand where we are gaining or losing ground with regard to marketing our products.

3. If we were starting today, we would try to place more emphasis on marketing. It is the part of this business that is most critical to our success, but the hardest to do without connections and knowledge of this field.

4. Modifying or customizing our business plan to take into account our current resources and strengths has helped us continue to grow during this calendar year. For example, we focused on sales and marketing (an area in which we have resources and growing expertise) instead of product and packaging development (an area which would have required us to purchase costly staff or consulting time, with less immediate financial gain).

5. While it was a good learning experience to design our own logo and labels, the help of marketing professionals is valuable. It would have been helpful to know these people and solicit their help in the first place.

Cooperators

Dan and Muriel French, DMJ Farms, Mantorville, MN
Ralph and Phyllis Stelling, Dennis and Ronda Stelling, Ral-Den Dairy, Millville, MN
Roger and Michelle Benrud, Goodhue, MN
Jon Kaiser, Mantorville, MN
Food Alliance Midwest, St. Paul, MN
Kirsten Bansen Weigle, PastureLand Cooperative, St. Michael, MN
Jeanne Quan, Jeanne Quan Fine Food Marketing, St. Paul, MN
John Seymour-Anderson, Minneapolis, MN
Dr. Paul Detloff, Arcadia, WI

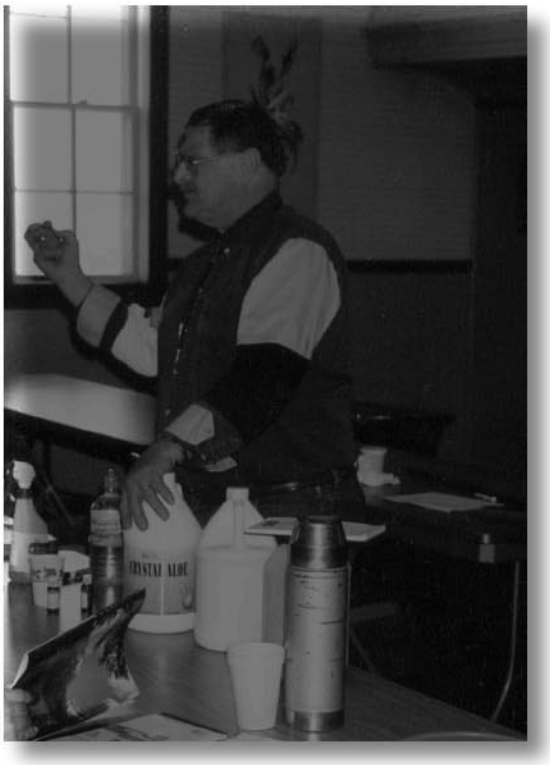
Project Location

For DMJ Farm: From Hwy. 52 exit on Hwy. 57. Follow Hwy. 57 17 miles south. The Co-op's warehouse and office facilities are also located at DMJ Farm. Directions to other co-op members' farms can be obtained from Dan French.

Other Resources

Food Alliance Midwest. 400 Sibley Ave., Ste Y, St. Paul, MN 55102, 651-265-3682. Available at: www.thefoodalliance.org/midwest

PastureLand information available at: www.pastureland.net



Dr. Paul Detloff presenting at PastureLand's Field Day.

Collaborative Character Wood Production and Marketing Project

Principal Investigator

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Ramsey County

Project Duration

2002 to 2003

ESAP Contact

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Keywords

alternative markets, cooperative development, sustainable forestry

Project Summary

Most of Minnesota's non-industrial private woodlots have suffered from high-grading (harvesting the high value trees and leaving behind the degraded material) and other logging practices that have left them in various states of degradation. In spite of this, these woodlands can still afford farmers and other landowners with economic opportunity. This project seeks to show how these woodlands can be improved ecologically and, at the same time, contribute to the total on-farm income. This can be done through processing and marketing of specialty wood pieces – character wood – for sale to woodworkers.

The idea for a collaborative character wood production and marketing project arose out of several discussions among private non-industrial woodland owners in Minnesota, woodworkers, and Cooperative Development Services, a non-profit organization working with landowners to develop cooperative businesses. As a result of the discussions, several woodland owner cooperatives have formed in the last few years. These woodland owners believe that they can develop a win-win relationship with Minnesota woodworkers by selling character wood directly to the people who use it. Character wood includes burls, crotches, figured wood, and wood with unusual graining such as birds-eye maple.

Project Description

Three woodland owner cooperatives, each located in a different part of the state, took part in this project: Cook County Sustainable Forestry Cooperative, based in Grand Marais; Woodlands Cooperative, based in Milaca; and Northwoods Forestry Cooperative, based in Aitkin. These cooperatives have a total of about 50 members together managing over 3,000 acres. The cooperatives are dedicated to helping these members meet their management and financial goals for their woodlands.

The woodlands owned by members of the co-ops are made up mostly of mixed hardwoods including maple, oak, ash, cherry, and other species. As with most of Minnesota's forests, the members' woodlands are, to some degree, degraded by the high-yield and unsustainable logging practices of the past.

Character wood is generally considered to be of little or no value in the traditional timber industry. As a result, a disproportionately high percentage of the timber that remains in today's degraded woodlots consists of character wood. The term character wood encompasses a tremendous variation in species, growth forms, grades, and

Black ash burls.

anatomical parts of a tree. Character wood can be generally defined as wood with unusual graining or other qualities that make it unusual.

The traditional lumber industry looks for straight-grained wood with few or no knots. The grain of wood is influenced by a variety of factors. A few of these include how fast the tree grew each year of its life; the degree to which the branch or trunk the board was derived from was straight or curved; whether the piece was cut at an intersection of branches, such as a crotch; any diseases the tree may have been afflicted with, such as spalted wood that has been infected with a fungus; deformities such as burls; and the presence of other patterns such as birds-eye maple. All of these "defects" create qualities coveted by furniture makers and other woodworkers.

Other types of character or specialty wood include pieces that are cut to the specifications of a woodworker, such as pieces with the bark left on the edges; cut to a greater thickness than typical boards; or boards cut from the same log and sold together, thus retaining the same grain pattern as one another.

How is character wood related to sustainable forestry? For many Minnesota woodland owners, one of the first steps toward improving the health of their forests is to undertake some kind of timber stand improvement, the equivalent of weeding an overgrown garden. In many cases, neglected or degraded woodlots have experienced one or more high grade harvests and are left damaged by the heavy equipment and the removal of the harvested trees. In order to bring the forest back to a state of ecological health and economic potential, it is important to remove weedy or undesirable species and make way for the desired species and composition to grow.

Through the course of timber stand improvement and the restoration harvests that are a critical part of improving a forest stand, many of the character wood pieces can be set aside for processing and marketing to woodworkers. In the long term, the forests will be improved ecologically while contributing to the bottom line.

Results

Each of the three cooperatives hosted a character wood field day. In all, over 100 people attended these events. Each of the field days included a variety of demonstrations and speakers on the topic of character wood. Foresters, woodworkers, sawyers, and loggers offered their experience and insight on locating, harvesting, processing, and marketing character wood.

At each event, experienced foresters walked through the woods with the participants to demonstrate techniques for locating and harvesting character wood. A portable mill was set up at each event to demonstrate specialized techniques for sawing various pieces of wood to the dimensions desired by the woodworker. Each event included lively discussions about marketing possibilities. In addition, contacts were made with the Minnesota Woodworkers Guild and with individual woodworkers regarding potential sales of co-op produced character wood directly to woodworkers.

Chuck Ouimette, forester and owner of Custom Wood Products based in Hazelhurst, WI, developed a spreadsheet tool that can be used by woodland owners and woodland owner co-ops to estimate their annual yield of character wood. The spreadsheet is based on Mr. Ouimette's extensive cruising of timber stands in Wisconsin and Minnesota, as well as his own experience processing character wood. This tool is available free of charge through CDS for woodland owner cooperatives in Minnesota. The spreadsheet gives a best estimate of one experienced professional, and actual numbers will vary depending on the make-up of each unique woodlot. Based on Ouimette's calculations, the following scenario can be surmised:

Assuming the members of the Woodlands, Cook County, and Northwoods cooperatives own a total of 3,250 acres, a harvest on an annual cycle of 10% per year and yielding 10 cords/A, would be a total annual harvest of 3,250 cords. Of this wood, some would be marketed to traditional markets to be sawn as lumber, some would be marketable as character wood, and some would be sold as pulpwood. If we make the very conservative estimate that 10% could be marketed as character wood (Ouimette's conservative estimate is 30%), the annual character wood harvest would be 325 cords. According to Ouimette's estimates, this would amount to about 292,500 board feet/year of character wood. If we estimate an average price of $2/board foot for Minnesota character wood, this amounts to about $585,000 or $180/A.

According to Jeff Zinsli, President of the Minnesota Woodworkers Guild, there are about 800 members of the Guild in Minnesota. The average subscriber to Woodworking Magazine purchases 958 board feet of lumber per year at a cost of $5,300 per year. This amounts to an average cost per board foot of $5.53. If we assume that Minnesota's woodworkers purchase the same amount of wood as the national average, the 800 members of the Guild (only a small percentage of total woodworkers in the state) account for 766,400 board feet of character wood per year. If Minnesota woodland owner cooperatives were able to

capture one eighth of the character wood purchased by members of the Minnesota Woodworkers Guild, they could sell 95,800 board feet/year, or about one third of the estimated character wood harvest. The Character Wood Collaborative should attempt to develop a close relationship with the Minnesota Woodworkers Guild.

In addition, the Collaborative should look at tapping into other local networks of woodworkers such as the local chapters of the Minnesota Woodturners Association. Minnesota's woodland owner cooperatives should consider looking more closely at working with woodland owner cooperatives in Wisconsin and Iowa. Preliminary discussions have already taken place among co-ops in the three states, and there appears to be good potential for the creation of a regional Character Wood Production and Marketing Cooperative. Some key considerations for such an organization, whether organized at the state or regional level are:

1. It would make sense for the Collaborative to be structured as a secondary cooperative (one whose members are cooperatives). Woodland owner cooperatives throughout the state (or region) would come together to form a legal entity formalizing their relationship.

2. The cooperatives should continue to develop techniques for harvesting, storing, and processing character wood. This project has begun the process, including introducing many woodland owners to the concept of character wood and how to recognize it on their own land. Important issues to address include:

- determine the species and types of character wood that are sought after;
- learn about drying, milling, or other processing specifications; and
- develop a pricing structure for sale of odd-dimension pieces such as burls and crotches.

3. While the individual cooperatives are developing techniques for harvesting and processing character wood, they should be developing the ability to maintain a joint inventory system, where a record of the total character wood inventory of all cooperatives involved is kept. A shared inventory would allow cooperatives in different parts of the state or region to combine their inventory for large orders or to offer a wider range of species and a greater selection of pieces. The inventory system would have to include a means of tracking each piece of wood in order to accurately return profit for each sale to the landowner.

4. Use of the internet as a marketing/sales tool should be explored. There are a couple of existing sites that may serve as examples of the kinds of things a web site can do, including www.specialforestproducts.com.

Over all, some important steps have been made toward the creation and development of a character wood processing and marketing collaborative. In particular, more and more of Minnesota's woodland owners are becoming aware of a market opportunity for products that exist in their woodlots.

Management Tips

1. If you are hiring a professional to do timber stand improvement on your land, or if you are doing it yourself, be on the lookout for pieces of wood that can be cut in such a way as to be marketable as character wood. You or your crew should be knowledgeable about the kinds of wood that are saleable as character wood before you begin cutting. Set these pieces aside as you work.

2. A key first step in pursuing markets for character wood is to find out what products are in demand. Attend one of the woodworking shows held annually in the Twin Cities and elsewhere in the Midwest. Bring a large sampling of character wood pieces to sell. This is a good place to distribute the woodworker survey available through Cooperative Development Services. Revenues from such an effort could go toward continued market research activities agreed upon by the group.

Cooperators

Shelly Larson, Woodlands Cooperative, Milaca, MN
Chuck Ouimette, Custom Wood Products, Hazelhurst, WI
Mark Adams, Cook County Sustainable Forest Cooperative, Grand Marais, MN
Gary Bradford, Northwoods Forestry Cooperative, Aitkin, MN
Kevin Edberg, Cooperative Development Services, St. Paul, MN

Project Location

Contact Isaac Nadeau at 651-228-0213 for locations.

Other Resources

Community Forestry Resource Center web site:
www.forestrycenter.org

Contact Cooperative Development Services for copies of the "Woodworker Survey" and Chuck Ouimette's spreadsheet "Potential Supply Implications for Character Wood."

Cooperative Development Services. 2002. Balancing Ecology and Economics: A Start-up Guide for Forest Owner Cooperation. 400 Selby Avenue, Suite Y, St. Paul, MN, 651-287-0184.

This is a good web site to begin exploring the internet as a marketing tool for character wood:
www.specialforestproducts.com

Woodworking shows are held at over 50 locations each year around the country, including in the Twin Cities. Attendance at one of these shows, either as a participant or as a seller, would provide valuable information to character wood marketers. There are also several magazines aimed at woodworkers, including *Woodworking Magazine*. These help provide information on the kinds of wood woodworkers are looking for.

Roger Howard with turned bowls.

Creating Consumer Demand for Sustainable Squash with Labels and Education

Principal Investigator

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Project Duration

2002 to 2003

ESAP Contact

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Keywords

labeling, marketing, sustainable growing practices, winter squash

Project Summary

Our main reason for starting this project was to increase consumer demand and awareness of sustainably produced winter squash. Using the Food Alliance Midwest (FAMW) seal of approval, we hope to create new market share, increase profitability, and raise awareness of sustainable agriculture at a commercial food retail level. Farmers whose products bear the FAMW seal meet strict standards in the areas of pest and disease management, soil and water conservation, and human resources development. We need to educate consumers on new crops as well as existing crops that are grown more efficiently and with environmentally sound sustainable growing practices such as integrated pest management and soil conservation practices.

Project Description

A product can fetch a premium price if it offers the consumer the "little extras" that let them know how the product is good for them. These extras can come in many forms. Nutritional content and ease of preparation are benefits as is having a product produced locally. Environmentally friendly growing practices can also be beneficial. If all of these benefits are combined and marketed to the consumer, they also benefit the farm and community. At Pahl's, we strive for a premium product with a larger market share and one that is produced with reduced farm inputs. We started our project with one product – winter squash – and hope to create demand for this product, and eventually others, using the above philosophy.

Winter squash demand has been declining for the past ten years. As a grower who produces 100 acres of assorted squashes, we continually ask ourselves, "Is there anything we can be doing to increase our market share of winter squash?" During the fall of 2002, we coordinated our efforts with Food Alliance Midwest (FAMW) in labeling winter squash designated to certain markets to try and increase not only our market share but to increase the consumer's knowledge of winter squash. (The FAMW is an independent third party. They endorse farms that meet their strict requirements and allow the growers' products to carry their seal of approval.) Our goal was to label squash with cooking instructions, nutritional values, and PLU (Price Look Up code) numbers. By doing so, we were hoping to create better demand from the younger generation that no

Squash with labels.

longer likes to cook; make it easier for the cashiers at the checkout counters with our PLU's; and lastly, we hoped to command a higher price for a superior product.

Achieving a higher price for any product is always a difficult task. When we started, we thought that our extra service and attention to this product as compared to other Minnesota growers would give us an advantage with the produce buyers. In-store demonstrations and one-on-one customer relations proved to be very fruitful. However, a grocer is looking to maximize his sales floor to the "highest volume product multiplied by the best margin which achieves the best profit scenario." By providing the labels, we convinced the grocer that there would be fewer mistakes at the checkout lane, the checkout process would be faster, and, ultimately, more money would be made. We also convinced them that the labels would encourage more impulse buying and create a larger demand from a more diverse group of people. Lastly, with the FAMW seal of approval, we were able to promote sustainable agriculture to consumers and command a higher price from the wholesaler.

During the project, we started our marketing effort in the metro area and northern Minnesota, and expanded it to our other customers in the Upper Midwest. Our goal, in the first two years, was to monitor the labeling so we could see how much of an increase in sales and profit the labeling caused. Every aspect of our project can be measured directly through the addition of labels on the squash. Our goal is to increase the amount of winter squash sold per retail outlet where we market.

Project Results

Three things happened that were of significant value. By putting on labels, we created more consumer awareness of winter squash and sold our product faster. We created demand that was not there in previous years because the consumer did not know enough about the product. Our average customer buying winter squash in the past five years has been 60+ years old. With the labeling and the increase of store demonstrations, we were able to target a younger customer, making them aware of how to prepare it and what to prepare it with. We expanded our customer base to include a younger clientele.

Secondly, we created more demand for our wholesalers. They were able to sell and market more winter squash. They specifically requested that the squash be labeled because they felt it fueled sales. It put our labeled product at a distinct advantage in the beginning of the year. However, as more squash became available during the fall season, they were reluctant to keep paying a premium for the labeled squash.

Lastly, with the increase in sales and extended effort put into marketing, the retailer was more willing to run more fall specials featuring winter squash. Their receptiveness towards labels with PLU's and cooking instructions, in store demonstrations, and increased customer service proved to push demand faster.

This project confirmed what we believed from the start. Consumers are thirsty for information about the products they buy including how to cook them. This in turn increases demand for the product that we sell to our wholesalers and retailers. By creating labels with PLU's and cooking instructions we differentiated ourselves from the other producers that wholesalers and retailers bought from. By doing this, the wholesalers and retailers saw an increased demand for the products that were purchased from us. We also felt we created a larger customer base with greater demand that allowed us to charge a higher price.

In the last year of our project, we were so convinced that we were on the right track that we expanded our program to other customers in the Upper Midwest. Using our label, we marketed our squash to new customers. Our product was well received and pushed up demand more than 20%. Not only was demand up, but we were also able to demand a price of nearly $1/box more than our competitors. The labels cost $.50/box, therefore, we were able to capture an additional $.50 in profit for the same squash.

A good example of how well our labeling did is the following. We had a customer who wanted us to cut the price for his weekly ad promotion. We told him that, if he wanted squash at that particular price, we could not afford to put labels on his squash. He said that would be fine, his volume dropped during the ad week. He didn't even sell as much as the week prior to the ad. He dropped his price from $.69/lb to $.29/lb. The following week we resumed stickering and he increased his price to $.49/lb and he sold the same volume as two weeks prior. The buyer and I had a conversation about the difference in the amount sold and we both agreed it was because of the stickering. The bottom line for labeling with the PLU's and providing cooking instructions is that we created more consumer awareness for winter squash and we created more demand from our existing customers - up 20%. Additionally, we eliminated confusion at the checkout counter by using PLU's and created a positive experience for the consumer when it came to making a choice about which product to purchase.

Management Tips

1. You must have a quality product. People buy with their eyes.

2. Be an aggressive marketer who is willing to spend time with the consumer by means of product demonstrations and other promotions.

3. Be efficient on the packing line. This labor is your largest cost.

4. Track who is getting the labeled product and who is not. Is there any increase in sales due to the labels?

Cooperators

Food Alliance Midwest, St. Paul, MN
H. Brooks and Company, New Brighton, MN
Wholesale Produce and Supply Company, Minneapolis, MN
Hy-Vee, Rochester, MN

Project Location

Pahl Farms is located 4 miles east of I-35 on Cty. Rd. 46 in Apple Valley.

Other Resources

Barco Labels, 1530 Glenlake Ave., Itasca, IL 60143-1173.
Web site: www.barcolabels.com
Custom label makers.

Food Alliance Midwest, Blair Arcade West, 400 Selby Ave., St. Paul, MN 55102, 651-265-3682. Web site: http://www.thefoodalliance.org/midwest.html

US Food and Drug Administration – Center for Food Safety and Applied Nutrition. 2000. Guidance on how to understand and use the nutrition fact panels on food labels. Web site: www.cfsan.fda.gov/~dms/foodlab.html

The Packer, 10901 W. 84th Terrace, Lenexa, KS 66214.
Web site: www.thepacker.com
Produce industry publication.

Integrated Demonstration of Native Forb Seed Production Systems and Prairie Land Restoration

Principal Investigator

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Project Duration

2001 to 2003

ESAP Contact

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Keywords

narrow leaf coneflower, native forb seed, prairie land restoration, purple prairie clover, seed production

Project Summary

This project was designed to demonstrate the production of native forb seed. Demand for the seed is growing. Native forbs are used for native prairie seedings such as CRP, wildlife acreages, roadsides, and landscaping. Some species are sought after for medicinal purposes. Native forb seed production could be a way for Minnesota farms to diversify into a new enterprise, decrease the amount and cost of annual crop inputs, improve profitability, increase crop rotation lengths and options, provide a wildlife friendly habitat, and make available a constant supply of native forb seed. My project looked at producing native forb seed in an economical and sustainable manner. My goals for this project were to find a new enterprise for our farm, reduce crop inputs, and ultimately become more profitable.

Project Description

Our farm is located in the west central part of Minnesota near the small farming community of Hancock. The landscape is diverse ranging from rolling hills to flat valleys. Historically, the land was covered by tall-grass prairie. The region is on the border of the lake country. Lakes, rivers, and wetlands speckle the countryside. The soil types vary from heavy clays to light sandy soils. Irrigation is prevalent on the lighter soils in the region. The main farm products of the region are corn, soybeans, swine, and beef cattle.

I farm in partnership with my brother, Randy, and his family. We raise the traditional crops of corn, soybeans, and alfalfa. Approximately half of our cropland is irrigated. In addition, we maintain a beef cow/calf herd, which is grazed on cool season grass pastures from May to October and on corn stover as late as the winter allows. As much as possible the beef cattle are wintered in pastures and on crop residues. Supplement and hay are fed in different areas in an attempt to spread the manure and nutrients across the field. The cattle are placed in a dry lot in extreme weather and just prior to calving. All the land is rented. Both my brother and I have jobs off the farm and do the farm work in the evenings and on weekends. We are very fortunate to have two outstanding part-time employees who are able and willing to work in the evenings and on weekends as well. Randy's wife, Lynn, maintains our financial records and his kids love to help out with the daily chores.

Most farmers have come to realize that margins are small on traditional crops and livestock. However, it is very difficult to break out of the pattern. The uncertainty of trying new ideas and the expense of new machinery makes it nearly impossible. Nonetheless, I am always looking for crops

Purple prairie clover plot (winter 2003/04).

that could fit our farm and allow us to become more diversified. Part of my off the farm job gives me the opportunity to work with native prairies. This has made me more aware of the importance of maintaining our existing prairies and increasing them if possible. I found one of the roadblocks to seeding more land into native prairie was the cost of the seed. Native grass seed prices have become more stable, however native forb seed prices are extremely high. Producing native forb seed could potentially allow family farms to diversify into a new crop, provide a stable market for native forb seed, and allow for more native prairie to be seeded. Other attributes are that the native plants grow best on marginal soils, and once established, can be harvested for up to 20 years, limiting the amount of fuel and chemicals used in their production.

Certified purple prairie clover and narrow leaf coneflower seeds were ordered from the USDA Plant Materials Center in Bismarck, ND. In the spring of 2001, a demonstration site was selected and the ground was tilled with a disk finisher. The 2.5 acre site was then packed twice with a roller packer. A no-till grass drill was used to solid seed the purple prairie clover seed at a 6 lb/A rate. Herbicide use was kept at a minimum as weeds were controlled by tillage and mechanically mowing the site.

Results

The purple prairie clover was evaluated on two levels (Table 1). I evaluated both the agronomics and the economics of producing native forb seed. The stands were rated on a 1-10 scale with 10 being the most desirable. A 10 rating equaled 100% of the seeds germinating the first year and 100% of the plants surviving the subsequent years. I took 12 ratings over the demonstration plot and then averaged the ratings.

2001: Weeds were controlled by hand weeding and mowing.

2002: Weeds became more of a problem during the growing season. The plot was mowed in early June of 2002 and then sprayed with 8 oz/A of herbicide in July of 2002. Fall of 2002 plant counts rated again at a 3 indicating no decline over the second growing season.

2003: In June of 2003, the purple prairie clover plots declined to a 2 rating (20% stand). This may be explained by the relatively snowless winter and a spring which brought harsh weather conditions. The plots were again sprayed with herbicide in June of 2003. Control of weeds in native forbs continued to be a problem with a lack of herbicide options. It appeared obvious in August that, due to the poor stands and weed infestation, a fall seed harvest was out of the question. The plots were mowed to control the weeds. It should be noted that, typically, the better stands were in a more protected area of the plot.

Seed generally can be harvested the third year after seeding. However, due to the poor stand, no seed was harvested during the project. In fields with good stands, seed can be harvested for up to 20 years with very few input costs.

The narrow leaf coneflower part of the project was not completed. The seeding method for the narrow leaf coneflower was a problem throughout the life of the project. The recommended seeding amount was 2 lb/A in 60" row widths. This type of delivery is best accomplished with specialized seeding equipment similar to research plot equipment. I initially tried to modify a drill to plant the seed into 60" rows and then tried a corn planter with small plates. I was unable to calibrate the drill low enough and get the seed to fall into the seeding tubes. As a result, there was simply too little seed available to try another method such as solid seeding and therefore, coneflower was not grown.

The narrow leaf coneflower seed is very expensive and extreme care must be taken to ensure that favorable seeding conditions exist. In 2002, certified native forb seed supply was limited and I was unable to purchase additional seed of purple prairie clover and narrow leaf coneflower. As a result, I was unable to continue the narrow leaf coneflower experiment because I had no leftover seed from 2001.

Table 1. Purple Prairie Clover Stand Ratings[1] and Input Costs

Year	Fall Rating	After Winter Rating	Input Costs[2]
2001	5	3	$831/A
2002	3	2	$114/A
2003	2	---	$290/A

1. Stands were rated on a 1-10 scale with 10 being the most desirable. A 10 rating equaled 100% of the seeds germinating the first year and 100% of the plants surviving the subsequent years. Twelve ratings were taken over the demonstration plot and then averaged.

2. Input production costs (data collection and unit purchasing costs not included). The inputs in 2001 were seed, tractor rent, labor, (including time spent hand weeding, mowing, seeding, and field tillage). The 2002 and 2003 inputs were herbicide, herbicide application, tractor rent, and labor including mowing and hand weeding.

Management Tips

1. It has been said a person learns more in failure than in success. This was certainly a case in point. The seeding rates I used were based on recommendation from Bismarck, ND. In retrospect, the seeding rates should have been increased to reflect the regions higher rainfall and higher weed pressure. I would recommend a seeding rate in the range of 8-12 lb/A, similar to alfalfa.

2. In order to decrease seed costs, I would recommend foregoing certified seed. The purchased seed should have a minimal amount of weed seed and a relatively high germination rate. In the case of native forbs, 70% would be a realistic germination rate.

3. Concentrate on making a good seedbed before seeding. Pack the soil so that it will only leave a .5" to 1" impression when stepping on the soil.

4. Pay particular attention to weeds. Spraying the site first with Roundup would be helpful.

5. Seed is expensive so it is important to calibrate the drill to ensure proper seeding rates and seed depth. Start by seeding a small area and then check the actual seeding rate, seed depth, and drill.

6. Weed control after establishment is critical when producing seed. If hand and mechanical weeding are insufficient, Plateau herbicide is moderately effective at controlling weeds. The recommended rate from the herbicide company for purple prairie clover is 8 oz/A either pre- or post-emergence. The rate recommendations and effectiveness will vary depending on the type of native forb or grass.

Cooperators

Dwight Tober, USDA, NRCS, Plant Materials Center, Bismarck, ND
Allen Holleman, Marketing Representative, Agassiz Seed Company, Hawley, MN
Margaret Kuchenreuther, University of MN, Morris, MN
Darrel Haugen, USFWS, Morris, MN
Av Singh, University of MN, West Central Research and Outreach Center, Morris, MN

Project Location

Drive 4.5 miles east of Hancock, MN on Stevens Cty. Hwy. 8. This will change to Pope Cty. 1. The certified native forb seed production site is on the north side of the highway.

Other Resources

Bismarck Plant Materials Center and Ducks Unlimited. 1995. Rebuilding your land with native grasses. USDA-NRCS Bismarck Plant Materials Center and Ducks Unlimited. Canada. 12pp. (Publication #2007)

Dodds, D., J. Carter, D. Meyer, and R. Haas. 1987. Grass seed production in North Dakota. NDSU Cooperative Extension Service, R-917, Feb. 1987. 30pp. (Publication #1805)

Haas, R. and L.K. Holzworth, et al. 1997. Native grass seed production manual. Cooperative Publication of USDA-NRCS Plant Materials Program. Ducks Unlimited Canada, Manitoba Forage Seed Association, and University of Manitoba. 155pp. (Publication #292)

Knudson, M.J. 1998. Plant Guide: *Helianthus pauciflorus* (stiff sunflower). USDA-NRCS Bismarck Plant Materials Center. Bismarck, ND. 1p. (Publication #1353)

Knudson, M.J. 1998. Planting Guide: *Helianthus pauciflorus* (stiff sunflower). USDA-NRCS Bismarck Plant Materials Center. Bismarck, ND. 1p. (Publication #173)

Packard, S., C. Mutel, et al. 1997. The Tallgrass Restoration Handbook for Prairies, Savannas, and Woodlands. Papers presented at the Society for Ecological Restoration's Second Annual Conference in Chicago, 1990. Island Press. Washington D.C.

United States Department of Agriculture – Natural Resources Conservation Service - The Plant Materials Program. Web site: http://plant-materials.nrcs.usda.gov/

Root Cellaring and Computer-controlled Ventilation for Efficient Storage of Organic Vegetables in a Northern Market

Principal Investigator

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Carlton County

Project Duration

2001 to 2003

ESAP Contact

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Keywords

community supported agriculture, organic vegetable production, post-harvest handling, season extension

Project Summary

We designed and installed an automated temperature control and monitoring system in our new root cellar. We demonstrated the efficiency and cost effectiveness of using the earth's natural temperature differences to heat and cool a space for vegetable storage. The environmental benefits of this project are tremendous. Instead of buying produce trucked in from thousands of miles away and stored in warehouses heated and cooled by fossil fuels, our customers are purchasing high quality produce, grown locally, and stored using a minimum of energy.

Project Description

Our family owns and operates a certified organic Community Supported Agriculture (CSA) farm 25 miles southwest of Duluth. We offer 100 summer vegetable shares (available from mid-June through mid-October) and 36 winter vegetable shares. The farm is diversified, producing meat chickens, turkeys, and eggs. The meat chickens and turkeys are raised in pastured poultry pens and add soil fertility to our vegetable crop rotation. The winter shares include a variety of vegetables for freezing, canning, and storage including carrots, beets, squash, and potatoes. Winter shares have worked well but participation has been limited because most customers lack adequate storage facilities in their homes.

Our marketing strategy also includes wholesaling vegetables to the Whole Foods Co-op in Duluth. We have a reputation for high quality with the Co-op clientele and have worked hard to maintain a good relationship with their produce department. The produce manager recognizes the superior quality of local produce and is eager to obtain vegetables locally over a longer portion of the year.

Our labor force in 2003 consisted of our two sons, Ben and Janaki, our friend and longtime employee, Dave Hanlon, a former intern, Teri Sackmeister, and one short-term intern, in addition to myself. It is very rewarding to have committed, long-term workers.

In 1999, we decided the time was right to build a root cellar to extend the period of time we could provide vegetables to both the Co-op and our CSA members. In the summer of 2000, we built a 24' x 32' root cellar with an attached 24' x 20' packing shed. The root cellar has a number of unique design

Unwashed carrots stored in pallet boxes.

features. It is built into a hill so that a van, pickup truck, or small tractor can back completely into the structure. This allows for efficient loading and unloading of vegetables.

Fans were installed to draw in outside air and lower the root cellar temperatures in the fall. A ventilation control and monitoring system was installed. Whenever the outside temperature is lower than that of the root cellar, the fans come on and blow in cool air until the inside temperature reaches the desired level or until the outside and inside temperatures equalize.

The monitor stores temperature information for each of three rooms in the root cellar and the outside temperature every half hour. This information can then be downloaded and printed out. The monitoring system enables us to document the overall performance of the root cellar so we can pass this information on to interested parties. Cindy Tong, University of Minnesota post-harvest handling specialist, maintains current temperature data on a web site at: http://smfarm.coafes.umn.edu.

Results

Gross sales increase due to the addition of the root cellar (over 2000 baseline). In 2001, the root cellar increased our gross income by $10,000 in CSA sales and by $2,400 in extended season sales to the Whole Foods Co-op. We limited the expansion of CSA winter shares until we could ensure our ability to operate the root cellar dependably. We experienced an ongoing increase in demand from our committed CSA customers.

In 2002, season extension increased CSA sales by $10,500 and Co-op sales by $3,000 over the 2000 baseline. We achieved the steady growth and customer base we planned for.

In 2003, the root cellar increased our income over the 2000 baseline by $10,750 in CSA sales, $5,000 in extended season sales to the Whole Foods Co-op and $2,600 in extended season sales to Roots and Fruits, a wholesaler in the Twin Cities.

Control and monitoring system performance. The control and monitoring system was more time consuming than we had expected. Time was spent monitoring the equipment, reporting malfunctions, replacing a computer, and learning how to make graphs. We had problems with motorized dampers not closing and temperature sensors not being accurate. When these mishaps occur, the entire stored crop becomes vulnerable to potentially devastating temperature swings. The entire system is vulnerable to electrical storms. We would have been completely baf ed without the assistance of our sons, Ben and Janaki.

Root cellar improvements. In 2000, the cellar walls were insulated on the outside with 2" Styrofoam to a depth of 2'. At the 2' level, the ground was insulated horizontally from the building to a distance of 4'. This allows the building to be maintained at the earth's ambient belowground temperature (approximately 45ºF). The earth's thermal mass serves both to heat the structure in winter and cool it in summer.

In August, 2001 we were forced to re-insulate the outside wall and surrounding surface due to excessive settling of the previous year's backfill. A gap had developed at the top of the foundation, allowing any surface water to funnel down the foundation wall. We decided to take this opportunity to extend the horizontal insulation from 4' to 8' since it would cost only $400 more than the original design.

This improvement paid off during the summers of 2002 and 2003 by keeping our root cellar between 50ºF and 55ºF all summer long. This compares to an average of 60ºF to 65ºF in the summer of 2001, even though the summer of 2002 was hotter. The newly extended insulation also contributed to the speed with which we were able to cool the root cellar in the fall.

During the 2002-2003 winter months the new insulation continued to pay off. We had no snow cover and in many areas the ground froze down to seven feet. Our septic system froze and did not thaw until mid-June. We would likely have had to heat the root cellar if we had not extended the ground insulation.

During our first season of using the root cellar, we discovered that our original layout of the storage rooms was not practical. The squash room got too cold because it had too much outside wall surface area. To remedy the problem, we switched the squash and potato rooms. The squash room is now insulated and has a heater for those times when the passive system cannot keep up with the warmer temperature requirements of the squash. The heater is controlled by the same computer system that manages the rest of the root cellar.

In 2001, we maintained a temperature of 45ºF in the squash room. We experienced unacceptable losses from spoilage at this temperature. On the advice of Cindy Tong, the post-harvest handling specialist at the University of Minnesota, we raised the temperature to 50ºF and installed an overhead fan to insure good air circulation.

Managing the root cellar takes more time than we expected. It is not unusual to spend three to four hours a week culling squash and tracking the condition of the vegetables. In the winter of 2001, unusually warm weather kept us hopping.

Slatted cold storage bins for root crops.

At times, temperatures remained too warm to cool the root cellar, even with the cooling fans running. This caused the fall carrot crop to sprout and the carrots had to be rewashed.

The 2002 fall harvest season provided cool enough temperatures to cool the root cellar before harvest. Unfortunately, heavy early frost in the field damaged the potato crop, creating the need to hand sort blemished tubers.

We installed two large auxiliary fans to hasten the process of cooling the root cellar. At harvest, we opened the root cellar door, turned on the fans, and rapidly cooled the facility. Once this initial cooling process was done, the smaller fan that came with the temperature control system was adequate to maintain optimum winter temperatures.

In 2003, we wired an extra outlet that activated whenever the computer-controlled ventilation system called for outside air. This allowed us to run three large fans set in the 10' outside doorway during the initial cool down period. We felt comfortable leaving them plugged in all night, even with temperatures in the lower twenties, because they would come on only when needed.

Winter squash storage and handling. In the summer of 2003, we built a shed for curing winter squash. We wanted to improve the quality of the squash and reduce labor involved with harvest and storage. The building is a 14' x 30' in ated hoop greenhouse attached to the south side of a barn. It has two 15' x 10' sliding doors that open into the barn, giving us full access to the curing shed with our skid-steer loader. Material costs for the curing shed were less than $1,000.

We cure the squash on large storage racks and then carry stacks of ten storage racks, complete with their dolly, to the root cellar with the skid steer loader. This eliminates the labor of unstacking and restacking the 80 lb racks by hand. Because the system is efficient, it tends to get done when the squash are ready, rather than waiting for the rush of fall work to subside. So far, we have experienced significantly less squash spoilage in 2003 compared to previous years.

The carrot harvest was abundant in 2003. We ran out of bin space and purchased 38" x 38" x 22" pallet boxes that hold 500 pounds of carrots each. We purchased a small but powerful hydraulic lift for moving and stacking pallet boxes in the root cellar.

Along with the increased storage capacity, the boxes are being used for two experiments. First, we want to see if washed carrots store better in the boxes or the bins. Theoretically, they should store better in the boxes because the 34ºF air surrounding the boxes should keep them cooler than the 45ºF oor and walls surrounding the bins. Second, we are testing washed versus unwashed carrots for storage quality. It takes more overall labor to wash carrots in winter compared to washing them immediately when they are dug. Not washing allows for quicker harvesting, making it possible to choose a harvest date just before freeze-up.

The root cellar project has proven beneficial in an unforeseen way. The added space provided by the 24' x 20' packing shed promotes greater organization. The shed is attached to the root cellar and has storage space for boxes used in shipping. The shed also provides a place for cooling vegetables (we immerse them in water). Pre-picked

vegetables like zucchini and cucumbers reside next door in the root cellar, just steps from the delivery boxes. The addition of tables to the packing shed made handling of delivery boxes much easier. During construction of the root cellar, it appeared to be quite a bit larger than it needed to be. However, now that it is in use, we are finding that it is just big enough. It takes a lot of room to pack 100 boxes of produce.

The addition of the root cellar evened out summer and fall workloads. There is a cool space for the pre-picked vegetables in the summer and fall harvest begins earlier. We are no longer dependent on guessing when early freeze-up, snow, or other bad weather may occur.

Cindy Tong is conducting a quality control experiment in the root cellar. She is monitoring the change in eating quality of the vegetables over time. Measurements include weight loss and sugar content throughout the storage period. She is also comparing the performance of our root cellar to laboratory controlled storage.

Management Tips

1. Expect to spend several hours each week managing the stored vegetables.

2. Take time to design work space ow to optimize the use of both the root cellar and the storage shed.

3. Place the cold-loving vegetables against the walls with the most exposure to the outside.

4. Get to know the long-term storage needs of each crop in detail. A difference of 5ºF one way or the other can mean success or failure.

Cooperators

Troy Salzer, Carlton County Extension, Carlton, MN
Mike LeBeau, Conservation Technologies, Duluth, MN
Michael Karsch, Whole Foods Co-op, Duluth, MN
Cindy Tong, Department of Horticulture, University of Minnesota, St. Paul, MN

Project Location

From Duluth, take I-35 to the Carlton/Scanlon exit. Turn left on State Hwy. 45 and go to the stop sign in Carlton. Go straight on Cty. Rd. 1 through Wrenshall. After the intersection with Cty. Rd. 4, we are the 7th mailbox on the left. From the south, take I-35 to the Wrenshall/Mahtowa exit. Turn right on Cty. Rd. 4. Go 15 miles and turn right on Cty. Rd. 1.

Other Resources

Contact Cindy Tong for detailed results of the vegetable quality experiment. 434 Alderman Hall, 1970 Folwell Ave., St Paul, MN 55108, 612-624-3419. Email: c-tong@tc.umn.edu

Web site with information on construction expenses, a schematic of root cellar insulation, and quality of winter stored vegetables:
http://smfarm.coafes.umn.edu/FM2002-3.htm

Organic Strawberry Production in Minnesota

Principal Investigators

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Project Duration

2002 to 2004

ESAP Contact

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Keywords

calcium sprays, compost teas, corn gluten, organic strawberries

Project Summary

For the past two years, we have been starting a farm, Wilson's Organic Strawberries, which is the only certified organic strawberry farm in Minnesota. Like most Minnesota berry growers, we have matted rows and we plan on keeping plants in for three years of production, but we are using no synthetic pesticides or fertilizers. This past year, we had a large crop of good quality berries, with little disease or insect damage, but a hailstorm destroyed the crop right before picking.

Project Description

We have always wanted to run a business from our family farm in the rolling hills west of Alexandria. We believe it is our responsibility to provide healthy produce to our customers and we want to prove that people can raise quality produce without chemicals.

Our objective is to show that organic strawberry production can be profitable when grown in a matted row on a four-year rotation cycle. People who raise strawberries organically must find ways to control weeds, fruit diseases, and tarnished plant bug. Fertilizing can also be difficult for organic strawberry growers because plants are in the same location for four years. Nutrients are released more slowly from organic fertilizers than chemical fertilizers and nutrients from organic fertilizers applied to the soil surface take a long time to enter the root zone.

We started many organic practices the summer before we planted. We chose a hill with good water drainage and air movement in order to minimize diseases. The year before planting, we applied five tons of manure per acre to increase soil fertility and to help beneficial soil organisms. After planting, we tried several practices specific to organic production. We compared fruit diseases in plants sprayed with calcium sprays to plants sprayed with compost tea. We experimented with corn gluten for weed control and for nitrogen fertilizer. We are monitoring nutrient levels in the soil and in the plants.

This project is important to us personally because we want to raise a family on a farm where we don't have to worry about our children being exposed to pesticides. We were blessed in late July by the birth of our son, Jack. We are proud and excited to know that he will grow up picking strawberries that are grown without chemicals, and he will learn the importance of respecting the earth and leaving it in a better condition than he found it. We live by the philosophy,

An organically produced strawberry from the Kangas-Wilson farm.

"We have not inherited the earth from our fathers, we are borrowing it from our children."

Results

We planted our first two acres in May 2002. The plants grew rapidly and the rows were filled in by late August. We covered the plants with straw in November and raked the straw off our plants in April. In May 2003, we planted a new two acre field. Although many strawberry farms in our area showed severe winter injury, our field had almost no winter injury. The only variety with minor winter injury was Jewel.

Organic Certification: We started the certification process the summer of 2002 and had all the paperwork filled out in March 2003. Certification requires a great deal of time and paperwork. On June 6, 2003, we were inspected by the certification agency, when we became officially certified organic. The only change we had to make is that we could no longer use corn gluten meal for weed control and nitrogen fertilizer because it may be produced from genetically modified corn. We had been using inexpensive corn gluten from the local feed store. Certified non-GMO corn gluten meal would have to be shipped from Texas or California and would not be cost effective, so we had to find an alternative nitrogen fertilizer.

Compost Tea: Our plants started to bloom on May 20, 2003. At full bloom we sprayed half of the field with compost tea and half of the field with Vigor Cal, an organic calcium spray that may control diseases. We did a second compost tea spray in August to reduce leaf diseases. We used a 50 gal compost tea maker that a nearby strawberry grower had constructed two years earlier. It uses air to mix the compost. We used eight month old compost from another grower. Our recipe was one gallon of molasses, eight gallons of compost, and 30 gallons of water. We let the mixture steep for 24 hours and it still had a pleasant, sweet smell. We sprayed the compost tea at a rate of 30 gal/A. We did not put humates or other additives in the tea mixture.

Insects: Tarnished plant bugs are the major insect pest in strawberries. Their feeding can deform the fruit and reduce yields. We monitored the tarnished plant bug population in the field every day. We found many unusual beneficial insects, but only three tarnished plant bugs at one time. This is well below the threshold for spraying with organic insecticides.

Harvest: The first Cavendish berries ripened in mid-June 2003. We planned to open our U-pick on June 25. Our crop looked quite good at the time, and we were expecting a yield of at least 10,000 lb/A. On June 23, we had the most severe thunderstorm in the 20 years our family has owned the farm. Our area experienced ooding, hail, and possibly a tornado. Strong winds blew down many large trees, blew our garage off its foundation, and sent our strawberry sales shack ying over a grove of trees and into our neighbor's field. Hail destroyed all leaves on the west side of each strawberry row. Over 99% of the strawberries were ruined. We managed to salvage 200 pounds of berries to sell to family and friends. In early July, we went through normal post harvest renovation of mowing the leaves and tilling between rows.

In spite of the hail damage, we were able to assess fruit quality, disease incidence, and determine if compost tea had any effect. On July 2 and July 9, we sampled berries on the lower east sides of the plant rows, where the hail damage was least severe.

Fruit Quality: 2003 turned out to be a year with a great deal of disease pressure, but our fruit was relatively clean (Table 1). Three percent of the fruit sampled had slight tarnished plant bug damage. There was no difference in tarnished plant bug damage between varieties. 2003 was a terrible year for anthracnose in Minnesota, but there was no anthracnose in our fruit. Heavy rains usually spread leather rot, but less than 1% of our fruit had leather rot.

People who ate our berries all commented that they were large and sweet. Cavendish had by far the largest fruit of the four varieties, but berries of every variety were larger than University of Minnesota averages. Fruit harvested a week after the hailstorm had average soluble solids of 7.55° Brix, which is considered sweet. Many of our berries had a sugar content greater than 10° Brix, which is a very sweet strawberry.

Table 1. Fruit Measurements for Whole Field

Fruit with Tarnished Plant Bug Damage	3%
Fruit with Leather Rot	1%
Fruit with Anthracnose	0%
Average Soluble Solids	7.55° Brix
Fruit Size by Variety (Grams)	
Cavendish	19.49
Honeoye	12.74
Annapolis	13.92
Jewel	14.18

Table 2. Comparison of Compost Tea and Calcium Sprays

Treatment	Gray Mold (% fruit infected)	Soluble Solids (°Brix)	Size (Grams)
Compost Tea	10.25*	7.12	14.68
Vigor Cal	20.18*	7.98	15.48

**Statistically significant at 95% confidence level using the Student's t test*

Table 3. Comparison of Nutrients in 2002 and 2003

	Soil (ppm)		Leaves (% dry wt)	
	2002	2003	2002	2003
Nitrogen (total Kjeldahl for soil)	2,211	2,010	2.67	2.28
Phosphorus (weak bray for soil)	42	37	0.33	0.23
Potassium	253	264	1.37	1.33
Sulfur			0.16	0.11

The compost tea did reduce gray mold (Table 2). In every variety sampled, berries sprayed with compost tea had half the gray mold of berries sprayed with Vigor Cal. Berries sprayed with compost tea had lower soluble solids and slightly smaller sizes than berries sprayed with Vigor Cal, but those differences were not statistically significant.

Soil Fertility: One problem that all organic strawberry growers face is keeping soil nitrogen levels high from one year to the next. Since we could not use corn gluten meal, we applied an organically approved feather meal. From 2002 to 2003, nitrogen levels decreased in both the leaves and soil as did phosphorus and sulfur. Only potassium levels stayed the same. Sulfur levels are low enough to possibly affect next year's crop. The low nutrient levels may have been caused by the late summer drought. We have a drip system, and there was not enough rain to move nitrogen from the fertilizer to the roots. By late August, the slough we use as a water source had dried up, and we had to stop irrigating.

Costs: The biggest cost in organic strawberry production is our own labor. We spent 350 hours weeding the field the first year, and spent another 50 hours weeding to prepare for the harvest that did not happen. The heavy rains also kept us out of the new field, washed away some of the new plants, and we got a little behind in weeding our new plants. The hail damage caused some cash ow problems for our operation. We are confident that we would have made money this past year had the hail not come. Many people called and wanted to buy our fruit.

Management Tips

1. Choose a location with good air circulation and water drainage, and start preparing the soil a year before you plant.

2. Plan so that you will always have adequate labor and you can keep up with the work.

3. Cultivate often to keep runners lined up and keep the aisles weed free.

4. Make sure that you have a good water source. The slough we used for irrigation dried up in August.

5. Don't brew compost tea when the temperature is too hot. Compost tea that we made in August when the temperature was over 90°F was not as good as tea made earlier in the year.

Cooperators

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

Project Location

Six miles west of Alexandria on I-94. Take Garfield/Lowry exit, then take the first left off Cty. Rd. 40, .5 mile north of I-94.

Other Resources

Ames, G. and H. Bom. 2000. Strawberries: Organic and IPM options. Appropriate Technology Transfer for Rural Areas (ATTRA). Web site: www.attra.org

Minnesota Department of Agriculture 2003 Strawberry Guides:
- Field Guide for Identification of Pest Insects, Diseases, and Beneficial Organisms in Minnesota Strawberry Fields.
- Integrated Pest Management Manual for Minnesota Strawberry Fields.

Web site: http://www.mda.state.mn.us/ipm/fandvipm.html#fipm2

Specialty Crops Management Course, Northland Community and Technical College, Thief River Falls, MN, 218-846-0741. Web site: www.mgt.org

Development of Eastern Gamagrass Production

Principal Investigator

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Project Duration

2001 to 2003

ESAP Contact

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Keywords

eastern gamagrass, perennial forage, winterhardiness

Project Summary

In this three year project, I hoped to determine if eastern gamagrass (Tripsacum dactyloides) was suitable as perennial forage in central Minnesota. Eastern gamagrass (EGG) is a native perennial warm season bunchgrass which grows in large clumps from 1 to 3' in diameter. It is related to one of the ancestors of corn and is highly palatable to livestock. Because of overgrazing, it no longer inhabits the extensive acres it did before white settlement.

Project Description

The current livestock stocking level in central Minnesota is very low, requiring three to five acres per cow/calf pair. We are located on the drumlins and, consequently, most of our pastures are noted for the amount of rocks. Over time, the productive plant species have gradually disappeared, leaving mostly plant species that are unproductive even with applied fertilizer, soil amendments, or rotational grazing. The main reason I decided to do this project was to reduce my production costs by making more efficient use of the land through increased forage production.

I believed that EGG had potential value as a perennial forage, wildlife habitat, soil stabilizer, and windbreak. Eastern gamagrass will grow up to 9' tall and has the potential to root through even compacted soils to over 9' deep. It spreads by short rhizomes and seeds that are produced from July to September.

EGG grown in other states has been found to be suited for rotational grazing, haying, and as silage. It has been shown to have high production during the summer slump that is experienced by cool season grasses, with an annual production of over 5 T/A. Tests in other states have shown that it can produce an average daily gain of 2.3 lb/day for pregnant dairy heifers. I believe these attributes would benefit livestock and hay producers in Minnesota.

During this project, I tested the viability of three varieties of EGG to see if they were suitable forage options for central Minnesota. The varieties were PETE, #9051771, and Nemahaw. PETE and #9051771 were acquired from USDA-NRCS Plant Materials Center in New York. Nemahaw was purchased from The Gamagrass Seed Company in Nebraska. PETE and #9051771 were planted in 2001, and Nemahaw was planted in 2002. They were planted in a one-acre plot and emergence, stand counts, winterhardiness, and forage quality and quantity were reported for three years.

Nathan describing eastern gamagrass production.

Results

2001

In early June 2001, the plot was sprayed with Roundup to kill the existing grass. I planted the EGG plots on June 28 with a rented 10' no-till drill from the Wadena Soil and Water Conservation District. I used a no-till drill instead of a corn planter because it provided closer row spacing and might provide better weed control through faster canopy cover. EGG seeds are similar in size to soybeans and could be planted with a corn planter.

In order to have enough seed to fill up to the agitators and feed properly, I mixed the EGG seed with soybeans. The drill was then calibrated to plant 15 lb/A of EGG at 1.5" deep. I planted east to west making one trip down and one trip back side by side with each variety planted alternately in small plots. I did not fertilize the plots because I thought this would encourage the weeds to grow.

We did not receive any rain in the first three weeks after planting and I did not see any emergence of EGG or soybeans. On July 18 we received 1.6" of rain and eight days later I noticed the first EGG plants, but it was a very spotty stand. The soybeans grew unexpectedly well and soon covered up the plot.

I chose not to spray to kill the soybeans for a couple of reasons. Paul Salon from the USDA-NRCS Plant Materials Center recommended not spraying the EGG because it is very susceptible to injury from herbicides, especially post-emergence herbicides. The second reason for not spraying was that the soybeans were the lesser of two evils. Wherever the soybeans were not growing, crabgrass came up in huge bunches.

By the time I completed my stand counts in the fall, most of the EGG plants ranged from 4 to 7" in height. Due to the poor emergence I decided that a full count would be more representative and I counted all the EGG plants in each plot. There was a wide range in plant numbers from a low of one plant to a high of 124 plants. From this data I could not say if one variety was better than the other.

I think the test plots were planted far too late. If the seed had been in the ground earlier, the plants could have taken advantage of the earlier rains. At this point I am happy to at least have some plants established so I can look at the winterhardiness of EGG in central Minnesota.

2002

After performing stand counts last year, I realized that we needed to plant another plot this year. In order to assure a decent plot, I tilled strips with a roto-tiller to turn over the existing sod and then planted with a hand corn planter. I roto-tilled during the first week of June and planted 10 lb of pure live seed per acre using an old hand operated corn planter from June 11 to 13. I also planted a third variety (Nemahaw) that was germtec II treated. The rows were 30" apart and the seeds were spaced at 1' intervals.

By July 1, we had fair emergence with plants about 1" tall. We had a decent amount of rain and the plot did fairly well. By fall, we had good stand counts with 5 to 13 plants counted in random 10' strips, but the plants still only ranged from 4 to 5" tall.

In the original plot planted in 2001, 50% of the plants survived through the second year. There were also a few plants that were not present last fall, that came up in the spring. Neither PETE nor #9051771 seemed to out-perform the other. The most significant difference appeared to be in the rows closest to the shelter of the fencerow on the south side of the plot. This area tended to have more snow cover and more protection during the winter. There were individual plants in this area that grew 4 to 5' tall. The rows farther out from the first couple of rows did not have the added benefit of protection and survival rates declined.

2003

During the winter of 2002-2003, we had negligible snowfall and very cold temperatures. The combination of these two conditions caused most of our alfalfa and EGG to be lost to winterkill. By the spring of 2003, only four EGG plants in the entire plot had survived. No forage yields and nutritional values could be taken this year.

Nathan checking the eastern gamagrass stand.

After three years of growing EGG, it still remains to be determined if EGG can survive most years in central Minnesota. I am not yet sure if EGG can survive like alfalfa and only be seriously affected by the severe winters or if EGG is not an option for Minnesota at all.

Management Tips

1. Tillage is a better option than no-till for planting preparation because tillage minimizes early weed population.

2. Do not use herbicides to control weeds in eastern gamagrass plantings.

3. Plant eastern gamagrass in early spring to take advantage of spring rains.

4. Winterhardiness of EGG is uncertain.

Cooperators

Lynda J. Converse, Sustainable Farming Association of Central Minnesota, Browerville, MN
Kirby Hettver, Livestock Specialist, Stevens County Extension, Morris, MN
Paul R. Peterson, Forage Agronomist, University of Minnesota, St. Paul, MN
Ivan Reinke, Wadena County Soil and Water Conservation District, Wadena, MN
Paul Salon, USDA-NRCS Plant Materials Center, New York, NY

Project Location

From Motley go 2 miles east on State Hwy. 210 to Cass Cty. 102 (61st Ave. SW). Go north on Cty. 102 for 2 miles. The pasture is on the east side of the road.

Other Resources

Peterson, Paul, et al. September 1999. Eastern Gamagrass Provides Summer Forage. Crop and Soil Environmental News. Report of research on eastern gamagrass in Virginia conducted by Virginia Tech and the Virginia Extension Service. Available at: www.ext.vt.edu/news/periodicals/cses/1999-09/1999-09-01.html

American Farmland Trust. Web site: www.grassfarmer.com A comprehensive information web site on grass-based farming systems.

Yield and Feeding Value of Annual Crops Planted for Emergency Forage

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Farmer Cooperator

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Project Duration

2002 to 2004

ESAP Contact

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Keywords

alfalfa, annual forage, corn, emergency forage, grasses, legumes, millet, forage quality, sorghum x sudangrass, soybean, yield

Project Summary

Forages are the basis of ruminant diets, and ruminant livestock producers need a constant supply of forages for their animals. Weather can make the production of adequate, quality forage a challenge. We set out to investigate a number of farmer questions, such as: What can I do when forage crops cannot be planted on time due to weather challenges? I need a constant supply of forage; are there alternative crops I can plant? What crop will give me reasonable forage yield and quality when planted in June or July? To answer these and other related questions, this demonstration study evaluated a series of alternative forage crop options. Team members included agronomists and animal scientists who worked together to evaluate agronomic and nutritional information about these crops. In addition, Pelican Rapids dairy producer David Sjostrom provided the on-farm site for this project and assisted with the project design, implementation, and dissemination of results, adding a practical perspective to the team.

Project Description

Perennial forage crops are the foundation of sustainable ruminant livestock operations in Minnesota. Because of the harshness of Minnesota's climate, perennial forage crops, particularly alfalfa, occasionally winterkill and leave producers faced with an immediate lack of high quality forage. In other years, excess spring moisture prohibits growers from planting perennial forages during the window of time critical for establishment success. In situations like these, producers who are faced with a forage supply shortage generally need to plant an annual forage crop to fill the gap.

Heavy spring rains that delayed planting during the 2001 growing season, and drought during the 2003 growing season provided prime examples of the climatic variability that farmers have to contend with. Sometimes, producers need to plant emergency forage in June or even July. While some information exists on yield and feeding value of various annual crop alternatives, there is no comprehensive comparative information, particularly at later planting dates. The goal of this project was to provide information that would help farmers select and manage emergency forages, which can be key to the farm's short- and long-term profitability and sustainability.

In 2002, we seeded this demonstration experiment at two locations in Minnesota: one on a dairy farm in Pelican Rapids, Otter Tail County (northern Minnesota), and the other at the University of Minnesota's UMore Park in Rosemount, Dakota County (southern

Early arrivals at the Sjostrom field day consider a trial entry.

Minnesota). In 2002, treatments included forage species (alfalfa and 16 annual crops with forage potential) and planting date (early, middle and late).

In 2003, we again seeded the experiment on the Otter Tail County dairy farm for the northern location. For the southern location, we planted the experiment at the University of Minnesota's St. Paul Campus, Ramsey County. We evaluated the same set of crops in 2003 as in 2002, with the addition of brown midrib sorghum-sudangrass in 2003.

Replicated plots were seeded at both locations. In 2002, the early, mid, and late seeding dates at Rosemount were May 15, June 10, and June 28, respectively. Corresponding planting dates at Pelican Rapids were May 21, June 17, and July 3. In 2003, the early, mid, and late seeding dates at St. Paul were May 8, June 6, and July 1, respectively. Corresponding planting dates at Pelican Rapids were May 16, June 16, and July 2.

In both locations, corn and brown midrib (BMR) forage sorghum plots were seeded 1-1.5" deep in four 30" rows with a single row planter. All other entries were seeded in ten 6" rows to a .25 to 1" depth, depending on seed size. Plots that included legumes were inoculated with the proper Rhizobium species.

In 2002, fertility was not limiting at either location. Dairy manure was incorporated prior to planting at Pelican Rapids. Soil test P and K levels were very high at both sites. All warm season grasses (corn, BMR sorghum, sudan, and millets) received 75 lb N/A within ten days after planting. Grass entries with multiple harvests received an additional 50 lb N/A after each cutting (except the final cutting). Thus, grass entries with three harvests received 175 lb N/A during the season.

In 2003, dairy manure was incorporated prior to planting at both locations so soil test P and K levels were very high. At Pelican Rapids, no synthetic fertilizer was applied during 2003. At St. Paul, nitrogen fertilizer was applied as follows: within seven days after planting, single-cut grasses (foxtail millets and forage barley) received 100 lb N/A, multiple-cut warm season grasses (sudan, sorghum-sudan, pearl millet, and Japanese millet) received 50 lb N/A with an additional 50 lb N/A for each additional harvest, and corn and forage sorghum received 150 lb N/A in one application.

In both years, corn and forage sorghum plots were harvested by cutting the center two rows of each four-row plot to a 6" stubble. The remaining entries were harvested with a ail harvester at Rosemount and St. Paul, and with a sickle harvester at Pelican Rapids. Stubble height for sudangrass, sorghum-sudan, pearl millet, and Japanese millet was 6" to encourage regrowth, with the last harvest at 3". All other entries were cut to a 3" stubble. In general, harvest timing was scheduled to optimize yield and quality. The exception was the final harvest of multi-cut warm season grasses, which were allowed to mature until temperatures were too cool for continued growth in September. Thus, midseason harvests of these entries were at vegetative stages, but the final harvest of some entries was at a reproductive (heading) stage. Based on previous research on regrowth potential after harvesting, sudangrass, sorghum-sudan, hybrid pearl millet, and Japanese millet were scheduled for multiple harvests. Foxtail millets were scheduled for just one harvest at boot stage.

Yield data were collected at each harvest. Feeding value of 2002 crops was determined by drying and grinding the samples and analyzing for several parameters in the University of Minnesota Forage Quality laboratory, including crude protein (CP), neutral detergent fiber

Table 1. Monthly temperatures (°F) and precipitation (inches) during 2002 and 2003 growing seasons.

	Southern Location Rosemount, 2002; St. Paul, 2003				Northern Location Fergus Falls (Pelican Rapids)			
	Temperature		Precipitation		Temperature		Precipitation	
Month	2002	2003	2002	2003	2002	2003	2002	2003
April	--	49.0	--	2.4	--	45.2	--	1.8
May	52.9	58.2	2.3	6.8	50.8	56.6	2.5	4.2
June	69.6	67.9	10.3	6.5	70.0	65.2	2.4	4.8
July	74.9	72.6	3.3	2.1	74.1	71.6	9.8	1.6
Aug.	68.5	74.8	8.2	0.9	68.6	74.3	4.6	0.8
Sept.	63.6	63.2	5.9	2.2	63.0	58.6	1.2	1.3
Oct.	--	52.0	--	0.9	--	49.2	--	0.7
Avg./Total	65.9	62.5	30.1	21.6	65.3	60.1	20.5	15.3

(NDF), *invitro* true dry matter digestibility (IVTD), and total digestible nutrients (TDN). The MILK2000 computer program was used to estimate potential milk production per ton and per acre, as well as net energy for lactation (NEL). Similar analyses will be performed for samples harvested in 2003.

Table 1 summarizes precipitation and temperature for both trial years and locations. After a cool, dry May, the remaining growing season in 2002 (June-September) was warm and wet with temperatures averaging 3°F above long-term averages. Rainfall was 8" above long-term averages at Rosemount and 10" above near Pelican Rapids during just July and August. By contrast, 2003 was a drier year. May and June were cool and wet, then from July through September, rainfall was 8" below long-term averages at St. Paul and 5" below long-term averages near Pelican Rapids. Average August temperatures were above normal in both locations.

Results

2002

Total season yield results are reported in Tables 2 and 3. Forage quality data for 2002 only is reported in Table 4. Yields of warm season species were unusually high at both locations, probably due to the combined effects of above average temperature and rainfall. Entries did not always produce less at later planting dates. For example, at Rosemount, yields of the 81 and 95 RM corn entries planted June 28 did not differ from yields for earlier planting dates. However, the longer-season 103 RM corn and BMR sorghum did produce greater yields when planted earlier. In contrast, at Pelican Rapids, late (July 3) planting resulted in reduced yields of all four of these entries. Nevertheless, within a location, these entries produced similar yields when planted late.

Total season yields of multi-cut warm season grasses were competitive with corn and BMR sorghum at all planting dates. The exception was the June 17 seeding at Pelican Rapids, and Japanese millet at all planting dates and both locations. Japanese millet may produce higher yields under a one-cut system. The one-cut foxtail millets (Siberian and Golden German) produced less forage than the other warm season forages, but they produced this yield in significantly fewer days. They tended to perform best at the middle seeding date in mid-June. The 3.7 ton/A produced by Golden German foxtail millet planted in mid-June was achieved within about 60 days. In addition, the foxtail millets established well at all planting dates and locations.

Barley and small grain/pea mixtures produced considerably less forage than the warm season grasses, and had difficulty with weed competition at later planting dates. Soybeans struggled with deer damage and weed competition at Rosemount, but performed surprisingly well at Pelican Rapids, where deer damage was lower and weed control more effective. The later-maturing soybean produced more forage than the earlier maturing soybean only for the early (mid-May) planting date. At Pelican Rapids, the 5.8 tons/A of forage produced by the later maturing soybean planted in mid-May was greater than total season yields of most established alfalfa stands, and based on previous work with soybean, forage quality may be similar. Thus, full-season soybean may have potential as an alfalfa forage replacement in emergency situations. Alfalfa generally produced considerably less forage than all warm season species at all planting dates, reinforcing the potential value of the warm season forage species in emergency situations. Stands of chickling vetch were generally poor, which may re ect inappropriate seeding depth. Plants that did establish appear to compensate for the thin stands, but regrowth after harvest was typically limited.

2003

Total season yield results are reported in Tables 2 and 3. At Pelican Rapids, precipitation was 2.6" above normal in May-June, but 5" below normal in July-September, resulting in significant summer drought stress and thus stunted forage yields. Total season forage yields of entries varied substantially, both within and among planting dates. Averaged across all entries at Pelican Rapids, delaying planting until June 16 or July 2 reduced total season forage

Marcia observing the research plot on the St. Paul Campus.

Table 2. Influence of planting date on total season dry matter (DM) yields of emergency forages at Pelican Rapids (Otter Tail County), MN in 2002 and 2003. Yields representing multiple harvests are followed by the number of harvests.

	2002 Planting Date			2003 Planting Date		
	Early: 21-May	Mid: 17-Jun	Late: 3-Jul	Early: 16-May	Mid: 16-Jun	Late: 2-Jul
	---------- Ton DM/A ----------			---------- Ton DM/A ----------		
Corn (81 day RM)	6.6	6.0	4.4	5.9	5.2	2.5
Corn (95 day RM)	6.6	6.0	4.3	6.8	5.4	2.5
Corn (103 day RM)	6.2	6.3	4.1	4.9	4.3	2.8
BMR Forage Sorghum	16.7	6.9	5.1	4.4	4.4	3.4
Sudangrass	7.8 (3)	4.3 (3)	4.2	4.8 (3)	3.7 (3)	3.0 (2)
Sorghum-sudan	6.5 (3)	3.7 (3)	4.9	4.3 (3)	3.2 (3)	2.9 (2)
Sorghum-sudan (BMR)				4.6 (3)	2.8 (3)	2.2 (2)
Japanese Millet	0.9 (2)	0.5	2.7	2.3 (3)	0.6 (3)	1.1 (2)
Hybrid Pearl Millet	6.5 (3)	4.4 (3)	5.4	3.5 (3)	2.8 (3)	2.6 (2)
Barley	1.4	1.2	0.8	3.1	1.3	0.9
Barley/Pea	1.8	1.2	0.9	3.4	1.7	1.3
Oat/Pea	1.6	1.6	1.3	3.1	1.1	1.3
Soybean A*	3.0	2.4	1.8	2.9	2.1	na
Soybean B**	5.8	3.6	1.8	2.9	2.3	1.2
Siberian Foxtail Millet	1.4	2.0	1.5	2.9	1.7	1.5
Golden German Millet	2.3	3.7	2.2	5.2	3.4	2.6
Alfalfa	0.9 (2)	1.1 (2)	0.4	1.0 (2)	0.4	na
Chickling Vetch	0.5	1.1 (2)	1.0 (2)	1.4	0.9	0.4
Mean	4.4	3.3	2.9	3.7	2.6	1.9
LSD (0.05)	1.5			0.89		

**Soybean A: 2002 - 0.8 RM; 2003 - 0.7 RM, **Soybean B: 2002 - 2.0 RM; 2003 - 2.5 RM*

Table 3. Influence of planting date on total season dry matter (DM) yields of emergency forages at Rosemount (Dakota County), MN in 2002 and St. Paul (Ramsey County), MN in 2003. Yields representing multiple harvests are followed by the number of harvests.

	2002 Planting Date			2003 Planting Date		
	Early: 15-May	Mid: 15-Jun	Late: 28-Jun	Early: 8-May	Mid: 6-Jun	Late: 1-Jul
	---------- Ton DM/A ----------			---------- Ton DM/A ----------		
Corn (81 day RM)	6.8	6.8	6.2	Poor stand	5.0	4.6
Corn (95 day RM)	6.9	7.7	6.9	Poor stand	5.6	4.2
Corn (103 day RM)	9.3	9.0	6.6	Poor stand	4.9	4.6
BMR Forage Sorghum	7.7	6.6	6.4	5.4	5.4	4.7
Sudangrass	8.3 (3)	7.6 (3)	5.9 (2)	3.7 (3)	3.8 (3)	3.9 (2)
Sorghum-sudan	7.6 (3)	8.2 (3)	6.4 (2)	2.5 (3)	3.4 (3)	3.6 (2)
Sorghum-sudan (BMR)	n/a	n/a	n/a	3.6 (3)	3.5 (3)	3.1 (2)
Japanese Millet	4.7 (3)	3.6 (3)	4.9 (2)	2.7 (3)	3.0 (3)	2.8 (2)
Hybrid Pearl Millet	7.4 (3)	6.6 (3)	5.9 (2)	1.2 (3)	3.6 (3)	4.0 (2)
Barley	2.0	1.2	1.5	2.4	2.0	1.2
Barley/Pea	2.2	2.1	0.5	2.9	2.2	1.5
Oat/Pea	2.4	2.3	1.2	3.4	2.5	1.6
Soybean A*	2.0	2.5	--	3.4	3.7	2.9
Soybean B**	2.8	--	--	4.1	3.7	2.9
Siberian Foxtail Millet	2.0	2.9	2.2	3.4	4.6	2.2
Golden German Millet	3.2	3.7	4.0	3.0	4.8	3.6
Alfalfa	1.6 (2)	1.7 (2)	1.2	3.4 (2)	1.3	1.6 (2)
Chickling Vetch	0.1	0.5	--	2.6	2.0	1.7
Mean	4.5	4.3	3.5	3.2 (no corn)	3.6	3.0
LSD (0.05)	0.8			0.9		

**Soybean A: 2002 - 0.8 RM; 2003 - 0.7 RM, **Soybean B: 2002 - 2.0 RM; 2003 - 2.5 RM*

Table 4. Feeding value of emergency forages sampled in 2002.

(Caution: results are preliminary and represent only one year of data)

	CP	NDF	IVTD	TDN	NEL	Milk/ton	Milk/A
Corn (81 day RM)	9.2	46.8	78.4	63.6	0.65	2,953	18,580
Corn (95 day RM)	8.8	45.6	78.0	62.9	0.65	2,883	18,878
Corn (103 day RM)	8.9	41.2	81.7	65.4	0.67	3,100	22,174
BMR Forage Sorghum	8.1	55.5	73	55.7	0.57	2,475	20,896
Sudangrass*	17.2	56.9	72.4	49.5	0.5	2,172	12,119
Sorghum-sudan*	16.8	56.1	72.1	48.4	0.48	1,941	11,298
Japanese Millet*	18.4	52.8	74.2	52.5	0.53	2,239	5,937
Hybrid Pearl Millet*	16.7	57.3	72.7	49.2	0.49	2,012	11,213
Barley	19.3	55.4	73.2	45.8	0.46	1,767	2,336
Barley/Pea	17.7	54.7	72.3	47.1	0.47	1,839	2,659
Oat/Pea	16.6	56.3	71.1	46.7	0.47	1,805	3,072
Soybean	18.4	43.7	74.8	54.8	0.56	2,328	6,650
Siberian Foxtail Millet	16.5	61.3	70.2	43.3	0.43	1,581	3,151
Golden German Millet	14.3	62.3	69.8	43.1	0.43	1,570	4,869
Alfalfa*	20.8	33.2	78.0	61.6	0.63	2,737	3,260

All results averaged across 2 locations and 3 planting dates.
**These crops also averaged across multiple harvest dates.*
Corn silage and alfalfa are included for comparison.
Definitions:
CP = crude protein, % of dry matter
NDF = neutral detergent fiber, % of dry matter
IVTD = invitro true dry matter digestibility, %
TDN = total digestible nutrients, calculated value, % of dry matter
NEL = net energy for lactation, calculated value, Mcal/lb
Milk/ton = milk production in lb/ton of forage, estimated using the MILK2000 spreadsheet
Milk/acre = milk production in lb/acre, estimated using the MILK2000 spreadsheet
(MILK2000 equations were developed for corn silage and alfalfa/grass mixtures; therefore we caution that these numbers are only estimates.)

yield by about 30 and 50%, respectively, compared to planting May 16. The mid- and early-maturity corn silage hybrids were the highest yielding entries for the May 16 and June 16 planting dates. In contrast, for the July 2 planting date, total season forage yields were greatest for forage sorghum, sudangrass, sorghum-sudan, late-maturity corn, and pearl millet. Corn populations were generally thinner than desired, so silage production potential was probably underestimated. In addition, deer damage to soybean and potato leafhopper damage to alfalfa resulted in stunted yields for those entries.

Total season yields of multi-cut warm season grasses were competitive with corn and forage BMR sorghum at the late planting date only. The exception was Japanese millet, which may produce higher yields under a one-cut system. The one-cut foxtail millets (Siberian and Golden German) were competitive with the other warm season forages. They performed best at the May seeding date at Pelican Rapids, and at the June seeding date at St. Paul. The 5.2 tons DM/A produced by Golden German foxtail millet planted in May at Pelican Rapids was achieved within about 77 days.

The high yields of June-planted foxtail millets at St. Paul approached yields of corn and forage sorghum planted on the same date. In addition, the foxtail millets established well at all planting dates and locations.

Barley and small grain/pea mixtures produced more forage at the early planting date. Soybeans struggled with deer damage at Pelican Rapids. The later-maturing soybean produced similar amounts of forage to the earlier maturing soybean. Alfalfa generally produced considerably less forage than all warm season species at all planting dates, indicating the potential emergency forage value of the warm season species.

In St. Paul, none of the early-planted corn hybrids produced a crop. Germination test results on the seed lot were acceptable, so we don't know for sure what caused the lack of growth. One hypothesis is that heavy rains soon after planting created soil crusting, which prevented emergence. Yields of mid- and late-planted corn were similar to those at Pelican Rapids. Yields of multi-cut warm season grasses were slightly higher at St. Paul than at Pelican Rapids. The

sorghum-sudan BMR had similar yields to the conventional sorghum-sudan at both locations. This is a positive finding, considering that the BMR variety is expected to have improved fiber digestibility due to a lower lignin content compared with the conventional variety. Soybeans appeared to yield better at St. Paul, and that result probably re ects absence of deer damage at St. Paul.

Conclusion

Results showed that some of the crops evaluated have potential as emergency forages. Based on yield performance, our data suggest that corn and forage sorghum may be among the best emergency forage options, even at planting dates as late as early July. Foxtail millets generally did not produce as much forage as corn or forage sorghum, but produced consistently good stands that were competitive with weeds and ready to harvest within an average of only about two months after planting.

The options we evaluated are primarily "emergency options", not "systems" per se. Our project demonstrated that it's pretty tough to beat corn as an emergency forage, even at late planting dates. The warm season annual grasses might provide a better option for those producers that are looking for an emergency grazing crop. The foxtail millets provide a nice and easy "quick" one-cut option. The soybeans really showed promise as the one emergency option that might be most similar to alfalfa in quality, and thus possibly serve as its replacement in emergency situations.

The project generated a lot of interest among producers in the area, and about 50 attended a field day at the Sjostrom farm in Pelican Rapids. Although we are not sure how many will use any of these emergency options, they now have a local database to draw from when faced with decisions about what crops to consider in emergency situations. Although the project has ended, cooperating farmer David Sjostrom is planning to plant soybeans for forage this coming year. Logical next steps to expand the knowledge gained from this project would be larger-scale plantings/research that compare feeding (as stored hay or silage) to grazing in order to evaluate animal acceptance/ performance and the more practical aspects of using some of these emergency forage options.

Cooperators

Paul Peterson, Dept. of Agronomy and Plant Genetics, University of Minnesota, St. Paul, MN
Douglas Holen, Jr., University of Minnesota Extension Educator, Fergus Falls, MN
Vince Crary, University of Minnesota Extension Educator, New York Mills, MN
Craig C. Sheaffer, Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, MN

Project Location

Otter Tail County site: Approximately 2.5 miles south of Pelican Rapids on the west side of Hwy. 59 at David Sjostrom farm.

Dakota County site: At University of Minnesota UMore Park in Rosemount. From the intersection of Hwy. 42 and Akron Ave., go south .5 mile.

Other Resources

Dan Undersander, Forage Agronomist Extension Specialist, Department of Agronomy, University of Wisconsin, 1575 Linden Drive, Madison, WI 53717, 608-263-5070, djunders@facstaff.wisc.edu

University of Wisconsin Forage Web site. Available at: www.uwex.edu/ces/crops/uwforage

Treating Field Runoff through Storage and Gravity-fed Drip Irrigation System for Grape and Hardwood Production

Principal Investigator

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Project Duration

2002 to 2004

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Keywords

black walnuts, contour curbs, diversification, erosion control, grapes, rock tile inlets

Project Summary

We are diversifying the labor, economic, and natural resource aspects of our farming operation through the establishment of genetically superior hardwoods and wine quality grape stock. Most of our soils and topography are not well suited for corn and soybean row crop production. We wanted to be able to farm the entire 300 acres of the farm in the future and provide a substantial amount of farm-derived income. Therefore, an increase in the diversity of the operation was needed.

We also appreciate the water resources created on farms, and understand the difficulties that occur when all the farmers in one area compete to remove excess runoff within 48 hours. We have installed contour curbs and rock tile inlets to improve runoff collection, infiltration, and water quality. The stored water is being used to provide for wildlife, groundwater recharge, and irrigation of grapes and hardwoods.

Project Description

The existing farm operation consists of 210 acres. I currently row crop 45 acres. A 25 acre field and a 19 acre field are rotated with corn and soybeans. A neighboring hog operation provides nutrients through manure which is fall injected into the soybean field for the following corn crop. A 3.5 acre field adjacent to a drainage ditch was enrolled in the USDA CCRP Buffer Strip Program in 2000 and planted to native grasses. This demonstration project is located on 2.5 acres where slopes average 6% with clay loam to gravelly soils.

The goals of this project are fivefold: 1) to demonstrate a rock inlet waterway weir system; 2) to demonstrate a contour curb system; 3) to promote infiltration into the soil profile with rock inlets; 4) to demonstrate reduced labor techniques in the establishment of grape and black walnut trees; and 5) to capture field tile drainage and excess surface runoff to be used for gravity-fed irrigation.

The rock inlet waterway weir system was installed to demonstrate its effectiveness in controlling erosion in fields with concentrated overland ow. Ideally, grassed waterways provide a protected conduit for excess runoff from fields, but due to the use of broad spectrum herbicides and wide application equipment, sod-forming grasses are often exterminated.

The rock inlet system has the potential to bring a new option to crop producers to address concentrated ows in their fields. We installed two rock inlets perpendicular to the waterway at about 200' intervals. Installation

Water stored in the runoff collection pond.

consisted of digging a trench 2.5' wide across the 20' waterway bottom. A total of 20' of tile line was connected to the existing subsurface drainage and the trench was backfilled with pea rock. The excavated material was placed downstream of the rock inlet to act as a small berm to capture the runoff.

The contour curb system was installed on the section of the hillside where the black walnuts were planted. The curb system was not installed in the gently sloping vineyard. The contour curbs act as a mini-terrace system. Each curb was constructed at 20' widths with 30" deep holes dug on the upslope side of the curb at 12 to 24' intervals and filled with pea rock. The intent is to capture and infiltrate all precipitation into the hillside soil. The curbs were constructed with a 0.5% gradient toward a collection pond to route any runoff.

Fifty black walnut seedlings were planted in the fall of 2002. A 9" diameter auger was used to drill 30" deep holes to plant the seedlings. About 125 more black walnut seedlings were planted in the spring of 2003. Weed suppressing fabric and vented tree tube protectors were installed to reduce sod competition and moisture loss. A small section of a gravity-fed drip irrigation system was installed and tested. The intent was to provide sufficient moisture to the seedlings and reduce labor cost in the establishment years.

The vineyard was laid out in parallel rows perpendicular to the slope. The site is near the top of a small hill with open space and good air and water drainage. Breezes are common on the site. Because of the taut trellis system to be installed, the grapes could not be planted exactly on the contour. The rows were planted on a slight slope, approximately 2%. The contour curbs that were to be installed did not position themselves on the landscape as well as they did on the steeper slope where the walnuts were planted and were not included in the vineyard. A 9" diameter auger was used to drill holes to make sure the hardpan was removed for each of the grape stock. The holes were then backfilled when the grapes were planted. The plants were spaced 8' apart in rows that were 12' apart. Wide rows were used to fit the size of the farm equipment available.

Peter Hemstad, horticultural scientist at the University of Minnesota Horticultural Research Center, recommended testing two types of trellis systems for the grapes. We installed both the more commonly used Hudson River Umbrella System (HRUS) and the relatively less used Vertical Shoot Position (VSP) trellis system.

The HRUS has a structure that encourages vine growth to 6' high and then allows the vines to grow out to mimic an umbrella shape. The VSP trellis encourages growth of the cordons (branches trained to grow horizontally) at a 3' height and then supports shoots to grow vertically to 6'. The VSP trellis may provide for a more uniform growth structure, more mechanized labor in pruning, and more ease in harvesting. These systems will be compared for growth characteristics and the labor requirements for maintenance.

The grapes were planted in mid-May, 2003. At planting, each hole was inoculated with commercially available mycorrhizal fungi and a small amount of compost. Five rows were inoculated and one row was left as a control. The plants were then staked, covered with vented growth tubes, and weed suppressing fabric was rolled out on the rows.

The runoff collection pond was installed in October 2002 to collect surface and subsurface field drainage water, to encourage infiltration, and to store and use the water for irrigation. Runoff water quality and quantity is being collected and analyzed. Excess water is pumped into a 1,000 gallon tank to be used as gravity-fed drip irrigation.

Starting in 2003, monitoring of the runoff collection and storage system includes:

- rainfall amount;
- runoff volume (from a staff gauge measuring pond depth);
- runoff samples from the pond and collection well analyzed for total suspended solids (sediment), total phosphorus, and nitrate; and,
- weekly pond staff gauge readings for infiltration or evaporation losses.

Results

In October 2002 we successfully installed the collection pond, the rock inlet waterway weir system, and a section of the contour curb. Black walnuts and grapes have been successfully established.

Rock Inlet Waterway Weir. The system was installed perpendicular to the waterway, and not parallel with the row crops. This caused an irregular angle to maneuver field equipment over. The inlets functioned well in spring runoff and normal rain events. However, they were overtopped during a late spring 2 ½"/hr rain. Two inlets were initially installed. It appears that we need more inlets with less distance between inlets to be able to handle these larger storms. The tile line below the waterway needs to be sized to accept the ow generated by larger storms.

The rock inlet waterway weir system did not function as well as standard basin rock inlets. The rock inlets we used are in a sloping, concentrated ow area making it difficult

for the runoff to enter the rock inlet under significant rainfall. This system may prove more workable in a high-residue cropping system such as no-till. Under no-till, much less runoff occurs and it moves off the landscape in a slower manner. Less sediment is transported under these conditions, reducing deposition on the inlet during high load events. Our system will be monitored under high residue conditions in the coming years.

Judging from the first year of use, it appears that the system can work on relatively small field sub watersheds of less than 20 acres, and perhaps less than 10 acres. The fall field tillage was custom hired and both inlets were chisel plowed through. The inlets will provide drainage in 2004, but it remains to be seen if drainage will be to the extent necessary to eliminate the need for a grassed waterway.

Contour Curbs. The contour curbs functioned well under the relatively wet spring in 2003. An intense ½" rain event in mid-May occurred during the construction of two contour curbs and rock inlets. Several other contour curbs and rock inlet infiltration systems were completed. The rain event showed the function of the contour curbs as well as the function of the rock inlets. The curbs under construction were built up and the holes were dug for the pea rock. The holes still had an auger berm around the top of the hole. The runoff was captured by the curb, but the runoff was not able to enter the hole because of the berm. The captured water ponded but the completed curbs and inlets had no water standing, due to the rapid infiltration capabilities of the pea rock.

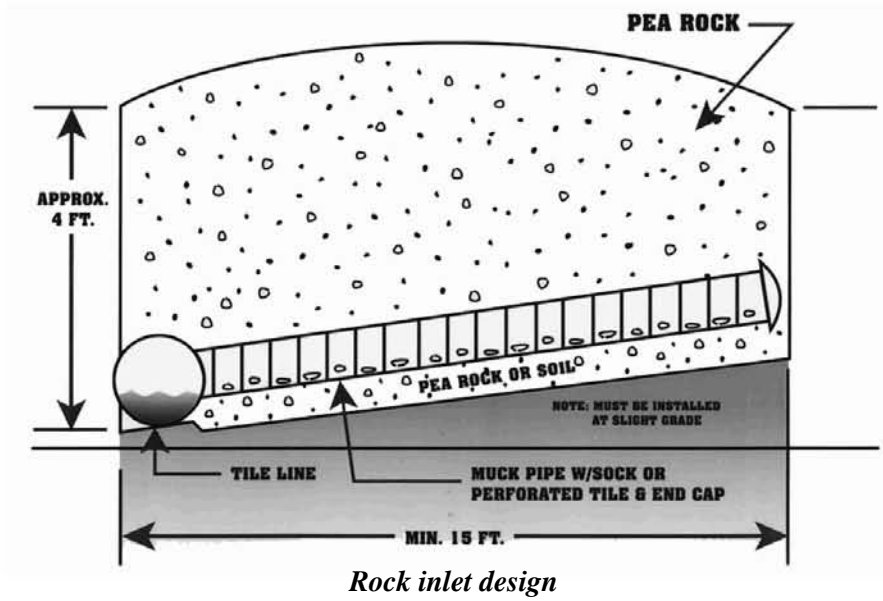
Vented Tree Tubes and Weed Suppressing Mats. The installation of the vented tree tubes went fairly well. Results of using the vented tree tubes will not be noticed until the spring of 2004. Weed suppressing mats were placed around the tubed trees and five staples were used to secure the matting. The performance of the mats was promising. The vegetative growth of grasses and broadleaves surrounding the mats was intense during the summer but the mats kept root competition to a minimum.

A neighbor mowed and baled the grasses between the seedling rows, but a minimum amount of weed control was done in the row. This was due, in part, to the difficulty in working around the contour curbs. In hindsight, this was not all that bad. The grasses were thick, but they were kept off the trees by the mats. The grasses also captured snow and protected the seedlings as winter began.

Seedling Establishment. Despite the fairly dry weather, with intermittent rain events during July, August, and September, the grape and black walnut seedlings fared well. The walnut seedlings had up to 20" of growth the first season. The grapes grew well during the summer of 2003. Many of them reached 6' in height and branched down the trellises. Fifteen of the grape stock died and were replaced in mid-June. Some of these replacements also reached over 6' in height. Some of the stock sunk into the holes that were not properly backfilled, but these were filled and growth was not affected. The trellis systems were not completed, but will be added to in the spring of 2004.

No herbicides, pesticides, or fungicides were used on the vineyards to this point. It is common for grape growers to get by the first year with no use of chemicals. We plan on pursuing an organic growing system as long as we can. There was no significant difference in the growth of the rows with or without inoculation of mycorrhizal fungi.

Runoff Collection Pond. The collection pond was constructed in October 2002. The snowfall amounts for the winter were fairly low, but the pond did collect spring runoff. Spring rains filled the collection pond approximately 60%. Infiltration was noted between runoff events. After early July, very little rainfall occurred and the pond completely dried. No runoff left the 10 acre watershed during this project. Either the runoff infiltrated or, later in the summer, evaporated. Runoff samples were collected and analyzed three times in 2003 for total suspended solids, total phosphorus, and nitrate. Data from the samples will be presented next year.



Rock inlet design

Drip Irrigation. Drip irrigation was installed on one contour row. An inexpensive plastic line was laid out and emitters were punctured into the line. Garden hose fittings were added to the connecting end and a plug was placed at the down slope end. A tank of water on a trailer was positioned uphill from the row and connected to the line. The spigot was opened and the irrigation water ran down the line and owed through the emitters. It appeared everything functioned well. Additional lines are planned for 2004 and will probably be used for at least the first three or four years of grape and walnut establishment. Water collected from the runoff pond was not used this year as a system for transferring water has not been installed.

Management Tips

1. When constructing a rock tile inlet, use the excavated material as a berm downstream to collect runoff.

2. Contour curbs are constructed so as not to compact the soil. This is contrary to the intentionally compacted construction of a field terrace system which captures runoff from a large area and routes it through a tile line. The contour curbs capture runoff from a relatively small area and infiltrate the runoff. The non-compacted curb is held in place by the vegetative growth around the trees as well as the tree roots. Pea rock infiltration inlets are required if a non-compacted curb is installed.

3. Fill each pea rock infiltration inlet hole with additional pea rock to create a mound to act as a catch berm for the water traveling down the contour. Each 9" by 30" hole with mound uses 3 ft^3 of pea rock. A wagon with a controlled chute reduces the labor needed to fill many holes.

4. Excessive buildup of crop residue from severe storms may affect the performance of the rock tile inlet.

5. Minimum tillage reduces the amount of soil brought into the rock inlet. Consider combining rock inlets with minimum tillage.

6. The contour curbs with rock infiltration inlets worked well on 6-15% slopes. Installation cost and increased field complexity may not warrant these structures on lesser slopes.

7. After several growing seasons, it may be advantageous to pull a chisel plow through the rock inlet to loosen up any tire compaction.

8. Soil that is mixed into the rock inlet does not significantly migrate below the tillage line.

9. Eventually, the top 1' of rock may have to be removed and replaced with clean rock.

Cooperators

Vern and Myrt Gieseke, New Ulm, MN
Ken Schneider, North Central Region SARE, Lincoln, NE

Project Location

From St. Peter, go west on Hwy. 5 until you reach Nicollet Cty. 12. Go north .25 mile until you reach the Brighton Township Church. Turn left down driveway. From New Ulm, go north on Hwy. 15. Turn east at Klossner on Hwy. 5. Go 4 miles to Nicollet Cty. 12 and travel north .25 mile until you reach the Brighton Township Church. Turn left (west) down driveway.

Other Resources

Minnesota Grape Growers Association, John Marshall, Secretary. 35680 Hwy. 61 Blvd., Lake City, MN 55041. Email: grapes@rconnect.com
This is a membership organization and publishes the quarterly newsletter "Notes from the North" with information about grape production.

USDA Sustainable Agriculture Research and Education web site at: www.sare.org

University of Minnesota Horticultural Research Center.

Pirog, R. 2000. Grape Expectations: A Food System Perspective on Redeveloping the Iowa Grape Industry. Leopold Center for Sustainable Agriculture, 209 Curtiss Hall, Iowa State University, Ames IA 50011-1050, 515-294-1854. Also available at: www.leopold.iastate.edu/pubinfo/papersspeaches/grapes2000.html

Minnesota Department of Agriculture. Greenbook 2003. Viability of Wine Quality Grapes as an Alternative Crop for the Family Farm, pp. 43-46. St. Paul, MN.

Minnesota Department of Agriculture. Greenbook 2003. Replacing Open Tile Intakes with Rock Inlets in Fairbault County, pp. 61-62. St. Paul, MN.

In-field Winter Drying and Storage of Corn: An Economic Analysis of Costs and Returns

Principal Investigator

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Project Duration

2001 to 2003

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Keywords

artificial drying of corn, Bt corn, corn, corn varieties, field drying, Roundup Ready® corn

Project Summary

I designed a project to determine if leaving corn to dry in the field was more economical than artificially drying the corn. In-field drying of corn could be economical at a certain percentage of moisture coupled with the cost of the drying fuel. I wanted to determine that point. The purpose of this project was to gather information to help farmers make rational decisions on when corn should be field dried. I also wanted to gather data on the amount of field loss that can be expected. This project fits into the long term plans for my farm because reducing costs and improving the environment are beneficial. The use of a nonrenewable resource (LP gas) would be eliminated. In addition, the natural barrier provided by standing corn would reduce the amount of drifting snow and provide improved habitat for wildlife.

Project Description

Red Rock Stock Farm consists of approximately 1,500 tillable acres in western Douglas County. The crops consist of 800 acres of corn and soybeans, and 100 acres of alfalfa. A small amount of wheat is also grown as a cover crop for alfalfa establishment. The remaining 600 acres are rented to neighbors. One hundred thirty beef cows are kept with the calves that are fed to maturity on the farm. The moderately hilly land is heavy clay soil. I am the main source of labor. My wife and daughter also help out. A foreign trainee is also usually present during the growing season. Labor is a limiting factor.

Energy is a major input cost for crop production. One of the major uses of energy is drying the corn crop. Corn drying would seem to be an area where energy costs could be reduced easily. My experience in 31 years of farming has indicated that sometimes corn is better left in the field until spring rather than harvested in the fall at a high moisture content. The low return on corn and the relatively high cost of LP gas for drying could make in-field drying of corn economically feasible.

The cost of corn drying is a major problem. The savings to Minnesota farmers could be huge should the in-field drying of corn be determined to be economical. Using the year 2000 statistical figures for Minnesota, there were 6,600,000 acres harvested at 145 bu/A. If $.10/bu in drying costs could be saved,

Farmers inspecting the corn quality before spring harvest.

the potential savings to Minnesota farmers could be over $95 million. A realistic goal would be a 10% reduction in drying costs which would still reduce the costs of a nonrenewable resource by $9.5 million.

I wanted information on the amount of field loss that could be expected should corn be field dried over the winter. Since the amount of loss would change with the severity of the winter, a three year comparison was developed. Likewise, the amount of loss will differ with the variety of corn planted. This information would help farmers make an intelligent decision on which varieties of corn to field dry based on the amount of expected field loss, especially in years when weather conditions, such as an early frost, could result in high moisture corn and large drying bills.

In all three years, I chose to plant varieties of conventional corn and their Bt (corn borer resistant) or Roundup Ready® (RR) counterparts. The purpose of planting different varieties was to determine if there was a significant difference in the amount of field loss between hybrids, especially Bt and RR® hybrids. The expectation was that the Bt corn would have better standability and less field loss. RR® corn was included because it has been observed that the corn has very tough stalks and also good standability. Some varieties with longer maturity than would normally be planted for this area were also included. I wanted to see if a higher yielding corn that is wetter at harvest will be more profitable if field dried than normal maturing corn.

2001: The varieties planted and harvested included: NK 4242 and NK 4242 Bt, NK 3030 and NK 3030 Bt, and DeKalb 440, and DeKalb 440 Bt RR. The corn was planted somewhat later than normal on May 10. Thirty two, 30" rows of each variety were planted with 16 rows harvested on October 29 and 16 rows harvested on April 20, 2002.

2002: Eight varieties of corn (NK 4242 Bt, NK 4242, NK 3030, NK 3030 Bt, DeKalb 4628, DeKalb 4222 Bt RR, NK 32L9 RR, and NK 43C4 RR) were planted on May 15 with the fall portion harvested on November 8. The spring portion was combined in April, 2003.

2003: Seven varieties were planted and harvested: DK 4628 RR, DK 4446, DK 4710, NK 3030, NK 3030 Bt, NK 32L9, and GHH 7233 Bt RR. Planting was on April 30 and harvesting was on November 8. The entire 2003 crop was harvested in the fall. The decision to fall harvest the crop was based on the low moisture content of the corn. Poor stalk conditions would have caused losses if the corn was left out over the winter resulting in a financial loss. Data is not presented because there was no comparison for fall and spring.

For all three years, the planting population was 32,600 plants/A and each plot was 3.7 acres. Thirty two, 30" rows of each variety were planted. Also, fertilizer and chemical applications were the same as for the rest of the corn planted on the farm.

Results

Comparisons of typically measured characteristics are presented in Tables 1 to 6. The results for fall vs. spring harvested corn in 2001/02 and in 2002/03 were evaluated by comparing the net value per acre of the fall harvested corn with the net value per acre of the spring harvested corn. It should be noted that for both fall and spring harvests, the corn was considered hauled directly to the local elevator and sold immediately. Average fall yield per acre exceeded average spring yield per acre by 16.67 bushels and 24.9 bushels for 2001/02 and 2002/03, respectively.
For 2001/02, the average fall net return exceeded average

Corn being harvested.

Table 1. Yield and Moisture Content Results for Harvested Corn 2001/02

Variety	No. of Days to Mature	Yield (bu/A) Fall 2001	Yield (bu/A) Spring 2002	Moisture (%) Fall 2001	Moisture (%) Spring 2002
NK 4242 Bt	101	153.4	126.7	19.5	13.3
NK 4242	101	143.5	144.3	18.5	13.0
NK 3030	93	157.8	143.2	17.3	13.0
NK 3030 Bt	93	165.8	145.3	18.9	13.0
DeKalb 440	94	164.6	157.5	18.9	13.1
DeKalb 440 Bt RR	94	182.1	150.1	17.1	12.8
	Average	161.2	144.53	18.4	13.0

Table 2. Yield and Moisture Content Results for Harvested Corn 2002/03

Variety	No. of Days to Mature	Yield (bu/A) Fall 2002	Yield (bu/A) Spring 2003	Moisture (%) Fall 2002	Moisture (%) Spring 2003
NK 4242 Bt	101	144.8	110.3	24.6	12.0
NK 4242	101	134.1	127.8	25.7	12.0
NK 3030	93	149.6	115.9	26.1	12.0
NK 3030 Bt	93	192.7	150.8	21.3	12.0
DeKalb 4628	96	159.3	137.1	28.8	12.0
DeKalb 4222 Bt	?	149.7	149.6	27.0	12.0
NK 32L9 RR	94	167.0	137.7	24.7	12.0
NK 43C4 RR	98	156.4	120.9	25.1	12.0
	Average	156.2	131.3	25.4	12.0

Table 3. Test Weight and Value Results for Harvested Corn 2001/02

Variety	Test Wt (lb) Fall 2001	Test Wt (lb) Spring 2002	Gross Value ($)/A After Drying Costs Fall 2001	Gross Value ($)/A After Opportunity Cost* Spring 2002
NK 4242 Bt	57.0	57	245.05	206.09
NK 4242	56.0	59	232.47	236.99
NK 3030	56.0	59	259.90	234.48
NK 3030 Bt	56.5	59	267.11	237.73
DeKalb 440	56.5	57	265.02	258.79
DeKalb 440 Bt RR	56.5	57	300.74	244.70

**Interest opportunity costs were calculated based on fall gross income (after drying), using an 8% rate for six months.*

Table 4. Test Weight and Value Results for Harvested Corn 2002/03

Variety	Test Wt (lb) Fall 2002	Test Wt (lb) Spring 2003	Gross Value ($)/A After Drying Costs Fall 2002	Gross Value ($)/A After Opportunity Cost* Spring 2003
NK 4242 Bt	53.0	54	274.98	226.15
NK 4242	52.5	56	248.95	264.79
NK 3030	54.0	56	281.92	237.94
NK 3030 Bt	54.0	58	383.86	308.88
DeKalb 4628	51.5	54	280.85	283.56
DeKalb 4222 Bt	52.0	55	273.65	310.68
NK 32L9 RR	55.0	54	320.53	283.24
NK 43C4 RR	54.0	55	298.31	247.99

**Interest opportunity costs were calculated based on fall gross income (after drying), using an 8% rate for six months.*

Table 5. Net Return Over All Listed Costs of Producing Corn Crop 2001/02

Variety	Fall 2001 Net Return ($)/A	Spring 2002 Net Return ($)/A
NK 4242 Bt	25.01	(13.15)
NK 4242	16.18	21.21
NK 3030	31.98	6.56
NK 3030 Bt	32.44	3.06
DeKalb 440	26.08	19.85
DeKalb 440 Bt RR	69.18	13.14
Average	33.48	8.45

Table 6. Net Return Over All Listed Costs of Producing Corn Crop 2002/03

Variety	Fall 2002 Net Return ($)/A	Spring 2003 Net Return ($)/A
NK 4242 Bt	50.68	1.84
NK 4242	24.65	40.49
NK 3030	53.88	9.89
NK 3030 Bt	144.21	69.23
DeKalb 4628	38.98	41.69
DeKalb 4222 Bt	40.81	77.84
NK 32L9 RR	74.51	37.21
NK 43C4 RR	52.29	1.96
Average	60.11	34.91

spring net return per acre by $25.03 (Table 5). For 2002/03 the average fall net return exceeded average spring net return per acre by $25.20 (Table 6). Therefore, for both the 2001/02 and 2002/03 seasons, it was not economical to harvest corn in the spring.

Delaying harvest until spring does not appear to be a profitable economic strategy under normal conditions. The better corn varieties presently available provide for a faster dry down than the hybrids previously available. Delaying harvest until spring resulted in a loss of approximately $25/A for each year of my project. The loss in corn yield was partially offset by the reduced drying costs. The ear loss could be partially offset if time was available to allow the fields to be grazed by livestock.

Under abnormal conditions, field drying of corn could be profitable. If corn is over 30% moisture, or the price of dryer gas is unusually high, producers should consider field drying. If field conditions in the fall make harvest difficult, spring harvesting is a reasonable alternative. Delaying harvest until spring will, in most cases, result in a loss of yield. There did not seem to be any significant difference in Bt or Roundup Ready® corn in standability as compared to conventional varieties.

Management Tips

1. Do not plant corn after spring harvested corn. The volunteer corn will cause a yield reduction, even if it is cultivated.

2. Harvest at least 24 rows around the outside of the field to stop the snow and lower the crop loss.

3. Monitor the deer pressure. If deer are a problem, chase them away or consider installing an electric fence.

4. Try to graze off spring harvested fields to recover the dropped ears.

5. Consider a spring harvest for those fields that have the highest moisture content.

Cooperators

Bret Oelke, University of Minnesota Extension Service, Elbow Lake, MN
Edgar Persons, Retired University of Minnesota Professor, Kensington, MN
David Peper, Crop Consultant, Alexandria, MN

Project Location

From Alexandria, go west on MN Hwy. 27 approximately 15 miles to Douglas Cty. Rd. 1. Turn right on Douglas Cty. Rd. 1 and travel about 3.5 miles. Red Rock Stock Farm is located on the right side of the road across from Urness Township Town Hall. The Jensen name is on the mailbox.

Other Resources

Mueller, J.P. and J. T. Green. 1987. Corn silage harvest techniques NCH-49. Purdue University - Cooperative Extension Service, IN.
Web site:
www.ces.purdue.edu/extmedia/NCH/NCH-49.html

Harvesting process with the corn being weighed.

Chickling Vetch – A New Green Manure Crop and Organic Control of Canada Thistle in Northwest Minnesota

Principal Investigator

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Project Duration

2002 to 2004

ESAP Contact

Meg Moynihan
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Keywords

acetic acid, Canada thistle, chickling vetch, green manure, legume, nitrogen, organic, vetch, vinegar

Project Summary

Because of its reportedly high nitrogen fixation rate and vigorous growth, chickling vetch may be an attractive cropping system option for farmers. The purpose of this project was to estimate nitrogen and ground cover provided by chickling vetch in a Northwest Minnesota location. The first year of the project, heavy rains ooded out the experiment and generated a healthy crop of Canada thistle and, the project team turned their attention to evaluating thistle control with organic-permitted sprays including acetic acid. In 2003, the project returned to its original objective of evaluating chickling vetch in comparison with other legumes.

Project Description

Dan Juneau has farmed near Red Lake Falls since 1972. He transitioned 885 acres to certified organic status and uses rotations that include rye, spelt, soybean, wheat, barley, and chickling vetch. His soils are predominantly sandy loams and his most problematic weed species are pigweed, mustard, smartweed, pigeongrass, and wild oats. Dan says he undertook this project to help other farmers learn about ways to fix nitrogen and believes chickling vetch will produce 200 to 250 lb of N/A. He wanted to demonstrate how a farmer can save money by "growing" fertilizer right on the farm while obtaining better soil conservation from winter ground cover. "Blowing dust every spring across many states is very common," Dan says. "More and more valuable topsoil is being lost every year to blowing. **We** can change this." Dan is also a seed dealer for a commercially available variety of chickling vetch called 'AC Greenfix.'

Green manures like alfalfa, clovers, and new legumes like chickling vetch are particularly important to organic farmers, because organic practices prohibit the use of synthetic fertilizer. According to Dan, many farmers in his area are looking for less expensive sources of nitrogen fertilizer and would benefit from research like these studies, and from learning opportunities like field days. Data that Dan will collect or observe include biomass, crop residue, root nodules (which indicate activity of nitrogen-fixing bacteria), and observations about wind and rain erosion.

The chickling vetch and wheat plots abutted on Dan's farm in 2003. Next year he'll solid seed all of the 2003 legume plots to wheat.

Activities

2002

The 2002 growing season started out dry. Shortly after planting, seeds were blown away in 40 mph winds. After Dan re-planted in early June, his area received about 3.5" of rain before the chickling vetch had emerged. Although the field plot was on relatively high ground, it ooded out completely. Alfalfa, hairy vetch, and 60% of the chickling vetch did not recover. By the end of June, he had a test plot full of 18" tall Canada thistle. Ordinarily, he would have eliminated the thistle by letting the field lie in summer fallow and deep chisel plowing as necessary.

Since it was too late to plant the original experiment again, Dan contacted staff at MDA along with project cooperators, organic crop consultant Glen Borgerding, and Extension Educator Hans Kandel, to ask their advice. Since the weather conditions had left him with thistles, they concluded Dan could use this opportunity to test vinegar (acetic acid) for thistle control.

Dan and his collaborators decided to try a number of natural sprays that would not jeopardize his organic status. Treatments included several concentrations of vinegar (acetic acid) with and without two surfactants, Alldown™ -- a non-selective herbicide approved for use in organic systems, and hydrogen peroxide. Plot size was 10' x 25' and treatments were replicated four times. Because the land was certified organic, it was not possible to include a chemical check similar to what a conventional farmer in the area might use.

2003

In 2003, things went a little more according to Dan's original plan for the experiment. He used a 3 acre test plot that had grown chickling vetch in 2002. In mid-May, he solid seeded approximately 1 acre each of spring wheat and soybean, and 1/3 acre each of chickling vetch, alfalfa, and hairy vetch using a John Deere 9300 press drill. He seeded hairy vetch at about 20 lb/A, alfalfa at 20 lb/A, and chickling vetch at about 60 lb/A. He seeded both soybeans and wheat at 2 bu/A. All treatments were seeded within about a week of each other. The hairy vetch had poor germination, so Dan ordered a different lot and reseeded it on May 30.

For weed control, Dan harrowed approximately every seven to ten days in all plots until the end of June. On June 21, Dan mowed a swath in each legume plot with a Toro lawnmower set to a stubble height of 4 to 5" because he wanted to see how the plots would perform in terms of regrowth. Biomass of chickling vetch, soybean and hairy vetch was clipped by hand to ground level in 1-meter square quadrates (in previously unmowed portions of each plot) on July 11 and again on August 12 in two locations per plot. The material was bagged and dried, then separated into crop and weed fractions. Dried fractions were weighed and the data recorded. Wheat harvest occurred on August 11 and soybean harvest on October 5.

Table 1. Experimental Treatments

Plot Size	2003 Crop	2004 Crop (planned)
1/3 A	Chickling vetch	Wheat
1/3 A	Hairy vetch	Wheat
1/3 A	Alfalfa	Wheat
1 A	Soybean	Wheat
1 A	Wheat	TBD

Results

2002

According to Dan, results from all treatments were fairly consistent and disappointing. Dan and the collaborators speculated that solution strength and timing are very important to effective thistle control, and that acetic acid solution might provide effective control if the thistles were very small. Dan said if he had it to do over again, he might use a higher acetic acid rate or would douse the crop more, but would need more information about potential damage to the crop. It is unknown at this time which acetic acid concentration and volume would work best in that situation.

2003

During the early part of the season when Dan was harrowing approximately every seven to ten days, he observed more damage in the alfalfa plot than in the hairy vetch or chickling vetch plots. There was little harrow damage to soybean and wheat.

After mowing a swath in all of the legume plots on June 21, Dan observed that weeds came up vigorously in the mowed swath of the hairy vetch plot, but less so in the chickling vetch swath. He noticed that the mowed alfalfa swath regrew slowly, "If it got to 8" we were lucky," Dan said.

Biomass measurements taken in the chickling vetch, soybean, and hairy vetch plots during the growing season are reported in Table 2. At the first sampling (July 11), chickling vetch had produced significantly more biomass growth than soybean or hairy vetch (it is unknown whether replanting of the hairy vetch two weeks after the other crops contributed to its inferior performance in biomass generation). This data did not surprise University of

Table 2. Biomass Components During the 2003 Growing Season in lb/A

	First Sampling 7/11/03			Second Sampling 8/12/03		
Legume	**Legume Fraction**	**Weed Fraction**	**Total Biomass**	**Legume Fraction**	**Weed Fraction**	**Total Biomass**
Chickling vetch	3,253a	687b	3,940a	4,648a	1,556a	6,204a
Soybeans	1,894b	290c	2,184b	4,190a	772a	4,962a
Hariy vetch	1,420b	1,222a	2,642ab	1,850b	2,010a	3,859a
LSD (0.10)	1,324	161	1,448	1,397	NS	NS

Compare differences within the column only. Same letter indicates that differences are not statistically significant.

Minnesota Extension Educator Hans Kandel, who says that chickling vetch is known as a sprinter that starts fast, while hairy vetch starts more slowly and typically produces tremendous growth in August and September, after chickling vetch growth slows as it matures and sets seed. In Dan's experiment, chickling vetch contained statistically fewer weeds by weight than hairy vetch at the first sampling, but more weeds than soybean. By the second sampling in mid-August, biomass production of chickling vetch and soybean were statistically similar. Both produced more biomass than hairy vetch. Again, this finding may be due to the fact that hairy vetch was seeded two weeks later than chickling vetch and soybean and thus got a later start. In mid-August, there was no significant difference among the plots in terms of weed biomass.

According to Hans, it is reasonable to assume that 4% of a legume's biomass on a dry matter basis is N. The amount of potential plowdown N contained in biomass at each sampling can therefore be estimated and is summarized in Table 3. Note that these estimates are for total N at the time of sampling only. There is no way to determine how much of the total N was fixed atmospheric N and how much came from the soil and other sources, nor does the data indicate whether any of the differences are statistically significant.

In 2004, Dan plans to solid seed wheat on the acre that grew chickling vetch, hairy vetch, and alfalfa in 2003. He'll follow the wheat plot with soybeans and has not yet decided what to follow the soybean plot with.

Observations and Speculations About Chickling Vetch

As a sales representative for one commercial variety of chickling vetch, Dan has paid special attention to how it behaves on his farm. One characteristic he has says he has observed is that chickling vetch " ushes" weed as it grows. "The first four or five weeks you notice ushes of weeds you've never seen before. That's good and bad," he said, commenting that while the weeds need managing, he believes the fields will become "cleaner" each year."

Table 3. Estimated N in Biomass (lb/A)

Legume	7/11/2003	8/12/2003
Chickling vetch	130	186
Soybeans	87	168
Hairy vetch	57	74

These estimates are based on assumed 4% N on dry matter basis. Note that statistical analysis was not performed on these estimates.

Dan has thought about some cropping system strategies that could incorporate chickling vetch. According to Dan, it germinates at cool temperatures "just like wheat" and in his part of the state could be planted as early as spring wheat, though he does not think frost seeding will work. After six or eight weeks, Dan believes, farmers could work the crop under for N release. Dan says planting in August to generate fall soil cover and N for the following spring is also an option and that the crop kills at 18-22°F. "Last year I planted it the third week of September. We had no moisture after that. By the third week of November, it grew 4 to 6". He stated that he found no volunteer chickling plants at all the following spring. Is important to note that none of these systems is being tested, agronomically or economically, as part of the current experiment. They are Dan's own speculations about what he might like to try.

Hans comments that there are several management options available for hairy vetch as well. Growers can plant in the spring if they plan to fall plow; most biomass will be generated after August. For those who want to spring plow, it makes most sense to fall seed. The hairy vetch can survive the winter and will typically come on strong in the early spring, providing cover and producing N until it is worked under. Hans doesn't advise growers to expect spring-established stands of hairy vetch to overwinter 100%, because by fall there is typically so much biomass on the ground that it impedes spring growth the next year.

Vetch is a strong plant and while some plants will survive the winter, those that already set seed in the fall of the first year will not survive, according to Hans.

Management Tips

1. Be sure to select the right inoculum for legumes because it is critical to formation of the nodules that fix N. "If you're not going to inoculate, don't plant it!" says Dan.

2. Plant chickling vetch at least six weeks before a hard frost and do not frost seed.

3. If growing chickling for a hay crop or green manure, cut in the first or second week of bloom to a 3" stubble. Seeds are poisonous to livestock.

4. Chickling vetch currently costs about $.50/lb for non-organic and $.60/lb for organic seed and is seeded at approximately 60 lb/A. Hairy vetch costs about $1.00/lb and recommended seeding rates are about 20 lb/A.

Cooperators

Glen Borgerding, Consultant, Albany, MN (2002)
Bobby Holder, University of Minnesota, Crookston, MN (2002)
Carlyle Holen, University of Minnesota, Crookston, MN (2002)
Hans Kandel, Extension Educator, Red Lake Falls, MN (2002 and 2003)
David and Ida Kruze, Farmers, Flasher, ND (2002 and 2003)

Project Location

From Red Lake Falls, go south on State Hwy. 32 approximately 3 miles. Go east on State Hwy. 92 for 6 miles, then turn south on County Hwy. 12 for 1 mile. At County Road 117 (gravel road), go east 1.5 miles. Plots are on the south side of the road across from a grove of trees.

Other Resources

Comis, Don. 2002. Spray weeds with vinegar? ARS News and Information. United Stated Department of Agriculture. May 15. Available at: www.ars.usda.gov/is/pr/2002/020515.htm

Dela Cruz, Rita T. 2002. Vinegar: the effective weedkiller. In Bureau of Agricultural Research Today, 4:2. United States Department of Agriculture, Washington, DC. Available at: www.bar.gov.ph/bar_today/biotechnology1.shtml

Kandel, Hans and Dave LeGare. 2004. Cover crop evaluation in NW Minnesota. In On-farm cropping trials - Northwest and West Central Minnesota. University of Minnesota Extension Service, St. Paul, MN.

Dan observes growth in one of the vetch plots.

Potassium Rate Trial on an Established Grass/ Legume Pasture: Determining Economic Rates for Grazing/Haying Systems

Principal Investigators

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Project Duration

2001 to 2003

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Keywords

forages, grazing, potassium fertilizer

Project Summary

We have a 534 acre farm, 388 acres owned and 146 acres rented. Most of the acres are in permanent pasture that we manage with rotational grazing. Our Spring Valley farm is on gently rolling, silt-loam soils, with Spring Valley Creek owing through the northern half of the farm. Crops consist of several different combinations of grasses and legumes for the purposes of haying and grazing. We have a 51 cow purebred Angus beef herd and custom graze 50 to 90 dairy heifers. Any surplus forage is made into hay.

The goal of this demonstration/research project was to help farmers that rotationally graze livestock gain a better understanding of the effects of potassium fertilization on forage production in pastures. We tested whether a four year old grass/legume pasture would respond positively to potassium fertilizer. In recent years, on-farm research in southeast Minnesota has shown profitable yield increases with application of nominal rates of potash fertilizer on corn fields that have relatively low potassium soil test levels of 80 ppm or less. We wanted to see if our grass/legume pastures with potassium levels of 60 ppm responded to potassium applications.

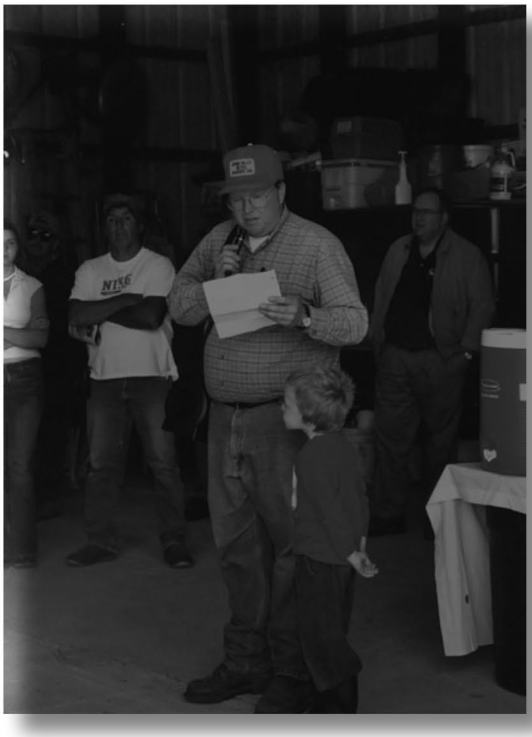
Project Description

We studied the effect of potassium fertilizer on the longevity of a four year old reed canarygrass/alfalfa stand. The size of the demonstration was about one acre set up in one of our grazing paddocks. We used four treatments with four replications randomly applied on 10' x 150' strip plots. The treatments of potash were 0, 75, 150, and 225 lb/A applied each year of the project.

In order to eliminate confounding soil fertility factors, additional fertilizer was applied according to soil test results. In the spring of 2001 and 2003, a mixture of 40 lb P_2O_5/A and 2 lb boron/A was broadcast on the entire plot area in the spring. In 2002, 50 lb P_2O_5/A was applied in the spring.

Forage samples were taken at least three times a year to evaluate forage yield and quality. We also used visual observations to determine if there were any changes in the percentage of grasses and legumes in the stand.

Each time the paddock was ready for grazing, the trial strips were windrowed. Grazing periods were determined by forage growth stage in order to obtain high forage quality and to enhance regrowth. Harvest weights from each strip were determined by weighing three randomly selected 6' portions of the windrow. A sub-sample was analyzed for percent moisture in addition to a routine feed analysis. The remaining windrows were baled and removed from the plot area after each harvest.



Dan sharing results at field day.

Table 1. Summary of 2001, 2002, and 2003 Potassium Rate Trial on Rotationally Grazed Pasture for Dry Matter (DM) and Relative Feed Value (RFV)

	2001		2002		2003	
Treatment (lb K_2O/A)	DM/A (lb/A)	RFV	DM/A (lb/A)	RFV	DM/A (lb/A)	RFV
0	3,136	124.6	4,799	115.3	4,313	95.8
75	2,878	129.4	5,332	119.7	5,174	93.1
150	3,158	120.4	5,552	115.3	4,975	92.4

Results

2001

The results for 2001 were greatly affected by the weather. Due to a dry and poor forage growing season in 2001, yield results were not sufficient for analysis. We received very little rain from June to August and had poor growth on the forages. Consequently, we took only two forage cuttings instead of the planned three or four. From these samples and our visual observations, we did not see significant differences between the treatments in yield, forage quality, or legume to grass ratio.

2002

2002 was a good growing season in contrast to the very dry year of 2001. Although forage yield results were not significantly different within sample harvest dates, the total yields for the season trended higher with increasing potash fertilizer rates. Potassium soil test results taken from each plot in the spring and fall of each growing season have shown a significant increase from the spring of 2001 to fall of 2002. This may explain the overall increase in forage yield.

2003

The results for 2003 were also greatly affected by the weather. We received very little rain after the end of June and therefore only harvested the plots two times. Consequently, the forage yields and relative feed values were low. This mixed forage pasture is now seven years old and still is a viable source of forage for our farm.

Table 1 is a comparison of the forage plots for the three years of the project. Although yield results from each harvest were not significantly different, yearly averages of dry matter for each treatment did show an interesting trend.

It appears that a potassium application rate between 75 to 100 lb/A is a reasonable amount (increases dry matter per acre while maintaining good relative feed value) for a mixed pasture. Table 2 shows the soil test results of the potassium trial from the start of the project to its completion. At the 75 to 100 lb/A rate for a $10 to $15/A cost for fertilizer would return 400 to 500 lb dry matter per acre which is cost effective. This rate is consistent with University of Minnesota fertilizer recommendations of maintaining the potassium levels to the 80 ppm level.

Another objective of the study was to determine if there was a difference in the amount of legume in the pasture with the different treatments of potash. From our observations over the three year period, potash does not appear to have an effect on the legume/grass ratio. It seems that weather is more a factor than potassium levels.

Management Tip

Follow the University of Minnesota soil tests recommendations for potassium fertilization in a grass and legume grazing and haying situation. Using more than recommended is a waste of money.

Cooperators

Tim Wagar, Crops and Soils Area Extension Educator, Rochester, MN
Jerry Tesmer, Fillmore County Extension, Preston, MN
Alfredo Dicostanzo, Beef Specialist, University of Minnesota, St. Paul, MN
James Fisk, Beef Farmer/Custom Hay Harvester, Roberts, WI
Hugh Kramer, Livestock Fence Expert, Zumbro Falls, MN
Howard Moechnig, USDA NRCS Grazing Lands Specialist, Rochester, MN
Paul Peterson, Forage Specialist, University of Minnesota, St. Paul, MN

Table 2. Potassium Soil Test Results for 2001 and 2003 from the Potassium Rate Trial

Treatment (lb K_2O/A)	2001 K Soil Test (ppm)	2003 K Soil Test (ppm)
0	72	70
75	78	86
150	71	103
225	70	127

Project Location

Go east from Spring Valley on State Hwy. 16 for 1.5 miles. Turn left onto the first gravel road just past the white Amoco fuel storage tanks and go north for 1.5 miles. Farm is on the west side of the road.

Other Resources

Albert Lea Seed House. 1414 W. Main, PO Box 127, Albert Lea, MN 56007, 800-352-5247. Web site: www.alseed.com

Bartlett, Ben. 1999. Watering systems for grazing livestock. Michigan State University, PO Box 168, Chatham, MI 49816, 906-439-5880.

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.

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

Graze-L email discussion group (graze-l@cygnus.taranaki.ac.nz). There is also an archive of past discussions at the web site: http://grazel.taranaki.ac.nz

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

University of Wisconsin Extension Service. Identifying pasture grasses. Publication No. A3637. University of Wisconsin Extension Publications, 630 Mif in Street, Room 170, Madison, WI 53703, 608-262-3346. A spiral bound 4 x 8" color pocketbook with information on seed, seedling and mature stages of all the major cool season pasture grasses, tailored to the north central region.

University of Wisconsin Extension Service. 1997. Pastures for profit: A guide to rotational grazing. WI No. A3529 or MN No. AG-FO-6145. University of Wisconsin Extension Service, Madison, WI, 608-262-3346 or University of Minnesota Extension Distribution Center, 612-625-8173 or 800-876-8636.

Field day participants in the pasture.

Use of Rye as a Cover Crop Prior to Soybean

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Farmer Cooperators

Will Anthony, Nicollet County
Robin Brekken, Polk County
Bill Langlois, Red Lake County
Leonard Runck, Redwood County
Lee Thomas, Clay County

Project Duration

2002 to 2005

ESAP Contact

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Keywords

cover crops, green manure, nitrogen cycling, organic production, rye (*Secale cereale*), soil erosion

Project Summary

Currently, most of our crops across the state are planted in the spring and harvested in the fall. This practice provides less than ideal ecosystem functioning. There is inefficient use of rainfall, solar radiation, and nutrient cycling. The result is nutrient loss through leaching (especially nitrogen), and wind and water erosion of our soils. This project evaluates the use of a fall-planted rye cover crop prior to soybeans in various cropping systems at five on-farm locations across the state (near Crookston, Moorhead, Lamberton, and St. Peter).

At the five locations, rye was planted in the fall of 2002 into corn or small grain residue. The rye survived the winter and was quick to put on additional biomass the following spring. In the spring of 2003, soybean was planted into the rye which was later killed with shredding, chopping, or herbicide. We are monitoring rye growth and development, soybean growth and yield, and weed pressure. We will continue evaluating rye at all five locations in 2004, with modifications based on what we have learned to date.

Project Description

Studies are being conducted on each of five farms where rye was planted in the fall of 2002 (see Tables 1 and 2). The studies at the Anthony and Runck farms were similar in that they involved evaluating the rye variety Homil21 at two seeding rates using herbicides to control the rye growth. The studies at the other three farms involved organic production techniques and each evaluated two of the following three rye varieties: Rymin, Homil21, or Prima. All studies include replicated control plots without rye.

Drilled soybeans growing through mowed rye on the Lee Thomas farm (July1, 2003).

Cross-seeded, drilled soybeans growing through harrowed rye on the Robin Brekken farm (July 1, 2003).

Table 1. 2002 Rye Planting Date, Row Width, Seeding Rate, and Variety on Five Farms

Grower Cooperator	Rye Planting Date	Rye Row Width (inches)	Rye Seeding Rate (bu/A)	Rye Variety[1]
Brekken (O)[2]	10-05-02	broadcast	2.1	P & H
Langlois (O)	10-06-02	7.0	2.1 & 3.0	P & H
Thomas (O)	9-19-02	6.0	1.4 & 2.2	H & R
Runck (C)	11-02-03	7.5	1.2 & 2.5	H
Anthony (C)	9-17-02	broadcast	1.2 & 2.5	H

[1] Rye varieties: P = Prima, H = Homil21, and R = Rymin.
[2] Farming operation: O = organic production, C = conventional production.

Table 2. 2003 Soybean Planting Date, Row Width, Seeding Rate, and Variety on Five Farms

Grower Cooperator	Soybean Planting Date	Soybean Row Width (inches)	Soybean Seeding Rate (seeds/A)	Soybean Variety	Rye Kill Date
Brekken	6-09-03	cross seeded	450,000	Atwood	6-09-03
Langlois	6-04-03	22.0	220,000	Atwood	6-17-03
Thomas	5-26-03	7.5	200,000	Norpro	6-14-03
Runck	5-12-03	7.5	180,000	Cenex 1771	5-28 & 6-11
Anthony	5-08-03	22.0	150,000	PrairieB2092rr	5-21-03

Anthony farm: conventional operation in Nicollet County in south central Minnesota.
There are three replicates of the treatments listed in Table 1. The approximate plot size is 44 x 1,100'.

Rye was broadcast seeded on September 17, 2002 with a 40' fertilizer spreader into sweet corn residue that had been worked with a JD512 disk ripper. The sweet corn residue was worked because of uneveness in the field due to sweet corn harvest truck traffic in the field at harvest.

Soybeans were planted on May 8 in 22" rows on this field (Table 2). The field was too uneven to no-till the soybeans into the rye residue – a practice that would be preferred. Also, there is some concern for soybean yield loss in no-till situations with the relatively wide row soybeans compared with drilled soybeans. The rye was killed with an herbicide.

Brekken farm: organic operation in Polk County in northwest Minnesota.
There are four replicates of the two rye varieties listed in Table 1. The plot size is approximately 140 x 2,640'. Soybeans were seeded perpendicular to the rye rows at two different seeding rates.

The rye was broadcast seeded on October 5, 2002 with a 70' oater into spring wheat residue that had been worked with a DMI Eclo-tiger deep tiller, and cultivated. The rye seed was incorporated using one pass with a field cultivator and one pass with a harrow. Seeding occurred later than desired, but wet weather delayed a timelier planting. Because of the relatively late planting, the rye was barely out of the ground by the time of freeze-up.

Weed pressure (lambsquarter, grasses, ragweed, and wild mustard) was obviously high by late May. It was evident that the rye was not adequately controlling weed germination and growth. This led Robin to alter his plan to plant no-till soybeans into the rye. Instead, he aggressively harrowed the field with a Brandt harrow with tines 5/8" in diameter and 28" in length. The field was harrowed in early June when the rye was approximately 30" tall and most of the heads had not yet fully emerged from the boot. On June 9, soybeans were cross seeded with a 7.5" drill at the heavy population of 450,000 seeds/A. The harrowing was aggressive enough to kill most all the weeds and the cross seeding of the soybeans cut up and killed most of the rye.

Langlois farm: organic operation in Red Lake and Polk Counties in northwest Minnesota.
There are two or three replicates of the two seeding rates and two rye varieties listed in Table 1. The plot size is approximately 40 x 1,000'.

The rye was seeded with a 40' AirSeeder into barley residue that had been worked with a chisel. The AirSeeder is on 7" row widths with 9" shovels, which results in a relatively wide band of seeded rye. The rye was seeded on October 6, 2002. This was later than desired, but wet weather delayed a timelier planting of the rye. It was barely out of the ground by the time of freeze-up and snow cover.

On June 4, 2003, soybeans were planted in 22" rows with a 24 row planter that is 44' wide (Table 2). Again, there is some concern over the potential for soybean yield loss in no-till situations with the relatively wide row spacing. Soybeans were planted perpendicular to the direction of planting of the rye. The rye was "killed" on June 17 by mowing after it headed.

Runck farm: conventional operation in Redwood County in southwest Minnesota.
There are three replicates of the seeding rates shown in Table 1. The plot size is approximately 60 x 1,000'.

The rye was drilled directly into corn residue that had been chopped after corn harvest. The rye was seeded on November 2, 2002, with a 15' JD750 no-till drill on 7.5" row widths. This rye seeding date was very late, in part because the cool fall temperatures delayed corn dry-down and harvest.

Soybeans were planted on May 12, 2003 with a 15' JD750 no-till drill on 7.5" row widths (Table 2). The rye in one half of the study was treated with Roundup on May 28 and on the other half on June 11 in order to test the in uence of herbicide application date on soybean yield.

Thomas farm: organic operation in Clay County in west central Minnesota.
There are four replicates of the four treatments listed in Table 1. The plot size is approximately 40 x 1,000' with Rymin and 20 x 1,000' with Homil21.

The rye was drilled in 6" rows with a JD9356 drill comprised of 3 x 10' units. Two of the units were filled with Rymin and the other unit was filled with Homil21. Seeding rates were changed manually halfway across the field on each pass. The rye was seeded into wheat stubble that was chiseled, field cultivated, then worked with a seed bedder basket (to break up clods). The rye was seeded on September 10, 2002 into dry soil. Germination and emergence of the rye was good. A good rain fell shortly after planting which brought up the rye seedlings uniformly.

Soybeans were planted on May 26, 2003 with a JD no-till drill with 7.5" rows at 220,000 seeds/A (Table 2). The rye was 'killed' by mowing on June 14 after it had headed and after the soybean crook stage.

Results

Anthony farm. On September 17, 2002, rye was broadcast seeded. Because the seed was not incorporated, it was slow to germinate and emerge. By October 3 it was up and had a height of about 2". The rye plant stand was not uniform, in part due to poor seed-soil contact as a result of broadcasting the seed. Approximate rye plant stands on November 21 were 22 and 43 plants/ft^2 for the 1.25 and 2.50 bu/A seeding rates, respectively. The rye was 3 to 4" tall. By this time the rye plants had begun to tiller.

By the end of April 2003, the rye had grown to approximately 6". Soybeans were planted in 22" rows directly into the standing rye on May 8, at which time the biomass was 1,060 lb/A and the plant height was 9" (extended leaf of 13"). By May 16, the rye biomass was 2,614 lb/A with a plant height of 23" (extended leaf of 30").

Table 3. 2003 Rye Biomass on Five Farms

Grower Cooperator	Rye Sample Date	Rye Biomass (lb/A)	Rye Sample Date	Rye Biomass (lb/A)
Brekken (O)[1]	5-27-03	2,280	-	-
Langlois (O)	5-27-03	3,080	6-13-03	6,150
Thomas (O)	5-27-03	3,630	-	-
Runck (C)	5-08-03	145	6-11-03	684
Anthony (C)	5-08-03	1,060	6-03-03	4,335

[1] *Farming operation: O = organic production, C = conventional production.*

The rye was killed with an herbicide (22 oz/A Weather Max Roundup) on May 21. The killed rye had a biomass on June 3 of approximately 4,335 lb/A (Table 3). On June 3 the rye that wasn't killed was fully headed out but not yet at 25% anthesis and had an extended leaf plant height of 4' in good areas, while the soybeans were in the cotyledon stage (VC). The soybean plant stand was approximately 137,000 plants/A, and no stand differences were detected between the rye seeding rates and the winter-fallow plantings.

In spite of early season rye plant stand differences, the rye seeding rate did not significantly in uence biomass when analyzed on May 16 and June 3. There were areas of poorer rye growth, which were probably related to soil fertility and landscape position. Those areas were known to have alkaline soils and the field was known to have soybean cyst nematodes. An herbicide was applied to the entire field in June to control later emerging weeds. Soybeans in the rye were notably elongated. Soybean growth in the alkaline areas was uniformly poor and not in uenced by the presence or absence of rye.

During the growth and development of the soybeans, there was a noticeable difference in plant height and vigor. The soybeans growing on the winter fallow land looked better than those grown in the rye residue. Due to the lack of visual difference in soybean growth between the two rye seeding rates, a yield monitor was used to determine soybean yields for the rye vs. no-rye areas. The soybean yield was 17.2 and 24.0 bu/A for the 6.6 and 5.9 acres of soybean grown on rye and no-rye land, respectively.

These yields were low due to aphid pressure and relatively severe moisture stress in late July and August during pod fill. Moisture stress in the soybeans may have been aggravated by the soil moisture usage by the rye cover crop earlier in the growing season, as the early season draw-down by the rye was never replenished. The rainfall patterns this growing season probably represented a worst case scenario for performance of a cover crop in a corn-soybean rotation.

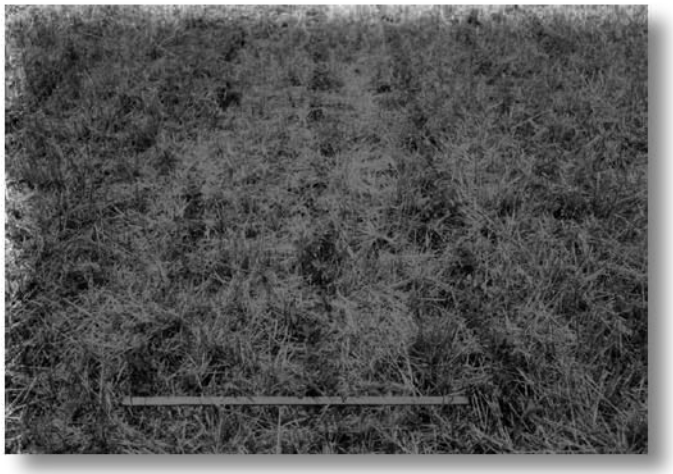
In the fall of 2003 approximately 80 acres of rye were seeded on land where peas had been harvested and manure applied. Various rye residue management scenarios are planned for the spring of 2004 prior to planting corn.

Brekken farm. There was a problem with uniform seeding of the rye. The 70' oater used to seed the rye created strips across that field with low plant populations. Early spring rye biomass was less than desirable as a result of the later than desired rye seeding. On May 27, in the best growth areas, the rye biomass averaged 2,280 lb/A, considerably less than the other two northern Minnesota locations (Table 3). Homil21 rye had 4.4% more biomass than Prima, both varieties were in the 2 to 3 joint stage, and both varieties averaged about 20.5" tall. The rye on the Brekken farm was noticeably less vigorous than that on the Langlois farm on this date, and the overall stand was thinner.

The heavy soybean plant stand (400,600 plants/A on July 1) helped suppress subsequent weed growth. Soil moisture at that time was adequate for good plant growth, but later in the month, a six to seven week dry spell occurred. By August 14, the soybeans had completely canopied over, averaged 30" tall, and looked to have very good yield potential. The apparent weed disaster of several months earlier was averted. No difference in soybean growth and development could be visually detected between the rye variety strips. Soybean yield in the field was 32 bu/A, which Robin considered very respectable.

Read an article about this and other research Robin has been involved with in the September 2003 issue of *New Farm* magazine at www.newfarm.org entitled "Weed FREE! An ode to rye."

Langlois farm. As with the Brekken farm, this trial was planted to rye later than desired. The early season rye growth was greater than at the Brekken farm, perhaps because of better fertility and the higher seeding rate and better stand (Table 3). On May 27, Homil21 rye had about 12% more biomass than Prima, was just slightly ahead of Prima in maturity (early head emergence vs. late boot), and was about 2" taller than Prima.



Soybeans growing through mowed rye on the Bill Langlois farm (July 1, 2003).

Soybeans were planted on June 4 on 22" row widths. On June 13, the rye biomass averaged 6,150 lb/A, was 60" tall, and was not quite at full pollen shed. There was no difference in biomass, height, or maturity evident between rye varieties at this time. The rye was mowed with a stalk shredder on June 17, at which point the soybeans were just past the crook stage. Mowing was approximately 10" off the ground – higher than desired but necessary because the field had not been 'rolled' for rocks. The rye appeared to hold the early season growth of weeds in check (especially wild mustard) but some weed seed did germinate. There was heavy grass pressure but the seedlings were very small. Rainfall and soil moisture was very conducive to both soybean and weed growth.

Soybean plant populations were monitored on July 1. The average population was 144,000 plants/A. There was no difference in soybean population due to rye variety or seeding rate. By August 14 the soybean canopy still hadn't closed and there were lots of regrowth rye heads evident. The foxtail population was high, but the plants were relatively small. Soil moisture conditions were dry and the combination of the rye regrowth and weed pressure probably negatively in uenced soybean growth, and ultimately yield. No visual differences in soybean growth and development were observed due to the different rye varieties and seeding rates.

Soybean yield in the field averaged 22 bu/A. In an adjacent field without a rye cover crop, Bill Langlois grew 28 bu/A soybeans. That field required additional tillage and cultivation.

Runck farm. The late rye planting date and the cool temperature after planting resulted in the rye being very slow to germinate and emerge. By mid-December it was not possible to see the rye rows and much of the seed had yet to imbibe water because of poor seed-to-soil contact due to the corn stover residue and dry soil conditions. We were not sure the small seedlings would survive the winter. We also wondered if the ungerminated seed would survive, and if the plants and seeds would achieve adequate vernalization for reproductive growth the next spring. By May 8, it was obvious there was a good stand of rye, but the rye biomass was much lower than at the Anthony farm (Table 3). The standing plant height was 6" and extended leaf height was 8".

22" row soybeans growing through rye killed with Roundup on the Will Anthony farm (July 1, 2003).

Soybeans were no-till drilled on May 12. Half the study was treated with Roundup on May 28 and the other half on June 11. On those dates, the rye biomass was 210 and 684 lb/A and the standing plant height was 8" and 16", respectively. Differences in rye biomass and plant height between seeding rates were masked by field variability, but obvious visual differences were apparent in places.

By July, there was an obvious soybean growth difference between the no-rye treatment and the rye treatments. The soybeans in the no-rye treatment were 4 to 6" taller. Dry conditions in July and August negatively in uenced soybean yields.

Soybeans were harvested on October 6. Yields were recorded with a yield monitor. There was no difference in soybean yields between the treatments that had no rye, rye at the low seeding rate, or rye at the high seeding rate. Likewise, there was no difference in soybean yield between the early vs. late herbicide application to kill the rye. In general, the weed pressure in the field was minimal. The mean soybean yield was 32.5 bu/A. No treatment differed by more than 1.0 bu/A from this mean. These results were fairly surprising to the Runcks. They thought the midseason visual differences in soybean growth would translate to a yield difference. As other work with rye has shown, visual differences can be deceiving.

Thomas farm. Because of the relatively timely rye planting date, there was a large amount of rye biomass in the spring (Table 3). Homil21 produced 25% more biomass than Rymin! As of May 27, Homil21 averaged 4,030 lb/A and Rymin averaged 3,230 lb/A. Seeding rate did not in uence rye biomass on this date. Rye plant stands were not determined, but it was obvious from shortly after planting that Homil21 had a better plant stand and plant vigor than Rymin. This difference between rye varieties could have been due in part to the quality of rye seed planted. Seeding rates did not in uence rye biomass on this date.

The rye growth stage on May 27 indicated that Homil21 was slightly ahead of Rymin, with Homil21 in early in orescence and Rymin in late boot.

In 2003, soybeans were planted with a JD no-till drill on May 26. The rye was 'killed' by mowing on June 14, after the rye had headed and after the soybean 'crook stage'. Lee said that if he could do it over again, he would have waited three more days to mow the rye. Lee also commented that when he mowed the rye at late anthesis, the air was thick with lacewing insects. These insects are predators of aphids, which had low populations in the soybean fields seeded in rye.

By July 1, visual observation suggested that there was less rye regrowth in Homil21 than in Rymin. The regrowth in Homil21 was also a lighter shade of green. Soybean plant stands were determined to be 169,000 plants/A, with no statistically significant differences due to rye variety or rye seeding rate. The soybean stand was numerically less in Homil21 than in Rymin. If real, this difference could be related to the rye biomass difference between the varieties. In patches across the field, there were areas where the mowed rye clumped-up, resulting in a thick thatch of plant material. Soybean survival was a problem under these clumps. By this date it was evident that field bindweed would be a problem in these patches.

Soybean yields were determined by small plot sampling on September 30. At that time, soybean plant stands were again monitored. The average stand was 165,000 plants/A and no difference was detected due to rye variety or rye seeding rate. Soybean plant height averaged 22.8", with no difference due to rye variety or rye seeding rate. Yields averaged 30.4 bu/A, with the soybeans grown on Homil21 land yielding numerically 1.3 bu/A more than those grown on Rymin land (not statistically significant). Rye seeding rates had no in uence on soybean yield. Whole field yields were estimated by Lee to be 27 bu/A.

Lee noticed the soybeans were free of dirt staining, perhaps due to the rye mulch. The mulch inhibited splashing of dirt and mud on the pods from the rains, and provided a cushion or barrier from plowing the soil with the combine header.

Summary

In these studies, rye varieties and seeding rates had relatively little in uence on weed suppression. On one of the two conventional operations, a sizable soybean yield reduction occurred where rye was employed as a cover crop. This was probably due to extremely dry conditions at that location. The other conventional operation achieved soybean yields using rye that were comparable to winter fallow.

The three organic operations had varying degrees of success with their use of rye as a cover crop and weed control method. Soybean yields were higher in the rye cover crop system on two of the three organic farms. Numerous management options remain to be explored. The studies will continue in 2004.

Management Tips

1. It is critical to have access to the proper equipment to drill the soybeans into the rye residue, to shred or mow the rye, and, if organic, to separate rye from soybean seeds. Narrow row, no-till drilling of the soybeans is recommended over wide row soybeans.

2. For optimum weed control, do not incorporate the rye residue. Instead, plant no-till directly into the rye or rye residue.

3. Climatic conditions will determine the time of soybean planting and the management of the rye residue (both chemical and mechanical).

Soybeans at canopy, grown in rye on the Lee Thomas farm (August 13, 2003).

4. Early spring rye biomass is a function of fall weather conditions, fall planting date, soil fertility, previous crop, and previous crop residue. Heading is largely in uenced by day length and less dependent on fall planting date or early season biomass.

5. There will be regrowth after the rye has been shredded or mowed, but there is less regrowth the later the rye is mowed in the spring.

6. Cross seeding of the soybeans appears to adequately chop up the rye residue, resulting in very little rye regrowth. This eliminates the need to shred the rye.

7. Rye variety selection and seeding rate are less important than the timeliness of the various agronomic operations.

8. The soybean seed harvested in this system was cleaner of dirt stains, an important consideration when growing food-grade soybeans.

Project Locations

Contact Paul Porter for directions to cooperator's farms.

Other Resources

General information on rye is available on the web at:
www.sarep.ucdavis.edu/cgi-bin/CCrop.exe/show_crop_12
www.hort.purdue.edu/newcrop/afcm/rye.html
www.mgo.umn.edu/crops/rye.htm
While this information is quite good about rye in general, it is weak on the use of rye as a cover crop.

Hyk, Deborah. September, 2003. Weed FREE! An ode to rye. New Farm. Available at: www.newfarm.org

Mechanical Tillage to Promote Aeration, Improve Water Infiltration, and Rejuvenate Pasture and Hay Land

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Project Duration

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Keywords

pasture renovation, water quality

Project Summary

Traditionally, established forage stands and permanent pasture have been considered off limits to renovation by tillage. Although a farmer may have a need to aerate the soil to increase the soil's permeability to water and to release nutrients, there has not been an effective way to accomplish a deep soil renovation without causing damage to the forage crop.

Robert Schelhaas and four other farmers have investigated the use of a Hay King pasture renovator in an attempt to improve the soil condition on permanent pasture, rotational pasture, and hay land. The forage renovating implement is designed to accomplish aggressive sub-soil loosening with a minimum of disturbance at the surface. These farmers have determined both positive and negative effects of this type of tillage.

Project Description

My stock cow herd is grazed mostly on pasture that is too hilly to be used for raising other crops. A rotational grazing method is used. The less sloping hay land next to the pasture is seeded to a mix of alfalfa and grasses. Land suited to row crops is rotated between corn, barley, and hay. I finish out my calves on a drug free program.

A number of years ago, I started looking for a method that would allow more water to infiltrate into my steeply sloping pastures. I wanted to reduce compaction as well. Most of the equipment I looked at was too large and expensive to fit into my operation. Two years ago, I found an affordable tool that could work my uneven ground. The Hay King pasture renovator has been tested on Bermuda grass in southern states and has been shown to improve forage production in Louisiana, Mississippi, and Colorado. I felt the next step was to test the renovator on several farm sites in the upper Midwest.

This project involved five cooperating farms, each actively engaged in either beef or dairy production. Collectively, we established ten sites, each approximately 8 acres, to compare renovated and non-renovated forage ground. Each site contained test strips using the Hay King pasture renovator and adjacent non-renovated control strips. At several sites, a new renovated strip was added each year so that by the end of the project, there were one, two, and three year old renovated sites.

The Hay King model used in this demonstration was ten feet wide. The pasture renovator penetrates to an average tillage depth of 5 to 7". Tillage is accomplished

Robert Schelhaas and Steve Gleis using rising plate pasture forage meter.

with eight individual shovels spaced 15" apart (the shovel spacing is exible) and staggered from front to back. They are designed to impart a significant lifting and shattering action on the soil above the base of the shovel. The forward shank moves the soil laterally in one direction while the back shank moves the soil back in the opposite direction. Each shank is ½" wide where it enters the ground (compared to an average width of 2" for a typical chisel plow). The narrower shank width makes it easier to accomplish significant subsoil aeration but with the sod returning almost to its initial pre-tilled position.

A large coulter is placed directly in front of each shank to provide the initial cut in the sod. A shear pin at each shank protects against damage from large rocks. The recommended speed of operation is four miles per hour. Tillage is done on the contour to control erosion and capture more water.

The effects of pasture and hay ground tillage are being measured by comparing renovated and non-renovated ground in the following ways:

- forage productivity;
- rate of water infiltration into the soil profile and runoff using simulated rainfall;
- level of compaction of the soil; and
- changes in species composition of the forage stand.

In 2002, late fall rain simulations were used at the James Sovell farm to test the effectiveness of both the Hay King and the Rolling Dutchman pasture renovator. The Rolling Dutchman is designed to rip 2" wide and 2" deep furrows in the sod every 40". This is done on the contour to capture and infiltrate water. The renovation significantly increases the surface roughness of the field. Please refer to *Greenbook 2001* for a detailed description of the Jim Sovell project.

In 2003, mid-August rain simulations were performed on pasture renovated in spring and compared to pasture renovated in late summer. This allowed us to see how long the renovation benefits last. The cattle were restricted from this set of plots after the rain simulations and throughout the fall. This allowed us to document forage productivity in detail at this site. We used a oating plate pasture meter to estimate forage yield on the rain simulation plots in November.

Results

Ease of Use of the Hay King Pasture Renovator. I was unable to renovate any pasture early in the 2001 growing season due to a wet spring. In late August, I was able to renovate several test strips on each of the cooperating farms, including strips in alfalfa hay ground, permanent pasture, and rotational pasture.

In the first year of the project, there were varied reactions concerning the ease of use of the Hay King. The Schelhaas farm contains few rocks and renovation proceeded smoothly. However, at the Sovell farm, an unacceptable number of shear pins had to be replaced. This was due to the combination of extensive rocks and low soil moisture.

In 2002, we renovated at a higher soil moisture level and were much more satisfied with the ease of operation. There was a narrow window for renovation under optimal conditions in late April. Then conditions became too dry until heavy rains returned in mid-August when we received 6.7" of rain for the month.

The deep tillage leaves pasture ground acceptably level but hay ground may be rougher than desired for later hay cutting. I found that, with a minimum of effort, renovated hay ground can be easily leveled with a drag.

At the 15" shank spacing and 6" tillage depth, we found the Hay King left behind approximately equal zones of deep tillage and undisturbed soil.

Water Infiltration and Runoff. Two renovated pasture sites were tested for water infiltration and runoff in 2002 using simulated rainfall. The first site was located on permanent pasture at the Schelhaas farm. The rain simulations were performed on August 14. The Hay King pasture renovator was compared to non-renovated control strips. There were no differences in infiltration and runoff due to the renovation done in April.

The second rain simulation site was located on heavily grazed pasture at the Sovell farm. Test strips were renovated in the first week of October using both the Hay King and the Rolling Dutchman pasture renovator. These were compared to a non-renovated control.

Both renovation techniques dramatically reduced runoff compared to the control (Figure 1). Extensive animal impact immediately prior to the rain simulations had created surface soil compaction, making the site particularly vulnerable to runoff. Only 15 minutes into the rain event, the non-renovated pasture was losing 90% of the water being applied. At the same point in time, the plots renovated with the Hay King and Rolling Dutchman were losing 45 and 20%, respectively.

Figure 1. Effect of Pasture Renovation on Runoff from Simulated 3.7"/hr Storm on the Jim Sovell Farm, Barnes Loam, 6% Slope (10-22-02)

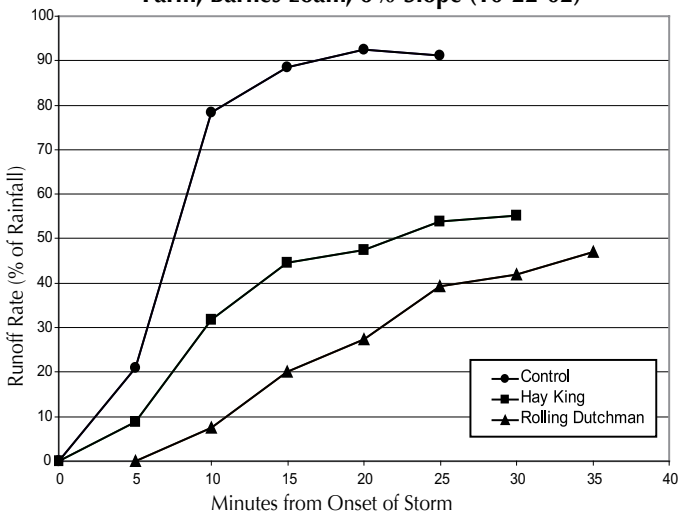
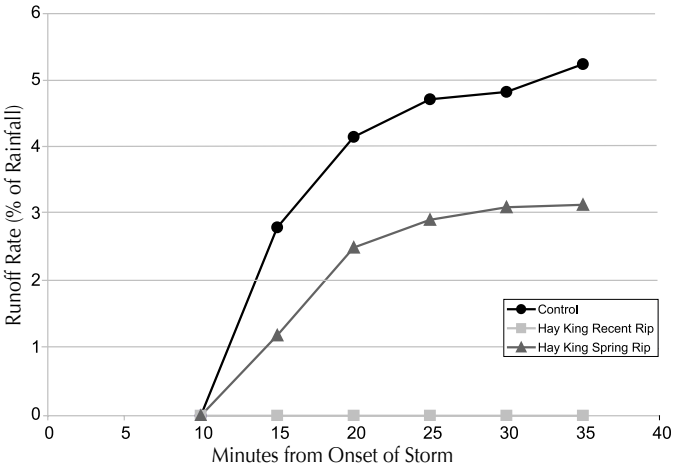


Figure 2. Effect of Hay King Pasture Renovation on Runoff from Simulated 4.4"/hr Storm on the Bob Schelhaas Farm, Barnes Loam, 6% Slope (8-13-03)



On August 13, 2003, rain simulations were performed on permanent pasture on the Schelhaas farm. Three conditions were compared:

- a control where no renovation took place;
- an early renovation, done on May 8, 2003 (spring rip); and
- a late renovation, done on August 2, 2003 (recent rip).

The cows grazed this area all spring and summer until July 24, when they were moved and not returned again.

Once again, we found strong evidence for a water conservation benefit as a result of pasture renovation using the Hay King (Figure 2). The plots renovated on August 2 showed no runoff and only localized ponding at points furthest away from where the ripping shanks had loosened the soil. The plots renovated on May 8 showed a 40% reduction in water runoff compared to the non-renovated control.

All three pasture treatments had low levels of sediment and phosphorus loss. However, the renovated plots conserved soil and nutrients better than the control (Table 1).

Table 1. Sediment and Total Phosphorus Loss After 35 Minute Simulated Rainfall on August 13, 2003

Renovation	Sediment (lb/A)	Total Phosphorus (lb/A)
Control	14.0	0.012
Spring Rip	7.9	0.006
Recent Rip	0.0	0.000

Pasture Productivity. In early June of 2002, forage samples were taken of the first alfalfa cutting. The non-renovated hay ground yielded 6,050 lb/A (fresh weight). The renovated hay ground yielded 7,260 lb/A, a 20% increase.

After the heavy August rains, the strips renovated in late April in permanent pasture could easily be seen from a great distance across our river valley. They were obviously greener than the adjacent non-renovated pasture. I do not know whether this was due to improved nutrient cycling, water infiltration, or both. When observed close-up, the grass in the renovated strips was deeper green, indicating improved nitrogen cycling. The effect was most pronounced in the grass directly over the path of the shanks.

Another unforeseen renovation benefit showed up in 2002. An extensive stand of native black medic germinated after renovation. The appearance of this legume was obviously due to the tillage. Just as with the improved forage condition, the medic appeared directly over the path of the shanks. In fact, this was the only place where the medic could be found in the immediate area.

We renovated a large portion of our permanent pasture in April 2003 when the soil moisture conditions were favorable. Just as in 2002, the native black medic began to appear in the openings formed by the shanks of the Hay King after it rained. As the summer went by, the stand of black medic became much thicker. Native grasses, such as big and little bluestem, were thicker in the renovated strips.

After a period of little rain in the summer, we began to receive more rain again in September. Soon after the fall rains began, the renovated strips became green before the non-renovated areas, indicating better water infiltration.

They were darker green, indicating greater nitrogen availability. Darker green renovated strips were also visible on nearly level fields recently seeded to a pasture mix for grazing.

On May 14, 2003, forage samples with three replicates were taken from pasture ripped in the fall of 2002 and from non-ripped pasture. Forage from 9 ft^2 plots were clipped by hand and dried. The predominant forages were bluegrass and a small amount of clover. Forage yields in the renovated strips were 20% to 50% greater than in the control with an average increase of 37%.

Forage samples were taken again on November 14, 2003 on the 24' x 3.5' plots that had received 2.5" of simulated rain on August 13. A "rising plate" pasture forage meter was used (see photo). The forage productivity benefits of both renovation and added rainfall were dramatic (Table 2).

Table 2. Effect of Pasture Renovation and a 2.5" Simulated Rainfall on Forage Yield on the Robert Schelhaas Farm (November 14, 2003)

Renovation	Simulated Rain	Forage Yield (% increase over control)
Control	no	0
	yes	97
Spring Rip	no	64
	yes	188
August Rip	no	15
	yes	142

Conclusion

Early results from this project suggest that the Hay King will provide an immediate benefit to overgrazed pasture. Pastures with moderate grazing pressure may respond positively as well. However, more experimentation is needed to determine the optimum timing of renovation with the seasons, soil moisture availability, and an adequate rest period before the next grazing cycle.

An important question remains to be answered. How can these documented renovation benefits be maintained over time? Annual renovation would be expensive and risk the development of deep compaction and loss of soil organic matter. Hopefully, a way can be found to combine occasional ripping with creative management of grazing cycles to bring the pastures to a new, lasting level of improved performance.

Management Tips

1. Stony ground should be worked before the soil becomes too dry. Adequate soil moisture helps to minimize the resistance imparted by rocks, thus saving on the labor and cost associated with replacement of shear pins.

2. Renovated hay ground can easily be leveled using a drag.

3. Renovated alfalfa should be allowed to recover significantly before exposing it to animal impact. Cows will forage on the exposed alfalfa crowns.

4. Cows should not be allowed to graze a field if a heavy rain falls shortly after renovation. The field will be so soft that the cows will damage the forage and leave deep tracks. Low fields with a high water table are the most vulnerable.

5. Early spring renovations are not visible until later in the summer in most years.

Cooperators

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Steve Gleis, Dairy Farmer, Lake Wilson, MN
James Sovell, Cow/calf Operator, Ivanhoe, MN
Dennis Schentzel, Cow/calf Operator, Canby, MN
Mark Zumwinkle, MN Department of Agriculture, St. Paul, MN

Project Location

From Pipestone, go 10 miles east on Hwy. 30. Turn south on Cty. Rd. 18 and go 6.5 miles south. The farm is on the east side of the road.

Other Resources

The reader is referred to the Jim Sovell article in *Greenbook 2001*. Jim's work shares similar goals with this project. The farmers in both projects are testing the Rolling Dutchman pasture renovator and the Hay King pasture renovator.

Northwest Minnesota Compost Demonstration

Principal Investigator

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Project Duration

2002 to 2003

ESAP Contact

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Keywords

certified organic farms, compost, dairy manure, turkey manure

Project Summary

We wanted to show that using compost in an agricultural application, especially on an organic farm, is an important alternative use to selling the compost for non-farm uses. There are environmental benefits as well because many of our soils have shallow water tables. We wanted to know what the fertilizer analysis looked like and develop a consistent product so that we could determine if the compost could be economically and efficiently applied to make a farm operation more profitable. In our project, we applied Class I compost on plots at three farms. Class I compost is made from dairy and turkey manure using an in-vessel method.

Project Description

Plots were established on three organically certified farms. All farms were located in the Red River Valley on at topography. Compost was made using an in-vessel system. In-vessel compost is preferable because the compost produced is more uniform and consistent than windrow produced compost. Manure was converted to compost in 14 days and applied to the plots.

Our original purpose was to add value to manure by making compost and selling it off the farm. The reason for having the experimental plots was to show there is value in applying compost to agricultural cropland. We eventually hope to show some of the additional value of compost besides the economic value of nitrogen (N), phosphorus (P), and potassium (K). The compost was tested for N, P, and K and many of the common micronutrients. A test for heavy metals was also completed to show that, over a long period of time, there is no adverse effect of compost. A soil test of the plots was completed to establish fertility levels prior to compost application. Compost was applied at three different rates of 1 ton/A, 2 tons/A, 3 tons/A, and a check, to help establish the optimum application rate.

Soybeans were planted in plots at the Paul Wilder farm near Crookston, MN. Spring wheat was planted in plots at the Michael Klawitter farm near Euclid, MN. Oats were planted at the Bill Langlois farm near Red Lake Falls, MN. A combine was used to establish correct yields.

Results

The initial spring (no compost) and complete fall (compost applied) soil analyses for each of the three experimental sites are presented in Tables 1-3. Differences between the Spring and Fall were measured for variables pH, CEC (cation exchange capacity), salts, NO_3 (nitrate nitrogen), Mg (magnesium), and S (sulfur) at the Langlois site. At the Klawitter site, differences between Spring and Fall were measured for variables P_2O_5 (phosphorus) and K_2O (potassium) and at the Wilder site, differences were measured for variables P_2O_5, Zn (zinc), and Fe (iron).

Russ harvesting oats on compost plots on the Bill Langlois farm.

Table 1. Langlois – Spring and Fall 2003 Soil Analyses

Parameter Measured	Spring, 2003	Fall, 2003 Compost Rate (Tons/A)			
		0	1	2	3
pH	7.7	7.8	7.6	7.6	7.8
CEC (meq)	12.2	13.3	10.9	11.9	16.6
O.M. (%)	1.5	1.3	1.4	1.3	1.4
Salts (mmho/cm)	0.11	0.11	0.10	0.14	0.14
NO_3 (0-6") (lb/A)	13	2.2	3.5	3.3	2.5
P_2O_5 (ppm)	57	34.5	38.8	24.2	41.2
K_2O (ppm)	174	115	125	144	144
Ca (ppm)	1,982	2,261	1,734	1,894	2,605
Mg (ppm)	227	193	220	241	223
S (lb/A)	28	6.5	8.5	8	9.5
Zn (ppm)	1.42	0.91	1.60	1.41	1.14
Fe (ppm)	---	22.2	17.6	20.2	15.3
Na (ppm)	---	10.3	11.5	17.5	15.5

Table 2. Klawitter – Spring and Fall 2003 Soil Analyses

Parameter Measured	Spring, 2003	Fall, 2003 Compost Rate (Tons/A)			
		0	1	2	3
pH	7.9	7.9	7.9	8	7.9
CEC (meq)	37.6	40.7	37.3	39.7	37.8
O.M. (%)	6.1	5.2	5.3	5.3	5.0
Salts (mmho/cm)	1.17	1.48	1.62	1.87	1.78
NO_3 (0-6") (lb/A)	18	4.2	4.8	4.5	3.8
P_2O_5 (ppm)	11	9.8	12.3	12.0	11.8
K_2O (ppm)	175	181	187	190	168
Ca (ppm)	5,015	5,339	4,864	5,226	4,920
Mg (ppm)	1,452	1,505	1,386	1,452	1,395
S (lb/A)	120	0.67	0.8	0.93	0.72
Zn (ppm)	0.64	120+	120+	120+	120+
Fe (ppm)	---	9.6	9.6	10.0	9.1
Na (ppm)	---	226	207	213	265

Table 3. Wilder – Spring and Fall 2003 Soil Analyses

Parameter Measured	Spring, 2003	Fall, 2003 Compost Rate (Tons/A)			
		0	1	2	3
pH	7.9	8.1	8.1	8.1	8.1
CEC (meq)	32.6	34.0	33.8	34.0	34.1
O.M. (%)	4.9	3.9	4.0	3.9	4.0
Salts (mmho/cm)	0.77	0.51	0.49	0.50	0.51
NO_3 (0-6") (lb/A)	119	14.0	13.2	16.8	12.8
P_2O_5 (ppm)	61	26.2	25.0	34.5	32.5
K_2O (ppm)	548	418	342	450	481
Ca (ppm)	4,569	4,852	4,851	4,863	4,827
Mg (ppm)	996	1,009	1,007	1,001	1,021
S (lb/A)	64	0.75	0.76	0.88	0.93
Zn (ppm)	1.21	14	16	19	26
Fe (ppm)	---	10.1	10.1	10.2	9.7
Na (ppm)	---	50	56	51	53

The oat yield, test weight, population, and height at the Langlois site are summarized in Table 4. There was a significant oat grain yield response with the application of 2 and 3 tons/A compost compared to the 0 tons/A rate. Test weight and population were not affected by compost rate. Oat height was significantly affected by compost rate. In addition, several other measurements were recorded for the Langlois site and are also presented in Table 4.

Table 4. Langlois oat yield, test weight, population and height, and organic oat quality data

Compost Rate Tons/A	Yield bu/A	Test Weight lb/bu	Population Plants/3ft^2	Height Inches	Beta-glucan (%)	Groat (%)	Oil (%)	Protein (%)
0	92.3	32.0	64.0	34.2	3.03	67.0	8.89	12.5
1	96.6	32.2	59.0	38.0	3.01	67.8	9.08	12.3
2	102.1	31.9	56.0	43.8	3.01	69.2	8.89	12.9
3	102.6	32.6	63.3	48.3	2.94	69.9	8.01	13.4
Significance	p=.08	NS	NS	p=.01	---	---	---	---
LSD .05%	7.9			7.2	---	---	---	---

The wheat grain yield, test weight, population and protein percentage for the Klawitter site are listed in Table 5. Test weight and protein percent were not affected by compost rate. Significant differences were, however, observed for yield and population. The 3 tons/A compost rate grain yield was statistically different from the 0 tons/A rate. The wheat populations were significantly higher for the 1 and 3 tons/A compost compared to the 0 tons/A rate.

Table 5. Klawitter wheat yield, test weight, population and protein percent

Compost Rate Tons/A	Yield bu/A	Test Weight lb/bu	Population Plants/3ft^2	Protein %
0	17.2	55.2	90.0	8.9
1	22.3	55.5	115.5	8.5
2	24.0	55.4	108.8	8.4
3	26.8	55.4	114.5	8.6
Significance	p=.10	NS	p=.13	NS
LSD .05%	7.8		23.9	

The soybean grain yield, protein percent, and oil percent at the Wilder site are presented in Table 6.

Table 6. Wilder soybean yield, protein and oil percent

Compost Rate Tons/A	Yield bu/A	Protein %	Oil %
0	31.5	30.9	18.3
1	33.6	30.1	18.3
2	22.2	31.9	17.4
3	24.1	31.3	18.3

An analysis of compost was also completed. The results of this analysis are presented in Table 7.

Table 7. Compost Analysis

Nutrient	Lb/Ton	Nutrient	Lb/Ton	Nutrient	Lb/Ton
N	33.6	Fe	4.6	Cu	0.28
P_2O_5	39.5	Al	3.8	B	0.06
K_2O	27.0	Si	3.4	Mo	0.006
Ca	46.5	Na	3.1	C	458
Mg	14.6	Mn	4.0	pH	7.2
S	5.0	Zn	0.38		

There are environmental benefits of using compost as a soil amendment. This is especially important for nitrogen and phosphorus and the effect they have on water quality. Compost is environmentally friendly and helps hold nutrients in the soil making them available to the plant. There are additional benefits of using compost such as improved soil quality with benefits from increased soil organic matter levels. Some studies have shown that compost has the potential to improve crop resistance to diseases, insects, and other pests without the addition of chemicals.

One of the benefits of using compost from animal operations is to show that these operations can be compatible with the environment. Composting adds value to manure and produces a material that is easier to handle.

Some organic farmers have indicated that they would be ready customers for a producer who could provide a consistent compost product of good quality. This could benefit all of agriculture. A large animal operation could add value to their manure and do it in an environmentally friendly manner. If an organic farmer could purchase a reliable, dependable, and consistent compost product, he/she could reduce some of their labor requirements and increase efficiency in other parts of their organic farm operation.

Management Tips

1. Apply compost at a rate of approximately 2 tons/A for optimum crop response.

2. Compost applied consistently over many years has the potential to improve soil quality for any farm operation.

3. For additional project information, not presented in this article, refer to the article in *Greenbook 2003*.

Cooperators

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Bill Langlois, Crookston, MN
Michael and Marypat Klawitter, Euclid, MN
Paul Wilder, Crookston, MN
Jerome Burkel, Greenbush, MN

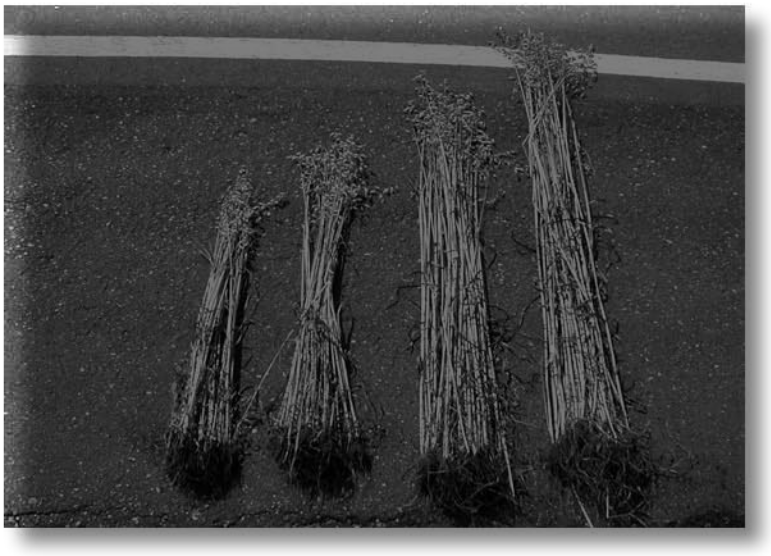
Project Location

For directions, contact Russ Severson or John Schmidt.

Other Resources

Diver, Steve. 1998. Farm-Scale Composting Resource List. Appropriate Technology Transfer for Rural Areas (ATTRA), PO Box 3657, Fayetteville, AR 72702. 800-346-9140. Web site: http://attra.ncat.org/attra-pub/farmcompost.html

Northeast Regional Agricultural Engineering Service. 1992. On-farm Composting Handbook, NREAS-54. Web site: www.nraes.org/publications/nraes54.html



Height of oats on plots with compost applied at 0, 1, 2, and 3 tons/A.

Woolly Cupgrass Research

Principal Investigator

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Project Duration

2001 to 2003

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Keywords

cover crops, organic farming, organic Vinton 81 soybeans, rye seed, tillage, woolly cupgrass

Project Summary

I am an organic farmer. I care for and manage our family's century old farm. My continuing goal is to maintain good soil health, manage weeds, and harvest a better yielding organic crop. Weed management, controlling erosion, cover crops, and green manure are all important to a balanced farming method. My objectives in this project were to look at the use of rye as a cover crop in soybeans and the management of woolly cupgrass without chemicals in the production of a rye seed crop.

Project Description

My farm is 58 tillable acres, all under the organic certification standards with 18.5 acres in transition. I use a rotation of small grains, legumes, and soybeans. I also have 11 acres in the Conservation Reserve Program. The soil is black with clay hills. My field preparation equipment includes a Howard Rotovator, a field cultivator, and a long tooth harrow. There isn't any livestock and only limited storage. My wife, my son, and I are the labor force.

In 1996, woolly cupgrass began showing up in some of my fields. I felt I needed to do something other than cultivating. I had read about the use of rye as a cover and weed control crop. I decided to try this method. I also began reading about a tillage tool called a rotovator. The rotovator leaves crop residue on the surface of the field. This was what I needed in order for the rye to do its job as a weed control crop so I purchased a Howard Rotovator and used it for field preparation. I was able to incorporate the rye residue into the top 3" of soil. By just working the topsoil, I could leave weed seed undisturbed at lower levels. Organic matter is available for quick breakdown and the nutrients can be used by the newly planted crops. Field work was reduced considerably with just one pass of a field cultivator and one pass with the rotovator. With the combination of rye as a cover crop and the use of the rotovator, I have spent less time on field preparation work, have cleaner fields, and have reduced cultivating time. With rye as a cover crop, I also have less hillside erosion and something green is always growing.

My project had two parts. I wanted to see how a cover crop of rye would help to alleviate weed problems in my organic Vinton 81 soybean field, particularly woolly cupgrass. I also wanted to look at how rye could control weeds in a rye seed production field.

Part I. Winter Rye as a Cover Crop in an Organic Soybean Field

I would like to review my fall 2002 test plot crop rotation. After the fall harvest of buckwheat, I rotovated the field once. A cover crop of rye and vetch was then planted. Planting was done with a grain drill at the rate of 1 bu/A of rye and 20 lb/A of vetch. This cover crop combination was left until May 21, 2003 when I used a stalk chopper and cut down the rye to ground level. The rye was 14" high and the vetch 4" high when it was chopped.

Spring wheat (left) and winter rye vetch (right).

As described in the *Greenbook 2003* article, I was going to prepare the fields by three different methods: plowing, disking, and rotovating. However, the entire field was rotovated once on May 23, due to a miscommunication between my son and me. On May 26, soil and air temperatures were conducive for planting soybeans. Air temperature was in the lower 60's, and soil temperature was at 46°F. Weather remained cool into early June, so I was unable to drag this field until June 14. At that time, I made two passes with a harrow. On June 17, another pass was made when bean height was 8".

The weeds were now under control. The exception was an area that had not been planted with the rye/vetch cover crop. In that area, ragweed and woolly cupgrass were growing fast. Also, because of the 2002 buckwheat crop, I was getting some volunteer buckwheat in the rows. Cultivating began on July 1 with a front and rear mounted cultivator. After one pass, I worked backwards in the opposite direction to remove any woolly cupgrass and buckwheat. Bean height was now at 14" and beginning to canopy. On July 15 and 16, we hand weeded to remove the buckwheat with very good results.

Beginning in late July and going through August 20, we had some soybean aphid problems. They did not seem to cause any major damage. During this same time, we only received 1 1/2" of rain. The lack of rain put stress on the crop. Even though the blossoming of the plants was in progress, the top 1/3 of the pods never filled out. Rain did fall later, but it was too late to give any aid to the crop which had already started to dry down.

On October 2, I harvested this field. Buckwheat was not present. Woolly cupgrass was not in between the rows, but some was present within the rows (2 plants/ft^2). This was less than in 2002 when the woolly cupgrass ranged from 3 to 6 plants/ft^2. Weather was good for harvesting and dry conditions had bean moisture at less than 13%. The beans yielded 25 bu/A, with a varying range in bean size. On October 7, after harvest, I planted rye at a rate of 2 bu/A, for seed in 2004.

Part II. Rye Seed Field and Weed Control

In the fall of 2002, I seeded the rye cover crop with vetch. The rye was seeded at 1 1/4 bu/A and cost $5.00/bu. The vetch was seeded at 20 lb/A and cost $.50/lb. Seeding was done with a grain drill. I added hairy vetch to my test plot to see if it would aid in controlling woolly cupgrass. On April 29, 2003, I also planted a test plot of spring wheat beside the rye. I added a strip of A.C. Green Fix (an annual chickling vetch) to my test plot. It was planted at 50 lb/A. I was curious to see if it had the ability to grow in woolly cupgrass infected fields. A bare strip was left beside the chickling vetch to monitor weed pressure.

Results

Part I. Winter Rye as a Cover Crop in an Organic Soybean Field

Results of the rye/vetch cover crop in the soybeans were well within my hopes for woolly cupgrass control. Even with the drought in our county, this field remained green and finished out a crop with soybean yields of 25 bu/A. In rotovated areas, the woolly cupgrass population was 2 plants/ft^2 or less. Soil conditions remained loose and moisture seemed to be at about 3.5" below the surface. The volunteer buckwheat was not a problem and plant health was not adversely affected by the aphids.

Our county had an infestation of Asian lady beetles. These beetles preceded the aphids and remained in the fields through harvest. The beetles preyed on the aphids giving some relief to the soybean plants.

The area of beans where I did not plant rye showed signs of increased weed pressure. Woolly cupgrass was noticeably more abundant, with 5 to 6 plants/ft^2. Ragweed populations were 2 plants/ft^2. These two weed plants did not grow together in the same area. Plant health in this area did not seem to be affected by the weed pressure.

Part II. Rye Seed Field and Weed Control

My test plot for spring planting was designed to evaluate spring versus fall planting of rye. I did this to see which was better at controlling woolly cupgrass. The fall planting of rye with vetch controlled the weeds. Early fall growth established a strong root system, with 3" of plant already present in the fall. Early spring moisture rapidly moved plant growth along with rye reaching heights of 6' or more. Shaded ground kept woolly cupgrass well in check.

On the other hand, spring wheat that I planted beside the rye had a difficult time with the grass. It emerged slowly, stayed short, and struggled until harvest. Woolly cupgrass counts in this area were 5 plants/ft^2. The A.C. Green Fix that was planted on April 25 seemed to do well until woolly cupgrass showed up in May followed by ragweed later in the season. It did not reach its expected height. It should have been cut down for forage at 12 weeks, but it remained too short. I waited for a fall seed harvest of it, but the weed pressure forced me to chop it down. In the area that was left bare, there was a mix of woolly cupgrass, ragweed, and foxtail: woolly cupgrass at 3 plants/ft^2; foxtail at 3 plants/ft^2; and ragweed at 1 plant/ft^2. The yields were as follows: 53 bu/A of rye, 100 bu/A of vetch, and 100 bales/A of straw.

Management Tips

1. Allow fields to dry down after chopping rye. Soil needs to be dry before rotovating. If the soil is too wet, the fields may become lumpy and require additional field work.

2. Keep the bean population count at 12 plants/lineal ft. This will reduce weed pressure.

3. Be patient and wait for warm weather for bean planting. This will prompt early emergence, and allow for another ush of weeds to be eliminated with the working of the ground.

4. Consider fall planting of small grains, especially rye. This crop fares well with late planting, grows fast in the spring, and yields well. It will tolerate a reasonable amount of woolly cupgrass.

Cooperators

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Bethany Schultz, Organic Foods-Cash Wise Groceries, Owatonna, MN
Dee Meiners, Minnesota BioAg Inc., Owatonna, MN
Tom Ehrhardt, Albert Lea Seed House, Albert Lea, MN
Jeanne and Charles Seykora, Owatonna, MN

Project Location

Go south on I-35 past Owatonna. Take the exit for Hwy. 14 and go east for 2 miles. Turn left off of Hwy. 14 onto Cty. Rd. 45 going south for 10 miles to 98th St. SE. Turn east onto 98th and go 2 miles then turn south onto 24th Ave. and go 1 mile to the Seykora farm.

Other Resources

North Central Region SARE. University of Nebraska-Lincoln. 13A Activities Bldg., PO Box 830840, Lincoln, NE 68583-0840, 402-472-7081. Email: ncrsare@unl.edu. Web site: www.sare.org/ncrsare
Sustainable Agriculture Research and Education (SARE) program works to increase knowledge about and help farmers and ranchers adopt practices that are economically viable, environmentally sound, and socially responsible.

Sustainable Ag. Network:
1998. Managing cover crops profitably, 2nd Edition.
1997. Steel in the field: A farmers guide to weed management tools.
National Ag. Library. Web site: www.sare.org/htdocs/pubs/resources/index.html#Profitably

Native Perennial Grass - Illinois Bundleflower Mixtures for Forage and Biofuel

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Project Duration

2002 to 2003

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Keywords

big bluestem, biofuel, forage, grazing, Illinois bundle ower, Indian grass, legumes, little bluestem, native perennials, switchgrass, warm season grasses

Project Summary

Illinois bundle ower is a native perennial legume that has potential for grain and forage production but field evaluation in diverse environments is required. We established mixtures of Illinois bundle ower and warm season grasses on farms and University of Minnesota Research and Outreach Centers in southern Minnesota where weeds were successfully controlled. We could not establish Illinois bundle ower on farms where high weed populations existed and weed control was not effective.

Project Description

There is potential in the Upper Midwest for supplementing the summer slump in cool season legume growth with warm season pastures. Native grasses such as big bluestem, little bluestem, and switchgrass are used in forage systems, but the forage quality of such grass-only pastures can be quite low. Mixing the grasses with legumes could increase the crude protein and decrease the fiber concentration of the mixed forage as well as increase total yield. However, attempts to mix cool season legumes such as alfalfa with warm season grasses ultimately results in the cool season legumes out-competing the grasses. One alternative is to mix the warm season grasses with warm season legumes that may be more compatible than cool season legumes due to similar periods of active growth. Currently, there are no domesticated warm season legumes being used for forage in the Upper Midwest.

Illinois bundle ower (IBF) is a native, warm season legume with potential as a forage crop. The perennial legume project at the University of Minnesota has developed unique populations of IBF. Research has demonstrated that pure stands of IBF can yield high quality forage from mid-July to mid-August, but little is known about how mixtures of IBF and warm season grasses would perform. The goal of this study was to evaluate the biomass yield, forage quality, and persistence of mixtures of IBF and warm season grasses.

We seeded replicated trials on four farms and at two University of Minnesota Research and Outreach Center locations in Southern Minnesota from late May to early June 2003. The trials were seeded at the Southwest Research and Outreach Center in Lamberton and the Southern Research and Outreach Center in Waseca. Farm sites included: Scott Sanders, St. James; Roger Bentz, Truman; Larry Spitzner, St. James; and Jesse Theis, Belle Plaine.

Illinois bundle ower plant.

Table 1. Seeding rates of warm season grass and Illinois bundleflower mixtures at all locations

Species	Nitrogen (lbs/A)	plants/ft²	lb plants/A
BB + IG	---	25 BB/25 IG	8.3 BB/5.2 IG
SG	---	50	4.4
LB	---	50	3.7
IBF	---	50	29.4
BB + IG	100	25 BB/25 IG	8.3 BB/5.2 IG
SG	100	50	4.4
LB	100	50	3.7
IBF + BB + IG	---	25 IBF/12.5 BB/12.5IG	14.7 IBF/4.15 BB/2.6 IG
IFB + SW	---	25 IBF/25 SG	14.7 IBF/4.4 SG
IBF + LB	---	25 IBF/25 LB	14.7 IBF/3.7 LB

** BB=Big Bluestem; IG=Indian Grass; LB=Little Bluestem; IBF=Illinois Bundleflower; SG=Switchgrass*

Table 2. Percent establishment of warm season grasses and Illinois bundleflower in 2003 at Waseca, Belle Plaine, and Lamberton, MN

Mixture*	Waseca		Belle Plaine		Lamberton	
	IBF	Grass	IBF	Grass	IBF	Grass
	percent establishment					
BB + IG	---	20.7	---	23.4	---	34.5
SG	---	11.7	---	6.8	---	26.6
LB	---	9	---	17.5	---	31.1
IBF	19.7	---	25.1	---	32.6	---
BB +IG + IBF	24.2	16.8	33.1	25.4	35.8	33.5
SG + IBF	22.9	9	33.6	4.7	35.3	22.5
LB + IBF	21.5	5.7	35.3	22.4	38.5	35.5

** BB=Big Bluestem; IG=Indian Grass; LB=Little Bluestem; IBF=Illinois Bundleflower*

Table 3. Effect of spray and mowing treatments on establishment of Illinois bundleflower alone and in mixture with warm season grasses on three southern Minnesota farms (Spitzner, Sanders, Bentz)[1]

		Spitzner		Sanders		Bentz	
Weed Control Treatment	Native Plant[2]	IBF	Grass	IBF	Grass	IBF	Grass
		plants/ft²					
Sprayed	IBF	3.5	---	0.5	---	1.0	---
	SG	---	1.5	---	0.1	---	0.5
	IBF + SG	3.0	1.0	1.0	1.0	1.0	1.0
	BBS + IG	---	3.0	---	1.0	---	1.0
	IBF + BBS + IG	3.5	4.5	1.0	1.0	1.0	1.5
Mowed	IBF	2.0	1.0	1.0	---	0.5	---
	SG	---	2.0	1.0	---	---	1.5
	IBF + SG	2.5	1.5	1.5	1.0	0.5	0.5
	BBS + IG	---	2.0	---	0.5	---	2.0
	IBF + BBS + IG	3.0	2.5	1.5	1.0	1.0	2.0

[1] *Populations measured in mid-August.*
[2] *BB=Big Bluestem; IG=Indian Grass; LB=Little Bluestem; IBF=Illinois Bundleflower; SG=Switchgrass*

The treatments differed somewhat among locations (Table 1). For the two University of Minnesota and the Theis farm sites, seeds were drilled to a ½" depth with a plot seeder designed for research plots. Weeds were controlled with 4 oz. of Plateau (imazipic) about one month after seeding. Switchgrass is highly susceptible to imazipic so plots with switchgrass were hand weeded. Stand counts were taken in mid-August.

At the other farm site, we seeded IBF, switchgrass, a mixture of big bluestem, and Indian grass, and mixtures of IBF with the grasses (Table 2). The plots were seeded with a Brillion seeder in late May or early June. For weed control, the plots were either mowed (when weed canopy closed over the seeded mixtures) or sprayed with Plateau (imazipic) herbicide in mid-July.

Project Results

Establishment of IBF was excellent at the Research and Outreach Centers and the Theis farm site; however, grass establishment differed greatly among species (Table 2). Illinois bundle ower establishment ranged from 20 to 40%. Stands were least at Waseca due to drought conditions following seeding. Big bluestem and Indian grass had the best establishment at all three locations. When not sprayed with imazipic, switchgrass established as well as big bluestem and Indian grass. Little bluestem establishment varied with location. Establishment was excellent at Lamberton and Belle Plaine, but poor at Waseca. Illinois bundle ower is tolerant of Plateau herbicide, but switchgrass is not. Establishing mixtures of IBF with switchgrass is therefore problematic. Clearly, alternative weed control measures need to be developed to successfully establish mixtures of IBF and switchgrass. Seeding year yields of grasses and Illinois bundle ower were low for all treatments and yield was not measured. Next summer, the forage yield will be harvested in mid-July or mid-August. The forage yield and quality will be determined and compared to the fertilized grasses and the unfertilized monocultures.

Stands of IBF and native grasses seeded at the other three farm sites with the Brillion seeder were considerably less than those achieved at the Research and Outreach Centers (Table 3). At these farm sites, annual weeds such as lambsquarters and foxtails provided significant competition with the seeded natives and reduced their establishment. Weed populations were observed to be significantly higher on these farm sites than those mentioned at the Research and Outreach Centers. Stands were similar for sprayed and mowed treatments indicating that neither was effective in weed control. Two factors led to the relatively poor performance of the herbicide in this study: 1) lambsquarters, a predominant weed at all sites, is not effectively controlled by the herbicide; and 2) because of logistical problems, we were unable to spray the herbicide until weeds were more mature than recommended. Mowing that was applied at a 6-10" height above the emerging bundle ower also was not effective in killing weeds because annual broadleaf weeds like lambsquarter regenerated from axillary buds.

Management Tips

1. To reduce potential competition with weeds, plant warm season grasses and Illinois bundle ower in fields where weeds have been controlled the previous year.

2. Mowing is not an effective strategy for control of weeds in Illinois bundle ower.

3. Herbicides can be an effective weed control strategy but must be applied according to guidelines to insure kill of target species.

Cooperators

Greg Johnson, Agronomist, Southern Research and Outreach Center, Waseca, MN
Paul Peterson, Extension Educator, University of Minnesota, St. Paul, MN
Gary Wyatt, Regional Extension Educator, St. James, MN
Steve Quiring, Agronomist, Southwest Research and Outreach Center, Lamberton, MN

Project Location

Contact Craig Sheaffer for directions to farms and Research and Outreach Centers.

Other Resources

Indigenous Native Legumes web site. Department of Agronomy and Plant Genetics. Available at: http://agronomy.coafes.umn.edu/index.asp then type "Indigenous Native Legumes" in the search box.

Minnesota Department of Agriculture. Greenbook 1998. Establishing and maintaining warm season grasses, pp. 26-29. St. Paul, MN.

Comparing Performance of Hoop Buildings to an Older Conventional Building for Finishing Hogs

Principal Investigator

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Project Duration

2002 to 2003

ESAP Contact

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Keywords

conventional building, finishing hogs, hoop building, Pig Win software

Project Summary

The purpose of this project was two-fold. First, I wanted to compare the hoop barns to older confinement buildings. Most comparisons have compared hoop barns to new facilities. New facilities are something many of us do not have. Secondly, I wanted to help smaller operators keep better records. I plan to use a computer software program called Pig Win to get a better handle on my record keeping. The Pig Win program utilizes a palm pilot for data entry that I thought would help independent farmers do record keeping more easily.

Project Description and Results

When we started this project, we had a 170 sow farrow to finish hog operation that used off-site rented finishing and nursery buildings. We purchased all of our feed. Most of the buildings we were renting were built or remodeled in the 1970's. The operation was very time consuming because of all the time spent on the road, usually 2 to 3 hours/day. Along with that, hog prices in 2002 were hard on many producers and we were no exception. It became clear that moving the entire operation to the home farm would save money.

I became interested in hoop barns as a way to build low cost finishing. I felt I could not afford new confinement buildings. As I started to research options, I began to wonder if hoop barns might be a more enjoyableway to raise pigs, both for the pigs and for myself. Also, the money now spent on lease payments could be used to pay off the hoops.

In the summer of 2002, we purchased two used 30 x 72' hoop barns from a farmer who was retiring. Because of the wet weather, we experienced many delays putting up our first building. With the help of my neighbors, the first hoop was put to use on August 19. The second building was completed by the end of the year.

As we prepared to switch to hoops, I knew that, for the hoop barns to work, we needed access to lots of bedding. It is often hard to get custom balers to come in the fall, so I felt it was important for us to own our own baler. We bought an older New Holland round baler and harvested about 150 corn stalk bales off our farm. This decision proved to be important because there were only a few days to bale due to a very wet October in 2002.

We had some mycoplasma-pneumonia disease problems in all of our facilities during the fall of 2002. It affected both systems, the conventional and the hoop barns. Our data showed that the hoops had a lower death loss; however, feed conversion and growth rates were poor in both systems due to the disease problems and the lower protein levels we fed due to the low hog prices (Table 1). Our first group closeouts did not look very good overall.

Table 1. Comparison of Pig Performance in Hoop and Conventional Finishing Barns, 2002

Performance Indicators	Hoop Barn	Conventional Barn	
		1	2
Group Open Date	8/19/02	9/27/02	11/14/02
Group Close Date	2/14/03	4/03/03	4/21/03
Total No. of Pigs	253	408	91
Mortality Rate (%)	4.7	10.5	22.0
Avg. Days to Market	186.9	158.1	175.4
Avg. Daily Gain (lb/day)	0.756	0.460	0.878
Feed Conversion (lb of feed/lb of gain)	3.80	3.47	3.63

Table 2. Comparison of Pig Performance in Hoop and Conventional Finishing Barns, 2003

Performance Indicators	Hoop House		Conventional Barn		
	West	East	1	2	3
Group Open Date	3/24/03	5/03/03	12/21/02	2/08/03	5/17/03
Group Close Date	8/20/03	10/03/03	5/26/03	7/16/03	10/30/03
Total No. of Pigs	179	172	107	148	77
Mortality Rate (%)	2.8	2.9	8.4	4.7	5.2
Avg. Days to Market	137.5	133.2	146.8	133.1	158.8
Avg. Daily Gain (lb/day)	1.461	1.340	1.291	1.430	1.437
Feed Conversion (lb of feed/lb of gain)	2.95	3.21	2.89	3.02	2.77

In 2003, we decided to downsize our operation to address continued low hog prices. We did not want to quit farming or quit raising hogs. We scaled back to a sow herd that would fill our two hoop barns, roughly 50 sows. Instead of farrowing every six weeks as we had done in the past, we started out with one large farrowing in the winter. We would then have the option, if it was economically feasible, to farrow again in the spring. I also found off farm employment with a construction company that allowed flexibility to do farm work.

Production improved in 2003 without the disease problems of 2002 (Table 2). Pig performance in the hoop barns compared quite favorably with the conventional buildings in death loss, feed conversion, and growth. There may be some seasonal differences caused by temperature but I wasn't able to account for these because of the small numbers of groups.

After looking at performance for two years, I believe I've proved to myself that hoop barns compare quite well with the older types of barns many of us are using for finishing. I really enjoyed working in the hoop barns and don't believe that it takes any more labor to run them than it does conventional systems. I also like the fact that the system uses minimal electricity and no supplemental heat. The low investment was a big help to us and the hoops allowed us the flexibility to make the changes we felt we needed to make in 2003. I am now considering changing my sow gestation to a deep-bedded system. Also, as my farrowing equipment wears out, I would consider some type of deep-bedded farrowing or even hoop barn farrowing. A straw-based system would give us the option of exploring the "natural" pork markets.

I think that converting more of my operation to solid manure will have a positive effect on the environment both for water quality and odor reduction. I think it could also actually reduce labor used in handling manure.

At this point I am very happy with the palm pilot for data entry of my records. I just write the information in the palm pilot every day and it takes a few minutes to download it to the computer. The Pig Win program will print out many different reports on production and financial information. I did learn, from experience, that it is important to back up your data frequently. I had a problem when the batteries died in the palm pilot. It went dead and I hadn't transferred the data to the computer. I was able to go back and reenter the data but it cost me time.

Management Tips

1. Record keeping is very important no matter what size operation you have.

2. The palm pilot is an easy way to keep records. Remember to back up your data.

3. It is important to use lots of bedding in hoop barns and other deep-litter facilities.

4. Hoop barns offer a lower cost option to construction of confinement buildings. They offer flexibility as operations change.

Cooperators

Will and Barb Marsh, FarmWise Systems, Little Canada, MN
Wayne Martin, University of Minnesota Alternative Swine Program, St. Paul, MN
John Goihl, Agri-Nutrition Services, Shakopee, MN

Project Location

From Le Center, go north on Le Sueur Cty. 11. Turn left at first stop sign, go .25 mile and turn right (stay on Cty. 11). Farm is approximately 2 miles on the right. House number is 33221.

Other Resources

Appropriate Technology Transfer for Rural Areas (ATTRA), P.O. Box 3657, Fayetteville, AR 72702, 800-346-9140. Web site: www.attra.org
Provides assistance and resources free of charge to farmers and other agricultural professionals.

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 Service, St. Paul, MN, 612-625-8173 or 800-876-8636.

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

Raising Cattle and Timber for Profit: Making Informed Decisions about Woodland Grazing

Principal Investigator

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Project Duration

2002 to 2004

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Keywords

forage yields, silvopasture, thinning, timber growth, understory, woodland grazing

Project Summary

Silvopasture is the intentional incorporation of trees into grazing systems. While grazing the woods is common, these woods can be degraded by the grazing and the timber is often unmanaged. We intend to test the effect of crop tree management (managing individual trees as a timber product) on the forage yields of grazed woodlands. We are not necessarily trying to encourage woodland grazing but instead to encourage management of grazed woodlands. We are in the second year of the project. So far, we have thinned the stand and taken samples for one year. During the first year, we quadrupled yield with no reduction in forage quality or protein levels by thinning the timber stand. We will follow the progress of the forage for one more year and then follow-up on the trees in about ten years.

Project Description

Grazed woodlots are common in central Minnesota. Grazing can damage timber value, but this does not always appear to be the case. On Don Sirucek's farm in Cass County (a former dairy that is now a cow-calf operation), a demonstration/research project was established to see the impact of crop tree management of grazed woodlots on both forage yields and timber growth. The crop trees are primarily burr oak and red pine. The woodlot also contains birch, aspen, white pine, black ash, and elm. Initial forage samples were taken this summer. During the next two years, forage sampling will be conducted to assess the forage yields and quality. Because trees grow slowly, while initial conditions were assessed, the timber aspect will not be assessed for ten years. We are not specifically encouraging opening up new woodlots to grazing. Instead, we are determining if forest management can have the added benefit of higher forage yields and improved tree growth for stands that are already being grazed.

Over 800,000 acres of woodlands are being grazed in Minnesota (Loeffler et al. 2000). These grazed woodlands are often unmanaged for timber, resulting in both low yields of forage and reduced timber value. Management of grazed woodlots could potentially increase both forage and timber value. Economically, this can be beneficial, especially if the landowner has an outlet for the thinnings, such as firewood or a small sawmill.

We want to compare forage yields and quality in woodlots managed under a crop tree system and woodlots that are unmanaged. We marked six plots: three as a crop tree thinning

Mike marking woodland grazing plots.

Table 1. 2003 Forage Yield, Relative Feed Value, and Protein Content for Thinned and Control Grazed Woodlands

		Forage Yield (Lb/A)	Relative Feed Value	Protein (%)
Early Season	Thinned	473	140	15
	Control	131	114	10
Late Season	Thinned	262	132	16
	Control	41	62	9

and three as controls (not thinned). We took three forage plot samples from each plot in mid-summer. The winter of 2002 we did the crop tree thinning. In 2003, we took two forage samples: one in July and one in September.

Results

The first year we took initial forage samples as the plots were still being established. The yield of the standing crop of forage cut to one inch tall was an average of 292 lb/A with a range from 155 to 532 lb/A. This yield was significantly higher than expected. However, this included a significant amount of indigestible material such as ferns on two of the plots where there was very limited grasses.

We observed that the sites that have not been grazed have a completely different group of plant species in the understory. While samples from the ungrazed area had higher yields, the forage was of limited palatability because of the presence of more ferns and woody vegetation. And, interestingly, it appeared to be less diverse (primarily hazel and ferns) than the grazed areas, although we cannot tell for sure because of the small number of samples we took in the ungrazed area.

Forage in the grazed plots primarily consisted of forbs and cool season grasses. The forbs varied, but included hog peanut (more than half of volume), some spring ephemerals (wild flowers) and, small Rubus (raspberry and dewberry). The grasses/grass-like plants consisted of Canada blue-joint, Kentucky bluegrass and some sedges. Ferns were a main component in both the thinned and control plots, but they were an overall minor component because they dry down to very low weights.

In 2003, the total forage yield for the year was 735 lb/A for the thinned plot and 172 lb/A for the control plot. The early season cutting was 473 lb/A for the thinned plot and 131 for the control plot (Table 1). The late season cutting was 262 lb/A for thinned plot and 41 lb/A for the control plot.

Early season relative feed value and protein levels were good but not significantly different between treatments. The relative feed value for the thinned plot was 140 and 132 for the control. Protein was 15% for the thinned and 16% for the control. The early season thinned forage made Grade 1 forage.

Fall relative feed value was different with 114 for the thinned plot and 62 for the control. Protein levels were similar for each treatment, but less than the early season levels.

Because the moisture coming into the season was low, early growth was somewhat delayed. However, we received good moisture for a month followed by nearly no moisture for most of the remainder of the season. We expect to do three samplings next year (assuming good moisture).

Woodland grazing.

Due to a very small sample size for the control woods, the samples had to be pooled to get enough to do forage analysis. These numbers must be understood to be just for this year which was very dry. By next year, hopefully, we will have a "normal" year and get a good full season of data. The results thus far can be looked at two ways: either it does not yield much to graze a not thinned woodlot, or you should thin the woodlot if you are going to graze it.

Management Tips

1. BUGS - As most people know, Minnesota has more than its share of biting insects. However, while cattle seem to enjoy a few trees around, a woodlot that is dense with trees can be pretty dense with biting insects. Opening the site up might reduce the vengefulness of the insect attack. The cattle seem to shy away from the woods during the periods that are heavy with biting insects.

2. Thinning the overstory more than quadrupled yield of forage.

3. Removing some trees from the stand increases the growth of the ones that remain. If you leave really good ones (crop trees) and take out the bad ones (culls), the wood that is growing on the site is going onto the best trees. These trees get more and more valuable each year.

Cooperators

Rick Schossow, Soil Conservation Technician, Natural Resources Conservation Service, Walker, MN
Howard Moechnig, Grazing Lands Conservationist, Natural Resources Conservation Service, Rochester, MN
Don Sirucek, Farmer, Staples, MN

Project Location

Plots are located off of State Route 64 north of Motley. For more information as to specific locations, call Mike Demchik at 218-894-5167.

Other Resources

Agroforestry Center in Missouri has a video and several publications on silvopasture.
Available at: http://agebb.missouri.edu/umca/

National Agroforestry Center web site has information on silvopasture. Available at:
www.unl.edu/nac/silvopasture.html

Performance Comparison of Hoop Barns vs. Slatted Barns

Principal Investigator

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Project Duration

2002 to 2004

ESAP Contact

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Keywords

annualized profits, carcass data, feed consumption, finishing hogs, hoop barns, rate of gain, rate of return on investment, slatted barns

Project Summary

There is a lack of information about performance of hogs in hoop barns versus slatted finishing barns in northern climates. This project will split groups of finisher pigs into two groups, about half going into hoops and the other half into slatted finishing barns. Each group is weighed going into the finishing units. Feed consumption and days on feed are being tracked. After the pigs are slaughtered, the feed conversion, rate of gain, and carcass data of the two groups will be compared. By comparing the dollars received in each system with the dollars spent to build each building, we can compute profit of each building and dollars returned to the operator.

Project Description

My wife, Judith, and I farm 500 acres nine miles southwest of Preston in southeast Minnesota. We live in country that has rolling terrain that is dominated by Fayette soil. We rotate corn, soybeans, and alfalfa in a minimum tillage system. We finish 2,600 hogs and have 20 beef cows. Jud and I are the main labor source; we do hire part-time help during spring planting and fall harvest seasons.

We have information from Iowa State University about the performance of hogs in hoop barns versus slatted barns but our winters are more severe here than in central Iowa. We need hard data on performance of pigs split into two groups; one in hoops and one in slats. We know that hoop barns cost less to build but we need to see if the savings transfer this far north.

We planned to divide groups of about 500 single source pigs into two groups – one subgroup into the hoop barn and the other into the slatted barn. This was an attempt to limit as many variables as possible from the study. We had a three-year contract for a single source of early weaned pigs prior to entering this study. The person on the other side of the contract decided to break the contract, so the first group was a different source than later groups but with the same genetics. After the problem with our source, eight neighbors formed a limited liability partnership and we purchased sows of the same genetics to supply all of us from the same farrowing unit. Since we now own the sows, there will be no change in the source.

Each group was weighed going into the barns with food consumption and days on feed tracked for the time they are in the barns. After slaughter, we will calculate feed conversion and rate of gain, and also compare carcass data. At the end of the three year project, we will calculate three year averages for rate of gain, feed conversion, days on feed, value of carcass in each system, and dollars returned per dollars spent in each system.

Kent with pigs in slatted barn.

Table 1. Comparison of Three Groups of Finishing Hogs in a Hoop Barn and in a Slatted Barn

	Hoop Barn			Slatted Barn		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Date In	3/22/02	9/16/02	5/13/03	3/6/02	9/9/02	5/13/03
Avg. Daily Gain (lb)	1.50	1.67	1.46	1.65	1.54	1.58
Lb Feed/Lb Gain (lb)	2.90	2.61	3.26	2.53	2.61	2.98
Feed Costs/Head ($)	29.46	35.58	39.04	27.88	36.05	33.75
Profit/Head ($)	13.66	15.22	(1.31)	26.99	17.56	2.85
% Death Loss	3.4	4.4	5.2	2.1	5.5	5.6
Avg. Carcass Wt (lb)	192	199	190	196	204	189
Avg. Backfat	0.97	0.96	0.87	1.01	0.89	0.93
Rate of Return on Investment (%)	NA	59.13	(4.16)	NA	18.63	3.70

Results

We have had three turns of the finishers at this point. It is still too early to make any definitive conclusions about the two systems because we are still learning how to manage hogs in a hoop barn as well as getting the hoop equipped as we want. A flare up of PRRS (Porcine Reproductive and Respiratory Syndrome) in the sow herd that supplies our finishing barns could have affected the pigs in the study. The close-outs from the comparison of finishers from the three groups show that the pigs in the slatted barn out-performed the pigs in the hoop barn though performance was poor in both barns for Group 3. Some of the close-out data is shown in Table 1. The rate of return on investment calculation that we added this year is another way of comparing financial performance of the two systems.

After the first group, we refined the software program that we use to track pig performance. We added rate of return on investment, annualized profits, and barn turn over rate.

The hoop structure is a good place to use the straw created from the nurse crop for alfalfa. Prior to construction of the hoop barn, using the straw was a problem. We are very happy that we decided to pour concrete side walls instead of using tongue and groove lumber. These are much more durable when you clean the barn and pigs cannot damage concrete by chewing on it the way they might damage wood. We made our own forms and using them made the cost comparable to wood walls.

With the disease problems we experienced this year, I started to wonder if I was leaving disease behind when I cleaned the bedding out of the hoop barns in the winter, or if the manure pack heated up enough to kill disease organisms. With the slatted floor finisher, we power wash when we move a group of pigs out, leaving little chance that disease organisms survive. Another possible disadvantage to the hoop barns is the stress put on animals being moved from the nursery to the hoop barn when there are wide temperature differences. We had a 30ºF temperature swing in 24 hr when one group was scheduled to move to the hoop barn. We delayed moving them until the temperature had moderated.

One additional problem to be aware of is that slatted finisher barns are fully insurable for wind and fire damage. Hoop barns are not insurable for wind but are insurable for fire. There is, however, greater risk of suffocation in slatted finishers and it can be costly to insure against that.

Management Tips

1. The hoop barn is a good place to use up the oat straw created from the nurse crop for alfalfa.

2. To avoid stressing the pigs, consider waiting to move pigs from the nursery to hoop barns if the weather is bad and there are wide temperature differences.

3. There is a greater risk of suffocation losses in slatted barns than in hoop barns. It is costly to insure against suffocation losses.

Cooperators

Wayne Pike, Riverland Community College, Leroy, MN
Doug Frodl, Riverland Community College, Austin, MN

Cleaning out the manure pack in the hoop barn.

Project Location

From Harmony go west on Hwy. 44 for 7 miles. Turn right on Cty. Rd. 15 and go 2.25 miles. Turn left on Cty. Rd. 20 and the farm is the first farm on the left.

Other Resources

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. 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.

Pigs in hoop barn.

Low Cost Fall Grazing and Wintering Systems for Cattle

Principal Investigator

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Farmer Cooperators

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Project Duration

2002 to 2004

ESAP Contact

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Keywords

fall grazing, livestock wintering, manure management, stockpiling

Project Summary

This project includes three farmers who are using an innovative and low-input livestock system for fall grazing and winter feeding. The system has two components. The main focus is the development of a winter feeding system that uses round bales strategically placed during good autumn or winter weather. This becomes the "rotational winter feeding area." When possible, the site is selected to provide both winter protection for the animals and proper placement of manure nutrients and organic matter where they are most needed for soil improvement.

Secondly, they are grazing their third crop hay rather than cutting and storing it. This enables them to stockpile other permanent paddocks for fall and early winter grazing. Their goal is to promote a livestock management system that is economically viable, environmentally friendly, with low labor input, and high energy efficiency. They wish to show farmers and other professionals a livestock wintering system that works for everyone and leads to a better quality of life.

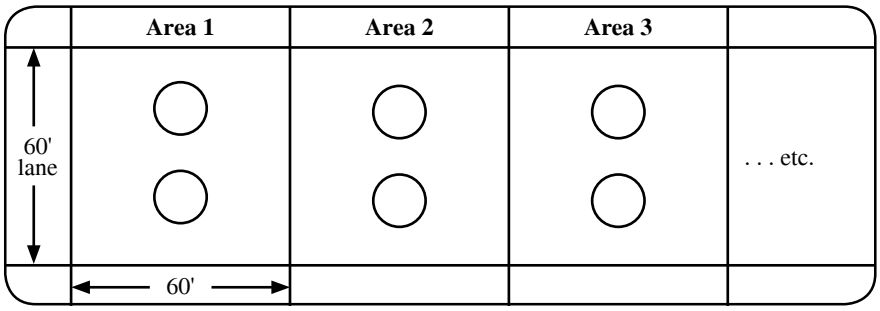
Project Description

Farm Descriptions. Dennis Rabe operates a diversified farm consisting of 320 acres of forages and row crops, a 75-cow beef cow-calf operation, and a 600 hog farrow-to-finish operation. Dennis also direct markets meat. Art Thicke operates a 477 acre grass-based dairy farm with 90 milk cows. Art raises no row crops. He purchases his grain and winters his dry cows and replacements using the same low-input system. Of the 477 acres, 135 are tillable. Ralph Lentz operates a 160 acre grass-based 40 cow beef cow-calf operation. One hundred ten acres are in grass or forage. All three farmers are rotational graziers using a low-input management system.

Rotational Winter Feeding Area. A description of Ralph Lentz' winter feeding area is presented here as an example. Each farmer is exploring variations on this theme. In late fall, Ralph places round bales in 'lanes' (see Figure 1). A 4' tall perimeter electric fence is placed to surround all of the bales in the 60' wide winter feeding lane. He uses 16 gauge wire and 3/8" round steel posts sharpened to a point. These posts can be moved in winter with a vise grip. A 60' temporary fence is placed between the first and second feeding area. Starting with "area 1," the herd is allowed access to two bales at a time using round bale feeders. As the animals are allowed into succeeding round bales, they continue to have access to the previously used portion of the lane. High fiber hay that is left behind becomes a convenient bedding site for the animals.

Winter feeding area on the Rabe farm.

Figure 1. Round Bale Placement in a Typical Winter Feeding Area at the Ralph Lentz Farm



We want to show that this is a low-cost, energy saving, labor saving way to farm. We are documenting the performance of this system in the following ways:

1. We are keeping track of the length of time the animals spend in the winter feeding area. From this we are able to estimate the labor and machinery savings due to reduced manure handling compared to a confinement system.

2. We are documenting the time spent in daily management of cattle and in hauling and placing round bales.

3. Animal health is being observed. Veterinary costs are being recorded.

Results

2002

We are observing far better animal health, lower vet costs, lower machinery costs, and increased labor efficiency. The long-term benefits of this system are apparent to us more and more as we observe what is happening to the land and to the livestock. We see increased soil fertility and better soil tilth. We find the greatest benefit of this system is that it enables us to get away from the confinement of livestock. Pollution problems from accumulation of manure and urine are greatly reduced.

Art Thicke Farm. Three groups of cows were wintered in an outside feeding area, including 55 dry cows and bred heifers (Group 1), 30 heifer calves (Group 2), and 56 milking dairy cows (Group 3) as weather permitted. The wintering system provided the following savings in manure handling over 4.5 months:

Group 1	55 tons per month
Group 2	15 tons per month
Group 3	56 tons per month
Total	**126 tons per month** or 567 tons per wintering season

In other words, this system saved the time, fuel, and equipment use that would have been required to haul 567 tons of manure. The bales were placed in November with a labor investment of 20 hours. This does not include the milking dairy herd. They are wintered away from the barnyard only in good weather.

Art used six round bale feeders for each group. His feeding time for each group is as follows:

Group 1	20 to 30 minutes every 6 to 7 days
Group 2	15 to 30 minutes every two weeks
Group 3	20 minutes every third day

He reported animal health to be excellent and had no vet bill for these groups in the winter of 2002.

Dennis Rabe Farm. Dennis wintered two groups of cattle for five months using the new system. The estimated manure output for this time period was:

Group 1	60 tons manure per month
Group 2	20 tons manure per month
Total	**80 tons manure per month** or 400 tons per five month wintering season

Dennis moved all of his bales in November. He found that round bale set-up time depends largely on hauling distance. The set-up time for one person and one 65 horsepower tractor was:

Group 1	4.5 hours (150 bales)
Group 2	1.5 hours (20 bales)

Feeding times for Dennis' two groups of cattle were:

Group 1	1.0 hour every two days (move three round bale feeders)
Group 2	0.5 hour every three days (move one round bale feeder) plus 0.3 hour per day (feeds some corn silage)

Animal health was excellent. Dennis incurred no veterinary costs in 2002.

Ralph Lentz Farm. Ralph winters two groups over a period of six months. The first group consists of 40 cows and one bull. The second group is 37 calves. The estimated manure output for this time period was:

Group 1	48.0 tons manure per month
Group 2	17.5 tons manure per month
Total	**65.5 tons manure per month** or 393 tons per six month wintering season

At Ralph's farm, bales were not placed in quantity until January during good weather. The time required for bale placement varied depending upon hauling distance. The chore time for moving bales and placing feeders for both groups of cattle was, at most, two hours per day. This included checking animal health and fences.

General findings. We find that a longer than normal rest period is necessary the following spring and summer to allow paddocks used for wintering to recover from the extreme disturbance.

Wintering sites have been targeted to optimize the placement of manure. For example, on the Lentz farm, last winter's site was intentionally located on a clay knoll. The combination of hay, manure, and animal impact create extensive pockets for water storage during spring snow melt.

Ralph found that the wintering system seeds the land. He has seen a good increase in red clover and orchardgrass after wintering on these sites. Other species can be introduced with a cyclone seeder in January or February.

Pure stands of alfalfa do not work well in our system for the following reasons:

- round bale thatching ability – a bale that is half grass shows far less loss over time;
- leaf loss – alfalfa takes far longer to dry when harvesting;
- cows do not like the coarse stems; and,
- a mix of grasses and legumes recover far better from cattle impact than alfalfa.

2003

This was an extremely dry growing season. We had planned on using simulated rainfall to compare runoff from pastures on wintered and non-wintered sites on the Lentz farm. However, the dry conditions caused drought cracks to form, making it impossible to collect meaningful runoff data. Rain simulations will be attempted in 2004.

We did not scientifically measure the change in soil organic matter after wintering. However, we observed that the combined effect of the added manure and the "pugging" (small depressions formed from hoof action) greatly increased water capture, available soil moisture, and forage yield in this droughty year.

Ralph spent less than $300 for diesel fuel over the last year. This cost is solely for moving bales and fencing work. Ralph hires out all his mowing, raking, and baling. Not having to start the tractor every day in winter is sure to lower the maintenance bill over time.

Ralph is having success combining the wintering system with late weaning of his beef calves. The calves are weaned in late December when mud is no longer a problem. The calves learn to become real ruminants as they eat along with the cows. Weaning in this way is less stressful on the calves and there have been few disease problems. Eight month old calves can be wintered in this fashion as long as they are allowed to come to the barn in severe weather.

Art Thicke sums up his overall wintering experience as follows: "For the past nine years we have been using this wintering system for our dry cows, bred heifers, calves, and even our milk cows when weather permits. The biggest benefit the system has brought to our farm is the improved productivity of our pastures in the following years. We have found the pasture improvement to be long-term. Pastures renovated in this manner are still more productive than non-renovated pastures even after nine years. We have been able to renovate our pastures with our cattle instead of machinery.

The bales are moved to their winter feeding position when it is convenient in the fall. This greatly reduces the labor associated with managing the cattle in the winter months. On the pastures used to winter our dry cows, bred heifers, and calves, a tractor is not used from the middle of December through May 1. With 90 head on our farm, we hauled only five loads of manure this past year. The cattle are healthier with access to fresh air and exercise. All the above mentioned benefits have tremendous economic value.

Along with our switch to controlled grazing, our wintering system has proven to be one of the best management decisions we have made on the farm."

Management Tips

1. This system of wintering is adaptable to any size dairy or beef operation. Severe land disturbance problems can occur when the group size gets to be 60 to 100 cows. However, at this point you can simply divide the cattle into smaller groups.

2. Cold weather doesn't seem to be a problem. However, wind and storm protection must be available.

3. Cows can utilize extremely poor quality hay. If there is waste, the cows will use it for bedding. The adage, "pollution is a resource out of place," can be applied here. The organic matter is then returned to the land where it is needed to rebuild the soil. This is extremely important to long-term sustainability.

4. If cows appear to be losing weight, add a lick tub, a few pounds of grain, or corn silage. When feeding poor quality hay to cows in the last stage of pregnancy, consider supplementing with vitamin A, D, and E plus 4% crude protein lick tubs.

5. The less livestock are confined, the better. Our system benefits the land, the livestock, and the farmer.

6. The animals can travel a good distance to the winter feeding areas. Ralph allows his cattle to travel up to one-half mile between the winter feeding area and water. Lanes are a good investment. Dennis allows his hogs to travel one mile between the barn and the winter feeding area.

7. When baling hay in summer, line up the bales as close to the wintering area as possible to avoid unnecessary transportation cost.

8. If the wintered area is to be used for row crops the following spring, avoid an early planting of field corn. Instead, consider planting corn for silage or soybeans and allow the soil to dry out thoroughly before working it.

9. Unseasonably wet weather can result in problems with mud and over-disturbance of the feeding area. Sites to be used in early fall and spring should be chosen to avoid poor drainage due to soil type or low position on the landscape. We suggest not using wet areas for wintering following row crops due to the lack of perennial roots and the protection they provide against excessive disturbance.

10. If, in spring, there are leftover bales in the wintering area, remove them only when the ground temporarily refreezes or when it dries out.

11. Avoid getting caught with snowbound stored bales by placing them on the winter area in November and on the early spring area in early March.

Cooperators

Steve Draskowski, Extension Educator, Wabasha, MN
Mark Kulig, Natural Resources Conservation Service, Wabasha, MN
Larry Gates, Minnesota Department of Natural Resources, Rochester, MN
Rodger Meyer, Minnesota Pollution Control Agency, Wabasha, MN
Howard Moechnig, Natural Resources Conservation Service, Cannon Falls, MN
Chuck Schwartau, Extension Educator, Red Wing, MN
Mary Jo Forbord, Sustainable Farming Association of Minnesota, Starbuck, MN

Project Location

Lentz Farm: When entering Lake City from the north on Hwy. 61, turn right on Goodhue Cty. 5 and go 2 miles west. Turn left on 340th street. The farm is .25 miles on the left. Contact Ralph for directions to other cooperators farms.

Other Resources

Graze-L email discussion group at:
graze-l@cygnus.taranaki.ac.nz
There is also an archive of past discussions at the web site:
http://grazel.taranaki.ac.nz

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

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

Dennis Rabe discusses desired thatching quality of good hay.

Using a 24' x 48' Deep Bedded Hoop Barn for Nursery Age Pigs

Principal Investigators

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Project Duration

2002 to 2004

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Keywords

daily rate of gain, deep bedding, feed consumption, hoop barn nursery, one-pen system

Project Summary

This project looks at how nursery age pigs gain weight and interact in a deep bedded hoop barn. The amount of bedding, temperature inside and outside the hoop barn, manure pack temperatures, feed consumed, and daily rate of gain were monitored.

Project Description

We currently farm over 700 acres with Trent's parents. The majority of the acres is in a corn and soybean rotation with some alfalfa acreage and occasionally oats for feed and bedding. We practice conservation tillage. We raise butcher chickens, cattle, bull calves, and Berkshire-cross hogs. We currently have 42 sows divided into three groups of 16, 14, and 12. We are a farrow-to-finish operation.

Our initial nursery building was a self-contained liquid manure confinement barn. With this building deteriorating, we decided to move away from a liquid manure system and built a 24' by 48' nursery hoop barn with a deep bedded system. We made some modifications to better control drafts when the barn is used as a nursery. We replaced the tarp ends with steel salvaged from the confinement nursery barn we tore down. We enclosed the "half moons" at the top of the barn that are traditionally left open in a finisher hoop barn. In the nursery setting, these could cause drafts on nursery age pigs. We also put an Accutrack door on the barn instead of the traditional roll-up tarp door because this door can be dropped from the top down to provide fresh air but keep a direct breeze off of the pigs.

The move to hoop buildings provided several advantages. Our whole family has allergies and we wanted to get away from the dust that was associated with our old nursery building and move to a more natural ventilation building. The hoop building also helps us to be a more environment- and neighbor-friendly hog farm. With non-farming neighbors and East Sunburg Lake within 500' of our building site, we wanted to get away from liquid manure. The hoop barn fits into our farm's future because it can be used for farrowing, as a nursery, a grower, or a finisher building. The building can also be used for other types of livestock, machinery, or hay storage. Our son, Josh, used the empty building this July as a training arena for his Limousin heifer while preparing to show her at the Kandiyohi County Fair.

In this project we will study how nursery age pigs gain weight and interact in a deep bedded hoop barn. We plan to use the hoop barn as a nursery in all seasons of the year. The amount of bedding, temperatures inside and outside of the building, manure pack temperatures, feed consumption, and daily rate of gain will be monitored.

Results

2002

Two groups of hogs were put in the hoop barn in 2002. Table 1 shows the dates, numbers, weights, feed and labor involved with both

Trent and son, Jonah in front of hoop barn.

Table 1. Results from Two Groups of Pigs in Hoop Barn, 2002

	Group 1	Group 2
Date Entered Barn	May 11	July 16-20
Number of Pigs In	84	97
Initial Pig Wt Range	10 to 50 lb	23 to 51 lb
Days in Barn	41	96
Daily Wt Gain - Range	.73 to 1.58 lb/day	.99 to 1.74 lb/day
Final Pig Wt Range	40 to 115 lb	118 to 218 lb
Number of Pigs Out	84	97
Feed/Head	150 lb	354 lb
Bedding Used (Bales)	3 – 1,000 lb round 5 – 40 lb square	7 – 1,000 lb round 30 – 40 lb square
Labor	23.25 hr	54.5 hr

groups. Before moving the first group of hogs into the nursery, we spread out one and a half round bales, leaving the other half for the hogs to explore. Approximately two weeks later, another round bale was added and we manually bedded when and where needed, leaving the rest of the bale for them to forage/destroy themselves. All pigs in the first group were brought into the hoop on the same day. We did a little experiment with the second group, putting hogs in the building over three different days to see how they behaved with split mingling. We were very pleased as they did not fight or single out any pig to pick on. The natural environment of foraging, digging, and burrowing seems to keep them quite active and content.

During the hotter months, the temperatures inside the hoop were 5°F warmer than the outside temperatures. When the outside temperatures became cooler, the inside temperatures averaged 11°F warmer than the outside temperatures. The manure pack temperatures usually ranged 40 to 60°F warmer than the barn temperature.

We were quite pleased with the hoop barn after our first year. We did not have a single death among either of the two groups that used the barn. The one-pen system is a nice change. We noticed that the pigs get used to the one-pen system while in the nursery, and when they are moved to the finisher hoop barn, they adapt very easily because it is the same setup only on a larger scale. We did not set up a separate pen for the runts and, even though the runts did not catch up to the larger pigs, they seemed to be much more active and healthy than what we used to see in our old confinement barn.

The only thing we would change about this nursery barn is the vent doors. We made hinged green treated plywood doors with latches along both sides. We thought these vent doors would provide more air circulation on hot days because the building is situated between other buildings with a lot of protection from trees. However, with the manure pack and nosey pigs, these vent doors were not a very good idea. We like the bi-fold doors that we have on our nursery hoop barn.

We have not yet tried the hoop barn as a nursery for pigs in the winter. Next year's report will have results of moving small pigs into the hoop barn from a heated farrowing facility.

2003

Three groups of pigs used the hoop barns beginning in February. Table 2 shows the dates, numbers, weights, feed, bedding, and labor involved with all three groups. We followed the same routine of spreading bedding as we used last year.

Table 2 shows the rate of gain and feed efficiency were better when the weather was warmer outside. Smaller pigs in particular had a better rate of gain in the July group (.98 lb/day) than in either the February (.73 lb/day) or May (.82 lb/day) groups.

When the first group was moved out of the barn in late March, we did not clean out the barn before moving the next group in. We wanted to see if leaving the manure pack affected the next batch of pigs. We did clean the cement slab and any heavily manured spots. As a precaution, the second group of pigs received a water soluble wormer after they were moved in. We did not experience any problems with doing this except, of course, there was more manure to remove after the second group!

We had problems with the second and third groups digging through the bedding into the gravel and dirt. The digging mixed the gravel/clay into the bedding material and a lot of gravel was hauled out when we removed the manure pack. Gravel was added to the floor of the barn after each of these groups. We don't know why the pigs did this because there was plenty of straw bedding each time. The addition of "toys" such as barrels and old tires reduced the digging a bit.

Differences between indoor and outdoor temperatures were the same as last year. With the manure pack being 40 to 60°F warmer than the barn air temperature, the pigs keeping their sleeping areas dry and cuddling together or up against the round bales, we have not used supplemental heat, calf hutches or extra tarps during either year of our project. We kept the doors closed during the coldest days but opened doors from the top to allow more air circulation on average days. During warm weather, doors are opened from the bottom and left open most of the time.

Table 2. Results from Three Groups of Pigs in Hoop Barn, 2003

	Group 1	Group 2	Group 3
Date Entered Barn	February 16	May 6	August 17
Number of Pigs In	76	80	103
Initial Pig Wt Range	18 to 59 lb	7.5 to 30 lb	7.5 to 33 lb
Days in Barn	36	51	50
Daily Wt Gain Range	.75 to 1.58 lb/day	.82 to 1.6 lb/day	.98 to 1.69 lb/day
Final Pig Wt Range	45 to 116 lb	49.5 to 112 lb	56.5 to 117.5 lb
Number of Pigs Out	75	80	101
Feed/Head	153 lb	217 lb	142 lb
Bedding Used (Bales)	5 – 1,000 lb round 6 – 40 lb square	6 – 1,000 lb round 0 – 40 lb square	1 – 1,000 lb round 84 – 40 lb square
Labor	22 hr	29 hr	37.5 hr

While each group of pigs is a bit different, all of the pigs seem more natural in this barn. We enjoy the one-pen system and it makes it easier for the pigs to adjust to the one-pen system in the finishing hoop barn. The only thing we would change is the vent doors we put on last year. We thought we would open them on very hot, humid days with no wind. We have not opened them in two years and probably never will.

Management Tips

1. During the winter, bed the floor of the barn immediately after cleaning to maintain ground heat. If the weather is warm, let the wet spots dry out first before moving bedding into the barn and moving the next group in.

2. Use plenty of bedding so the pigs can burrow without digging in the ground. If they still dig, add "toys" such as old tires or plastic barrels.

3. Do not use corn stalk bales for bedding in a nursery hoop in the winter. Corn stalks do not provide heat. They work fine the rest of the year.

4. Do not be afraid to keep the current manure pack if it is not too dirty or hasn't gotten too deep. You might want to worm as a precaution.

5. Bi-fold doors are a good investment.

Cooperators

Wayne Martin, University of Minnesota Alternative Swine Program, St. Paul, MN

Project Location

Farm is located 2 miles south of Sunburg on Hwy. 104 in the northeast corner of the intersection with Cty. Rd. 40.

Other Resources

Appropriate Technology Transfer for Rural Areas (ATTRA). PO Box 3657, Fayetteville, AR 72702, 800-346-9140. Available at: www.attra.org
Provides assistance and resources free of charge to farmers and other ag professionals.

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. 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.

Small nursery pigs in August.

High Value Pork Production for Niman Ranch Using a Modified Swedish System

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Project Duration

2001 to 2003

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Keywords

alternative swine system, antibiotic-free hogs, co-mingling, marketing, Niman Ranch, pen farrowing, winter farrowing

Project Summary

We farm 350 acres where we grow corn, oats, hay, and pasture. We try to feed all of our crops to our livestock. We have an 80 cow beef herd and finish out the calves. We also have a 50 sow farrow-to-finish hog operation. A small flock of sheep, chickens, and rabbits complete our farm. My wife, Diane, and our children, Hannah (18) and Ethan (13), all help on the farm.

Since 1998, we have been selling our pigs to Niman Ranch, a pork marketing company based in Iowa. In return for a premium and a solid floor price, we raise pigs with bedding and without antibiotics. It has been a very good market for us. Part of their humane protocol requires no use of crates for farrowing. When our old barn that was used for farrowing burned in April 2000, we decided to use a hog house built on our farm in 1989 for winter farrowing rather than build a new building.

We monitored the effectiveness of winter farrowing and energy costs in this hog house. This building had been a nursery-to-grower combination building; hence, we dubbed it a "starter" hog house. We modified this building to meet the farrowing requirements of Niman Ranch. Also, Niman Ranch needs more hogs of market size in the summer months and we wanted to have hogs available for that market.

Project Description

During the summer of 2001, we remodeled our 30 x 48' starter hog house to make it ready for winter farrowing. The remodeling included installing an insulated ceiling with chimney ventilation. The chimneys are 2 x 2' with a sliding plywood baffle. This replaced an insulated roof with an open ridge. Waterers and feed troughs were modified to accommodate 10 lb piglets to 500 lb sows. The feed trough was 10" deep with a 3.5" lip with 15" wide openings with solid dividers. It also has a homemade plywood feeder that runs on the outside wall the length of the building. Small pigs could climb into the trough with their front legs but would not get trapped with the solid dividers. The waterers were trough style also, with lower heights for the small piglets.

The building has a 7'x 4" gutter that I clean with a tractor loader. The building was divided into four pens, each with a 12 x 12' bedded area next to the gutter.

We built gates from home-sawed oak boards that allowed us to make three farrowing pens in each 12 x 12' section, giving us a total of 12 farrowing pens in the building. The pens were constructed as trapezoids,

Dave and son, Ethan.

allowing the sows more room to turn around and making an obvious choice for the creep area. The pens were made to be disassembled. A 2 x 2.5' piece of plywood was used as a door that is dropped in to keep the sow in or out of her farrowing pen.

The building was rewired and a 110,000 BTU LB White heater was installed. Originally, we were not going to use any supplemental heat, but we decided to include the LB White along with heat lamps in a creep area. As one of our advisors said, "After all, this is a Minnesota winter you are trying to farrow in."

In 2002, we concentrated on remodeling our two hog houses that serve as "pre-wean to finish." We moved the sows and their litters into them when the piglets were approximately four weeks old. The pigs stayed in the same building until they were sold as market hogs. In one building we installed an insulated ceiling with chimney ventilation much like our "starter" hog house remodel. In the other building, we completely replaced the entire deteriorating west wall with an insulated wall with drop down insulated doors. Both remodeling efforts were to "tighten up" the buildings to make them warmer for the group nursing situations in the winter. With tighter buildings, we wanted to compare the benefits of supplemental heat in a creep area in group nursing situations. We also compared sizes of group nursing situations.

We also formed a producer group with the help of a USDA Sustainable Agriculture Research and Education (SARE) producer grant. The group includes Dwight Ault, Arvid Jovaag, and Glen Bernard. Besides visiting each others' farms and exchanging ideas, we also monitored temperature, relative humidity and animal performance at each farm during the weeks of farrowing during two winters. Monitors recorded temperature and RH every half hour at the Serfling, Ault, and Jovaag farms. The monitor failed at the Bernard farm; however, Glen had data for 2001-2002. The Bernard and Serfling farms were also able to keep energy use and cost records.

In 2003, we changed a few more things on one of our pre-wean to finish hog houses to help our group nursing situation and save labor. We added an outdoor exercise lot and removed many of the pen dividers so more space would be available. We also put large doors in one end so that the manure could be removed totally with a tractor and loader. We also experimented with varying the age when we started our group lactation. One group was started at four weeks and the other at six weeks. Preliminary findings show a huge benefit to the older age. More detailed results were not available at the time of printing of this article.

Table 1. 2001-2002 and 2002-2003 Winter Farrowing Comparisons with Farm Management Records

Farrowing Month	Number of Litters		Death Loss from Birth to Co-mingling (%)		Litter Size Weaned	
	Year		Year		Year	
	01/02	02/03	01/02	02/03	01/02	02/03
December	11	10	6.1	4.4	10.6	10.0
January	18	15	5.1	12.2	9.9	8.8
February	18	11	4.8	13.0	11.0	8.9
Farm Mgmt. Records	433	-	14.0	14.0	8.7	8.7

Results

Winter 2001-2002

We had 47 sows farrow in the building from late November through February, 2002. On November 29, 2001, our first pigs were farrowed in our remodeled "starter house." This was the beginning of a group of 11 sows. These sows and their piglets were co-mingled at three weeks of age in a group nursing situation in another building. We weaned an average of 10.6 pigs per litter.

In the middle of January, we farrowed a group of 18 in our 12 pens. The extra six litters were moved to various sites on the farm at 2 to 3 days old. These sites included places that had not been satisfactory during the previous winter. But they worked very well if the pigs were a couple of days old. We even put a hut on dirt in the back of our cattle shed. That litter had no death loss! At three weeks of age, the litters were all co-mingled in another building. This group had an average weaning of 9.9 pigs per litter.

Finally, another group of 18 sows farrowed in the latter half of February with the extra six litters moved out at 2 to 3 days old. The 12 litters in the starter hog house remained, and at three weeks the farrowing pens were removed for each set of three litters to co-mingle.

Our weaning numbers compare very well with the Adult Farm Management Records from 56 farms of similar size from across the state of Minnesota. We had a weaning average of 10.5 pigs per litter whereas, the Farm Management participants had an average of 8.7 (Table 1). We also compared the death loss from birth to co-mingling because, on typical hog farms, the weaning age is similar to our co-mingling age of three weeks. Our system had a much lower death loss percentage than the Farm Management group. The numbers are a little hard

Table 2. Temperature and Relative Humidity during 2001-2002 and 2002-2003 Winter Farrowing on Four Farms

Farrowing Dates	Farm	Avg. Outdoor Temp (°F)[1]	Barn Temperature (°F)			Relative Humidity (%)		
			Avg.	Max.	Min.	Avg.	Max.	Min.
12/28/01 to 1/3/02	Bernard	13	36.9	42.5	30.9	61.7	73.4	50.4
1/14/03 to 1/20/03	Ault	6	30.4	34.9	23.3	78.9	88.2	65.8
12/1/02 to 12/7/02	Jovaag	25	52.0	53.7	49.7	51.5	63.8	42.2
12/1/02 to 12/7/02	Serfling	23	46.7	56.6	37.2	64.1	74.9	51.0
1/10/03 to 1/16/03	Serfling	7	45.6	64.2	32.5	56.6	74.4	25.7
2/17/03 to 2/23/03	Serfling	21	52.5	67.6	30.1	61.0	92.8	32.8

[1]*Outdoor temperatures as recorded at the nearest temperature reporting station, www.crh.noaa.gov/arx/climo/data*

to compare because of many variables including parity number. Our sows were all second litter. Obviously, the Farm Management Records include many gilts.

In general, we had a very successful winter farrowing. Co-mingling occurred on average at three weeks of age with weaning at an average of nine weeks of age. The late weaning has really helped with raising the pigs without antibiotics. We lost one pig per night due to crushing for the first three nights after the December pigs were co-mingled. We started leaving the lights on and the losses stopped. We left the lights on for January and February's co-mingling and had no crushing losses.

Our biggest problem was after co-mingling the January sows and litters for group nursing. It was 18 large litters. Even though it was a mild winter, we had too many pigs that couldn't make it in the group nursing setting. We euthanized several runts. It may have been too many litters in one group.

Of course, the winter of 2001-2002 was one of the mildest on record. We only used 75 gal of LP for the entire winter in our three farrowings.

Winter 2002-2003

We had another very successful winter farrowing in 2002-2003. Co-mingling occurred on average at four weeks of age with weaning at an average of nine weeks of age. Although our numbers were not as impressive as last winter's numbers, we were still above industry averages (Table 1). We were able to lower our death loss during group nursing. In the December 2002 farrowing, we used nursing groups of five sows and litters with no heated creep areas. We housed all 15 sows in one group in the January group with a heated creep area.

Based on our death loss percentages, the heated creep areas appear to be more important than group nursing size. The February group had no heated creep areas, but this is really a group nursing in early spring instead of a winter situation. The pigs that we lost in the group nursing situations were primarily pigs that didn't compete well and fell further behind. We did have a higher death loss this year prior to co-mingling. There were many reasons for this including very weak pigs born, castration losses of herniated pigs, and crushing losses.

Energy Use and Cost

As shown in Table 2, using somewhat similar farrowing set-ups, our producer group was using much lower critical temperatures than a conventional farrowing barn even with supplemental heat available for the little pigs. The Ault barn was able to achieve an average of 24°F above the outside temperature without supplemental heat. The Bernard farm had an average of 23°F above the outside conditions. The Jovaag farm had the most consistent temperature and the lowest humidity. During the monitoring period, the Jovaag barn was at 50% capacity. Our barn had the most variation in temperature and RH, as well as the highest stocking density. The variation might have been affected by readings taken when the barns were cleaned every third day.

Arvid Jovaag and I tried to keep our barns just warm enough to avoid chilled newborn pigs. This also encouraged the little pigs to utilize the heated creep areas. It appears that 50°F in a bedded environment is near the pigs' critical temperature for farrowing. Both of us tried to attend farrowings and move newborns to the heated creep areas until dried off. I now turn the thermostat 10°F higher during periods when I can't attend the farrowings.

Table 3 summarizes the energy use and cost data collected at the Bernard and Serfling farms. My barn was the smallest and best insulated as shown by the reasonable energy cost and the temperatures I was able to maintain. The Ault farm used no supplemental heat therefore there was no energy cost.

Table 3. Energy Cost Comparison

	LP/Litter (Gal)		Electricity/Litter (KWH)		Cost per Litter ($)		Cost per Pig ($)	
	Year		Year		Year		Year	
Location	01/02	02/03	01/02	02/03	01/02	02/03	01/02	01/02
Bernard Farm	18.50	24.50	-	-	16.61	25.00	2.37	3.29
Serfling Farm	3.68	3.57	160.0	175.8	15.54	15.88	1.49	1.90
Ault Farm	-	-	-	-	-	-	-	-

Overall, the productivity numbers from the four farms compare favorably with industry averages (Table 4). Although the Ault farm had the lowest production numbers, it also had the lowest energy costs and the coldest outdoor temperatures. Arvid Jovaag and I used heated creep areas. These creep areas are used much differently by our pigs compared to the creep areas next to a farrowing crate. Newborn pigs needed to be 24 hr old before they would use the creep area on their own. The losses by crushing after the first day were extremely minimal. Farrowing occurred at the highest temperatures in Arvid and my barns. It appears that the higher temperatures and inclusion of a heated creep area help with production efficiencies. As with most productivity measures, the number of pigs per litter has the greatest effect on efficiency. The supplemental heat cost per litter could easily pay for itself with one more pig saved per litter.

The vast majority of death loss occurred in the first week. All four farms reported how critical it was to keep sows and litters isolated from other sows and litters. I had my largest death loss in the group lactation setting probably related to the large group sizes – up to 18 sows and litters in a group. I was able to document a 60% decrease in mortality in that setting by vaccinating for illeitis and using a heated creep area at an energy cost of about $.25 per pig.

There is still a lot of skepticism about farrowing without the use of crates and about winter farrowing. Our farmer group has shown that the system can be as productive as more conventional systems and with lower energy costs. My pigs raised in this system are in high demand with Niman Ranch Pork Company because of winter farrowing and meat quality.

Management Tips

1. For farrowing or group nursing situations in the winter, make sure your building is well insulated and tight, and provide supplemental heat.

2. Sows must have a dry, clean place to farrow. They should be isolated from one another during farrowing. Feed and water sows outside their farrowing pens to keep the pens dry and clean.

3. Attend farrowings if possible and dry pigs off in a heated creep area. Warm any chilled pigs. If unable to attend, set the temperature above 60ºF and use supplemental heat. Use heated creeps in both farrowing and group nursing situations.

4. Keep the lights on when you co-mingle the sows and pigs. This will help prevent the crushing of little pigs.

5. Smaller groups are not as important as adequate space and heated creep areas.

6. Keep litters separate for the first week. Co-mingling of sows and pigs works well at three weeks of age. Ear notch pigs and keep records so that "lost" pigs can be returned to the correct sow.

7. Keep temperatures in a range that will encourage little pigs to sleep in the creep areas. Use plenty of straw to lower the pigs' critical temperature significantly.

8. Do not over-crowd the sows and pigs when co-mingling. Too many litters may cause too many pigs to not make it in a group nursing setting.

9. Vaccinate, vaccinate, vaccinate, especially in an antibiotic free production system.

Table 4. Pig Number Comparisons among Four Farms and Farm Management Records for Two Years

	Number Born Live		Number at Co-mingling		Number at Weaning	
	Year		Year		Year	
Farm	01/02	02/03	01/02	02/03	01/02	02/03
Ault Farm	8.7	10.7	8.0	8.0	7.8	7.8
Bernard Farm	12.8	10.0	9.3	8.3	9.0	7.6
Jovaag Farm	12.4	11.0	10.1	9.9	9.7	9.5
Serfling Farm	12.1	10.1	11.4	9.6	10.2	8.7
Farm Mgmt. (56 farms)	10.1	10.1	NA	NA	8.7	8.7
USDA – 2000 NAHMS[1]	10.0	NA	8.9	NA	8.6	NA

[1]*National Animal Health Monitoring System*

10. Use solid dividers in sow feeders so little pigs will not get caught.

11. Group nursing works well for late weaning situations. It saves tremendous labor. Have pigs as old as possible when you begin the group lactation phase.

12. Select from large litters when choosing replacements.

13. Remember safety when dealing with sows in pens. Always have an escape route planned for the unexpected. Lock the sows out of their farrowing pens when processing pigs, preferably while the sows are eating.

14. When considering remodeling or building a new structure, put together an advisory team of engineers, people with experience in alternative housing systems, university swine researchers, and farmers using alternative systems. They will provide very good information and help you see the numerous issues you need to deal with.

Cooperators

Dwight Ault, Farmer, Austin, MN
Glen Bernard, Farmer, Rushford, MN
Dick Carroll, Farmer, Austin, MN
Joe Hahn, Architect, Harmony, MN
Diane Halvorson, Animal Welfare Institute, Northfield, MN
Marlene Halvorson, Resource on Swedish Systems, Northfield, MN
Lori Lyon, Niman Ranch, Thornton, IA
Larry Jacobson, University of Minnesota, St. Paul, MN
Arvid Jovaag, Farmer, Austin, MN
Wayne Martin, University of Minnesota, St. Paul, MN
Dave Munkel, Construction Manager, Lime Springs, IA
Paul Willis, Niman Ranch, Thornton, IA
Mark Honeyman and Jay Harmon, Iowa State University, Ames, IA

Project Location

From Spring Valley go south 5 miles on US Hwy. 63. Turn right on Cty. Rd. 14 and go 11 miles and turn left (south) on township road. Farm is .25 mile on the right.

Other Resources

Alternative Swine Production Systems Program, University of Minnesota, 385 Animal Science Building, 1988 Fitch Ave., St. Paul, MN 55108, 877-258-4647, marit067@umn.edu

Niman Ranch Pork Company of Iowa, 2228 Eagle Ave., Thornton, IA 50479, 515-998-2683, www.nimanranch.com

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.

Completed Grant Projects...

Year Completed	Title of Project	Grantee

Livestock Grants

2003	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
2002	Adding Value for Small Producers via Natural Production Methods and Direct Marketing	Pete Schilling
	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
	Programmable Approach to Pasture Renovation for Cell Grazing	Daniel Persons
2001	Grazing Beef Cattle as a Sustainable Agriculture Product in Riparian Areas	Frank & Cathy Schiefelbein
	Improvement of Pastures for Horses Through Management Practices	Wright Cty. 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
	Viability of Strip Grazing Corn Inter-seeded with a Grass/Legume Mixture	Stephen & Patricia Dingels
2000	First and Second year Grazers in a Year Round Pasture Setting Served by a Frost Free Water System	Don & Dan Struxness
	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
1999	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

Year Completed	Title of Project	Grantee
	Learning Advanced Management Intensive Grazing Through Mentoring	West Otter Tail SWCD
	Low Cost Sow Gestation in Hoop Structure	Steve Stassen
1998	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 Assn. 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
1997	Buffalo: Animal From the Past, Key to the Future	Richard & Carolyn Brobjorg
	Grass Based Farming in an Intensive Row Crop Community	Douglas Fuller
	Marketing Development - Small Farm Strategies Project	Sustainable Farming Assn. of NE MN
	Pastured Poultry Production and Riparian Area Management	Todd Lein
1996	Butcher Hogs on Pasture	Michael & Linda Noble
	Developing Pastures Using Various Low-input Practices	Ralph Lentz
	Establishing Trees in Paddocks	Dave & Diane Ser ing
	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
	Raising Animals for Fiber	Patty Dease
	Rotational Grazing Improves Pastures	MISA Monitoring Team
	Seasonal Dairying and Value-added Enterprises in SW MN	Robert & Sherril Van Maasdam
	Swedish Style Swine Facility	Nolan & Susan Jungclaus
1995	Dairy Waste Management Through Intensive Cell Grazing of Dairy Cattle	Scott Gaudette
	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
1994	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

Year Completed	Title of Project	Grantee
1993	Economics of Rotational Grazing vs. Row Crops	Harold Tilstra
	Winter Grazing Study	Janet McNally & Brooke Rodgerson
1992	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 SW MN	David Larsen
	Intensive Rotational Grazing	Chad Hasbargen
	Research and Demonstration of Rotational Grazing Techniques for Dairy Farmers in Central Minnesota	Stearns County Extension
1991	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

Cropping Systems Grants

2003	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 Bundle ower Mixtures for Forage and Biofuel	Craig Sheaffer
	Northwest Minnesota Compost Demonstration	John Schmidt & Russ Severson
	Potassium Rate Trail 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
2002	Aerial Seeding of Winter Rye into No-till Corn and Soybeans	Ray Rauenhorst
	Replacing Open Tile Intakes with Rock Inlets in Faribault County	Faribault County SWCD, Shane Johnson
	Soil Conservation of Canning Crop Fields	Andy Hart
2001	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
	Increased Forage Production Through Control of Water Runoff and Nutrient Recycling	James Sovell
2000	Biological Control of Alfalfa Blotch Leafminer	George Heimpel
	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

Year Completed	Title of Project	Grantee
	Living Snow Fences for Improved Pasture Production	Mike Hansen
	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
1999	Forage Mixture Performance	Itasca County SWCD
	Growing Corn with Companion Crop Legumes for High Protein Silage	Stanley Smith
	Inter-seeding Hairy Vetch in Sun ower and Corn	Red Lake County Extension
	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
1998	CRP in a Crop Rotation Program	Jaime DeRosier
	Evaluating Kura Clover for Long-term Persistence	Bob & Patty Durovec
	Timing Cultivation to Reduce Herbicide Use in Ridge-till Soybeans	Ed Huseby
1997	Sustainable Agriculture in Schools	Toivola-Meadowlands School
1995	Biological vs. Conventional Crop Systems Demonstration	Gary Wyatt
	Living Mulches in West Central MN 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
1994	Energy Conserving Strip Cropping Systems	Gyles Randall
	Integration of Nutrient Management Strategies with Conservation Tillage Systems for Protection of Highly Eroded Land and Lakes in West Otter Tail County	Harold Stanislawski
	Reducing Soil Insecticide Use on Corn Through Integrated Pest Management	Ken Ostlie
1993	Annual Medics: Cover Crops for Nitrogen Sources	Craig C. Sheaffer
	Biological Weed Control in Field Windbreaks	Tim Finseth
	Fine-tuning Low-input Weed Control	David Baird
	Flame Weeding of Corn to Reduce Herbicide Reliance	Mille Lacs County Extension
1992	Chemical Free Double-cropping	Jeff Mueller
	Demonstration of Land Stewardship Techniques in the Red River Valley	Donald H. Ogaard
	Early Tall Oat and Soybean Double Crop	Charles D. Weber
	Nitrogen Utilization from Legume Residue in Western MN	Arvid Johnson
1991	Alternative Methods of Weed Control in Corn	Sr. Esther Nickel

Year Completed	Title of Project	Grantee
	Demonstration of Tillage Effects on Utilization of Dairy and Hog Manure in SE MN	John Moncrief
	Herbicide Ban? Could You Adapt on a Budget?	David Michaelson
	Improving Groundwater Quality and Agricultural Profitability in East Central MN	Steven Grosland & Kathy Zeman
	Modified Ridge-till System for Sugar Beet Production	Alan Brutlag
	Using Nitro Alfalfa in a No-till Corn and Soybean Rotation	Jeff Johnson
1990	Hairy Vetch and Winter Rye as Cover Crops	Mark Ackland

Manure & Nutrient Management

2002	Dairy Manure Application Methods and Nutrient Loss from Alfalfa	Neil C. Hansen
	Evaluation of Dairy Manure Application Methods and Nutrient Loss from Alfalfa	Stearns County SWCD
	Manure Spreader Calibration Demonstration and Nutrient Management	Jim Straskowski
	Using Liquid Hog Manure as Starter Fertilizer and Maximizing Nutrients from Heavily Bedded Swine Manure	Dakota County SWCD, Brad Becker
2001	Agricultural Use of Rock Fines as a Sustainable Soil Amendment	Carl Rosen
	Turkey Litter: More is Not Always Better	Meierhofer Farms
	Land Application of Mortality Compost to Improve Soil and Water Quality	Neil C. Hansen
2000	Applying Manure to Corn at Agronomic Rates	Dakota County Extension & SWCD
	Managing Dairy Manure Nutrients in a Recycling Compost Program	Norman & Sallie Volkmann
	Using Nutrient Balances to Benefit Farmers and the Environment	Mark Muller/IATP
1998	The Winona Farm Compost Strategies	Richard J. Gallien
1997	An Evaluation of Variable Rate Fertility Use on Ridged Corn and Soybeans	Howard Kittleson
	Farming Practices for Improving Soil Quality	Sustainable Farming Assn. of SC MN
1996	Converting from a Corn-Soybean to a Corn-Soybean-Oat-Alfalfa Rotation	Eugene Bakko
	Manure Application on Ridge-till: Fall vs. Spring	Dwight Ault
1995	Building Soil Humus Without Animal Manures	Gerry Wass
	Controlled Microbial Composting to Improve Soil Fertility	Howard & Mable Brelje
1994	Manure Management/Utilization Demonstration	Timothy Arlt
	Taconite as a Soil Amendment	Donald E. Anderson
1992	Cooperative Manure Composting Demonstration and Experiment	Rich Vander Ziel
	Economically and Environmentally Sound Management of Livestock Waste	Fred G. Bergsrud

Year Completed	Title of Project	Grantee
	NITRO Alfalfa, Hog Manure, and Urea as Nitrogen Sources in a Small Grain, Corn, Soybean Crop Rotation	Carmen M. Fernholz
1991	Soil Building and Maintenance	Larry H. Olson
1990	Strip-cropping Legumes with Specialty Crops for Low-cost Mulching and Reduced Fertilizer/Herbicide Inputs	Mark Zumwinkle

Alternative Markets & Specialty Crops

2003	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
	Root Cellaring and Computer-controlled Ventilation for Efficient Storage of Organic Vegetables in a Northern Market	John Fisher-Merritt
2002	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
	Research and Demonstration Gardens for New Immigrant Farmers	Nigatu Tadesse
	Viability of Wine Quality Grapes as an Alternative Crop for the Family Farm	Donald Reding
2001	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
	Increasing Red Clover Seed Production by Saturation of Pollinators	Leland Buchholz
	Integrating Livestock Profitably into a Fruit and Vegetable Operation	David & Lise Abazs
	Propagation of Native Grasses and Wild owers for Seed Production	Joshua Zeithamer
	Soil Ecology and Managed Soil Surfaces	Peter Seim & Bruce Bacon
	Value Adding to Small Farms Through Processing Excess Production	Jeffrey & Mary Adelmann
2000	Bio-based Weed Control in Strawberries Using Sheep Wool Mulch, Canola Mulch and Canola Green Manure	Emily Hoover
	Cover Crops and Living Mulch for Strawberry Establishment	Joe Riehle
	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
	Sustainable Weed Control in a Commercial Vineyard	Catherine Friend & Melissa Peteler

Year Completed	Title of Project	Grantee
1999	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
1998	Cultural and Management Techniques for Buckwheat Production and Marketing	Tom Bilek
	Development of Mating Disruption and Mass Trapping Strategy for Apple Leafminer	Bernard & Rosanne Buehler
	Jessenland Organic Fruits Project	MN New Country School
	Pond Production of Yellow Perch	John Reynolds
1997	Alternative Point Sources of Water	Joseph & Mary Routh
	Comparison of Alternative and Conventional Management of Carrot Aster Leafhoppers	MN Fruit & Vegetable Growers Assn.
	Establishing and Maintaining Warm Season Grasses (Native Grasses)	Pope County SWCD
	On-farm Forest Utilization & Processing Demonstrations	Hiawatha Valley RC&D
	Propane Flame Weeding Vegetable Crops	Jean Peterson & Al Sterner
	Soil Quality Factors Affecting Garlic Production	Tim King
	Wine Quality Grapes in Otter Tail County	Michael & Vicki Burke
1996	Community Shared Agriculture and Season Extension for Northern MN	John Fisher-Merritt
	Living Mulch, Organic Mulch, Bare Ground Comparison	Dan & Gilda Gieske
1994	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
	Wild ower Seeds as a Low-input Perennial Crop	Grace Tinderholt & Frank Kutka
1991	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

Big Woods Dairy at Nerstrand-Big Woods State Park

Project Coordinators

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Written by Melissa Driscoll. Melissa is working towards a master's degree in conservation biology and a minor in sustainable agriculture at the University of Minnesota. Part of her program requirements was to do an internship on rotational grazing. Melissa interviewed the Brossards' and wrote the following article as a step in fulfilling the internship.

The summer of 2004 marks the eighth growing season for the grass-based Big Woods Dairy, a unique collaboration between the Phil and Dawn Brossard family and the Minnesota Departments of Natural Resources (MN DNR) and Agriculture (MDA) and in cooperation with the Natural Resources Conservation Service (NRCS), University of Minnesota Extension Service, and other partners. The Big Woods Dairy is the only modern operating dairy farm within a state park in the nation. This unique distinction provides the Brossards' an opportunity to share farm life with the public during designated tour days. To gain valuable economic, social, and environmental data the MN DNR monitors farm wildlife, the MDA monitors soil quality, the NRCS and extension monitor nutrient and manure management, and Extension in consultation with the Brossards' Farm Business Management instructor monitors the farm's economics.

After seven years of providing farm tours and working with the project partners, Phil and Dawn are re ecting on their experiences and planning for their future. Their lease with the MN DNR runs out at the end of 2006. At that time all of the buildings will be removed and the land they are currently farming will be converted to tallgrass prairie and big woods ecosystems.

The first year at the farm was probably the hardest. It took four months to iron out a lease, there was some lack of coordination among all of the agencies that were collecting data, and farm tours took extra effort to organize and execute. Seventeen tons of old junk were removed from the farm and the rotational grazing system was installed.

Phil and Dawn and their children, Amber, Trent, Seth, and Evan, farm 80 acres of state land and 40 additional acres that are rented from a neighbor. The neighbor's land is a critical part of the farm as there are restrictions on spreading manure within 300 meters of a stream and almost all of the state land where the Brossards' cattle graze is within that limit. The rental land is far enough from the stream to safely spread pit manure. Phil and Dawn run 60 milk cows and about 60 heifers and dry cows on 3 to 4 acre paddocks that are strip grazed. Half of a

The Brossard family.

Trent showing calf at field day.

paddock is grazed between each milking and Phil estimates that the cattle gain 75 to 80% of their diet from the pasture during the grazing season, with each cow consuming 120 lb of pasture forage per day. Each paddock is rested six to seven days before cattle graze it again, although some paddocks rested for 60 days during the drought in August of 2003. Their lease forbids plowing so Phil inter-seeds with perennial ryegrass and Alice white clover when a pasture performance begins to decline. The herd is primarily Holstein crossed with Brown Swiss, Jersey, and Normandy. They do not treat their cows with BST. Their milk is sold to the Hastings creamery.

Dawn and Phil give three to four farm tours each summer. They find that the preparation can be stressful but they enjoy the actual tours. Early farm tours involved different stations that participants could walk to and learn about water runoff, manure management, or wildlife. Dawn felt that, although some farmers and agency personnel liked this style of farm tour, many non-farm families wanted more of a farm experience. She drew on her years as a school teacher to change the feel of the farm tours to suit families with kids, and other people who don't have a farm in their lives. Now everyone walks out to pasture to bring the cows in, they get to milk a cow themselves, and they are likely to get some manure on their shoes. While walking to and from the pasture, Dawn and Phil talk about water runoff and stream protection, or list the birds they have seen in the pastures. In this way, many issues are brought up in the context of daily chores, much the way Dawn and Phil experience these issues themselves every day.

As time marches on and their lease runs out, Phil and Dawn are starting to search for land. They would like to continue to farm in the area. They have family in the area, they like the local schools, and they don't want to disrupt the kids' lives by moving. Unfortunately, land prices are prohibitive around Northfield and farms are regularly selling for $3,300/A. Phil understands that older farmers who are retiring want to sell their land for as much money as possible, but he wishes that more of them would help younger farmers get in and stay in business. He thinks a contract for deed signed between an older seller and younger buyer could benefit both parties. He is also finding that many old barns are located directly uphill from a stream. A century ago, streams were needed to water livestock but, today, water laws to protect streams make many of those old barns expensive to use or unusable for livestock housing.

Despite their wish to continue farming, Dawn and Phil are accepting of whatever comes along. Although Phil really enjoys dairying and rotational grazing, he says that, if they and all of their friends and relatives are on the lookout for a good farm for them and nothing happens, then perhaps they should get out of farming. Dawn would also miss farming but says that, if necessary, she can go back to teaching. Luckily the day to decide whether to stay in farming is still two years away.

Integrated Pest Management (IPM) Program

Program Contact

Jeanne Ciborowski
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Integrated pest management (IPM) looks at pest problems using a multi-strategy approach. IPM considers all aspects of the interactions between people and pests to find the easiest way to resolve problems with the lowest overall risk to people's health and the environment. IPM looks beyond the use of preventative regularly scheduled pesticide applications. It is a dynamic system that is adaptable to diverse management approaches. Factors that allow pests to become problems in the first place are considered, and a combination of physical, cultural, biological, and chemical pest management strategies are used.

Fruit and Vegetable IPM

The *Minnesota Fruit and Vegetable IPM New*s is produced in cooperation with Dr. Bill 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) and the RMA Community Outreach and Assistance Partnership Program.

The newsletter is a multi-disciplinary approach to disseminating IPM strategies, educating producers, communicating timely pest pressure and control information to growers, and providing feedback information for use in prioritizing basic research. The Newsletter is published weekly from May through August, cooperatively, by the Minnesota Department of Agriculture (MDA) and the U of MN. Reports are posted on the U of MN and MDA web sites on Fridays. The newsletter can be found at: www.mda.state.mn.us/biocon/fruitreports

In 2003, the United States Environmental Protection Agency (US EPA) funded the production of four MDA fruit publications. These include: *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 Field; and, Integrated Pest Management Manual for MN Strawberry Fields. The Minnesota Fruit and Vegetable IPM News*, the manuals, and other fruit IPM information can be found at: www.mda.state.mn.us/biocon/fruitipm.html

In 2004 using the previously funded fruit publications listed above, the US EPA provided follow up funding to implement an Apple and Strawberry IPM Project. The MDA will have consultants work with five apple and five strawberry growers on the identification of major fruit pests and the use of IPM techniques to enhance pest management practices.

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School IPM and IPM for Kids

The MDA has a set of IPM fact sheets for schools. They include: School Integrated Pest Management - What Is It?; Ant Management in Schools; Cockroach Management in Schools; Head Lice Management in Schools and Home; Landscape Insect Management on School Grounds; Nuisance Invader Management in Schools; Silverfish and Firebrat Management in Schools; Small Fly Management in Schools; Wasp and Bee Management Around Schools; Broadleaf Weed Management on School Grounds and Athletic Fields; Grassy Weed Management on School Grounds and Athletic Fields; Weed Management on School Grounds and Athletic Fields; Diagnosing Plant Disease on School Grounds; Preventing Plant Disease on School Grounds; Rat and Mouse Management in Schools; and, Management of Pesticides. A

fact sheet, "Cockroaches in Your Home," is also available. All fact sheets are available at: www.mda.state.mn.us/ipm/ipmpubs.html

Another item is "Join Our Pest Patrol - A Backyard Activity Book for Kids - An Adventure in IPM." The book and the companion "Teacher Guide" are for use by third and fourth grade teachers. It includes many fun activities and is available at: www.mda.state.mn.us/ipm/IPMPubs.html

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Plant Pest Survey Program

The mission of the Plant Pest Survey (PPS) is to provide current information on the abundance and distribution of major pests in Minnesota crops. In 2003, pest surveys were conducted in corn, soybeans, small grains, alfalfa, and sun owers. Surveys were conducted in seven of the nine crop reporting districts including the northwest, west central, central, east central, southwest, south central, and southeast. The PPS also publishes the *Minnesota Pest Report*, a weekly newsletter summarizing trends in pest abundances. Fact sheets, field pest identification guides, weather information, and other links to crop and pest information can be found on the PPS page located at: www.mda.state.mn.us/pestsurvey

Special Projects

- The PPS is currently developing an online database of insects collected by survey personnel during the 2001 season. Thousands of specimens have been collected and identified for the database, which will include digital images and distribution maps for all species included in the database. The database is targeted for completion in August, 2004.
- The PPS will begin implementing data collection in the field with hand held computers in 2004. Improving data collection technology will increase the amount and quality of data that the PPS collects.

Program Contact: Mark Abrahamson
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Weed IPM Program

The MDA Weed IPM Program staff performs statewide weed surveys of cropland and noncropland weeds as a tool to assist land managers with the control of economically and ecologically damaging weeds. In addition, staff members work with local cooperators to release weed biological control agents and evaluate the impacts of weed biological control on leafy spurge and spotted knapweed.

To improve the methodologies for tracking and recording weed distribution, emergence, and shifts in weed types over time, staff members have developed a mobile global positioning system/geographic information system (GPS/GIS) procedure for mapping important weeds throughout the state. The Weed IPM Program's goal is to have a system that will effectively update existing weed databases with survey data on noxious and problematic weed species. Both the cropland and noncropland surveys are intended to provide more insight for land managers into where major weed infestations occur and the abundance of weeds in those areas. More information on the survey will be available in the near future. Additional information on weed IPM can be found at: www.mda.state.mn.us/weedcontrol

In addition to the very successful leafy spurge biocontrol program, the Weed IPM staff is increasing activity in the spotted knapweed program. Staff will be conducting intensive research studies at spotted knapweed biological control sites to assess the impacts that biological control agents are having on this aggressive weed species. Both leafy spurge and spotted knapweed release sites, along with site characteristics, are being mapped using GIS technology. This information will allow both state and local cooperators to better manage future biocontrol agent harvests and releases, as well as to monitor control effectiveness.

Special Projects

- Demonstrated the WIPM Program's Weed Survey Mobile GIS/GPS system at over 25 township meetings.
- Summarized data from a statewide thistle survey conducted by MDA field staff in 2003.
- Working with several cooperators to begin mobile GIS surveys for nuisance weeds throughout the state during the summer of 2004.
- Creating updated maps and summaries of biocontrol releases for all counties.
- Assessing the biological control of spotted knapweed in Minnesota through a Legislative Commission on Minnesota Resources (LCMR) grant.
- Updated the historical biological control release database. Maps are being created and will be sent to each participating County Agricultural Inspector indicating all releases in their county.
- Working to develop strategies for online mapping of data.

Program Contacts: Anthony Cortilet, Monika Chandler, and Jill Babski
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Weed IPM Working Group

A multi-agency Weed IPM Working Group was formed as a result of the 1996 IPM on State Lands Plan. The MDA works cooperatively with the MN Department of Natural Resources as co-chairs of the group. The Working Group developed the "*Thicket!*", a newsletter for integrated weed management in Minnesota. It is published in the late fall and early spring of each year. "*Thicket!*" is available at the MDA's web site: www.mda.state.mn.us/ipm/thicket

"*Thicket!*" is for all land managers interested in weed management. It is a way to share information about the many weed management activities carried out in Minnesota by the different local, state and federal agencies, and the U of MN. If you are interested in signing up to receive the electronic "*Thicket!*", please send an email to either Jeanne or Anthony.

Program Contacts: Jeanne Ciborowski and Anthony Cortilet
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General Biological Control Program

Indoor Plantscape and Urban Biological Control Project
The Indoor Plantscape and Urban Biological Control Project (IPUBCP) consists of two content areas - product information and insect identification. Both of these areas function as outreach sections of the Biological Control Program. Since 1999, staff members have given over 300 public presentations on the effective use of biological control products. In addition, this project provides ongoing technical support to growers adopting biological control and other compatible methods for managing plant pests in greenhouses, conservatories, atriums, gardens, and homes.

Examples of some groups served by this project in 2003 included: K-6 students working on insect units, high school students participating in School-to-Work programs, U of MN Landscape Arboretum staff for the "Big Bugs" exhibit, biology and horticulture postsecondary students, homeschool students and their parents, rose growers, corn growers, Ramsey County Master Gardeners, Willmar-area Master Gardeners, and others.

Biological Control Product Information and Biological Control Facility
Currently, the IPUBCP conducts most of its outreach activities at the Biological Control Facility, also known as the Biological Control Teaching Greenhouse. The materials used in presentations include live beneficial and pest organisms, pinned insect specimen displays, slide presentations, digital videos, web pages, and various handouts that describe - and attempt to demystify - insect biology and the process of buying and applying various products sold by biological control suppliers. The web site for the Biocontrol Facility is located at: www.mda.state.mn.us/biocon/plantscape/biofacility.htm

Project staff can be available as guest speakers or exhibitors for classroom presentations, yard and garden shows, and environmental fairs. Some of the information created by the IPUBCP can be found on its web page at: www.mda.state.mn.us/biocon/plantscape/default.htm

Insect Identification and Entomology Outreach
The Plant Pest Survey and Biological Control Outreach give talks with displays of entomology to schools, science centers, environmental fairs, and similar groups - with particular emphasis on the aspects of insect classification, identification, and morphology. School presentations are typically in classrooms to students and their teachers in grades K - 12, although most are grades 3 - 5. Over a dozen display drawers and riker mounts of insects are used to show insect diversity, classification, and insect types used in biological control or encountered during surveys.

Topics of presentations include general information on insects and spiders, how to tell the difference between helpful or harmful insects, biological control concepts and how to apply them, IPM tools and how to use them, and collecting and/or mounting insects. Presentations have been made annually for the past ten years, reaching between 400 and 600 people each year.

Special Projects in 2003

- Gave 102 presentations on biological control practices and products to over 900 people in 2003 at the Biological Control Facility and other locations.
- Wrote the *Guide to the Encounters with Insects*, an online description of 21 major insect orders, including a downloadable color poster. Available at: www.mda.state.mn.us/biocon/insectorders
- Helped plant and maintain the Insect Garden at the Biological Control Facility with volunteer help from Dayton's Bluff Center for Community Design and Ramsey County Master Gardeners.
- Created four digital videos—*Ladybeetle Life Cycle*, *Lacewing Life Cycle*, *Insect Chewing Mouthparts*, and *Piercing-Sucking Mouthparts*.

Program Contact for Product Information Outreach and Biological Control Facility:
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Program Contact for Insect Identification and Entomology Outreach:
Dr. John Luhman
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Biological Control Laboratory

The laboratory serves a support function for all Plant Pest Survey and 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 also houses the MDA's Insect Reference Collection which currently contains close to 20,000 pinned insect specimens and is cared for by Dr. John Luhman. Insect rearing procedures are available at: www.mda.state.mn.us/biocon/plantscape/default.htm

Special Projects

- Beginning work on the development of an artificial rearing system for Spotted Knapweed biological control agents.
- Investigations into the mass rearing of the minute pirate bug and lacewing utilizing an artificial diet.
- Development and archiving of insect rearing protocols.

Laboratory contact: John Luhman
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2004 Organic Demonstration Grant Program

For organic growers, practical information can sometimes be difficult to find. This year, with help from the USDA Risk Management Agency, the Minnesota Department of Agriculture offered a special, one-year demonstration grant program to help farmers try out new organic practices on their farms.

A technical review committee selected the following nine projects for funding. Reports will be published in *Greenbook 2005*. You may also contact the grantees directly for more information about their demonstrations.

Adding Value to Small Grains

Joseph Guiney
502 - 22nd St. W
Minneapolis, MN 55405
612-874-8739
joe.guiney@co.ramsey.mn.us
Mower County

Southern Minnesota has fallen out of favor as a small grains growing region. However, extended rotations and marketing options for crops like these can be important to the success of organic operations. This project will conduct varietal trials to test yield and quality of several varieties of wheat suitable for southern Minnesota.

Demonstrating and Publicizing Organic Agricultural Methods in Minnesota

Nett Hart
15455 - 195th Ave. NE
PO Box 53
Foreston, MN 56330
320-983-2289
Benton County

While a wide selection of organic foods is readily available in urban areas, the same is not true for rural communities. This project will introduce organic food and organic growing practices to food buyers and farmers in this farm's rural mid-Minnesota neighborhood. Various organic food demonstrations will be held every Friday throughout the 2004 growing season with a midseason field day to answer commonly asked questions about organic growing practices such as weed management, pest control, cover cropping, and soil issues.

Exploration of Market Crop Season Extension Through Innovative Subsoil Heating

Sean Albiston
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Stillwater, MN 55082
651-430-1307
lab@physics.umn.edu
Washington County

While Minnesotans are hungry for fresh vegetables year 'round, our growing season is a relatively short one. This project will assess how well a subsoil hydronic heating system in a hoop house can extend the growing season. A wood boiler will provide subsoil heat through a thermal mass system using tubing that is buried under low raised beds. Goals include: 1) increase the growing season for market crops in Minnesota; 2) develop a system that uses on-site resources as energy inputs; and, 3) improve marketability through continued production into the winter holiday season.

Gypsum Trial

Tom Wencl
5133 - 128th St. SE
Blooming Prairie, MN 55917
507-583-7120
Steele County

Weed control is a continuing challenge for organic farmers. This project will test a current theory that soil-applied gypsum will suppress giant ragweed growth. Project objectives include determining: 1) whether gypsum affects giant ragweed; 2) what effect variable application rates have; and 3) what effect gypsum has on the crop.

How to Benefit from the Fertility of a Cattle Wintering Area Without Excessive Weed Pressure

Donald Struxness
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Milan, MN 56262
320-734-4877
dbstruxness@fedteldirect.net
Chippewa County

In winter, livestock wintered on pasture spend much of their time close to water and shelter. The result can be compaction and weed pressure in these areas. This project will test the effects conventional till (control), rip rototilling with 100# applied gypsum, rip rototilling with applied Soil Restore bacteria on compaction and weediness on corn ground and on oat/legume ground.

Natural/Organic Alternatives for Parasite Control in Meat Goats

Wendy and Mark Lange
8095 - 40th St. NW
Milan, MN 56262
320-269-9617
dwcreek@fedteldirect.net
Chippewa County

This project will test various organically approved methods to control parasites in meat goats, including herbal, microbial, and nutritional strategies. Goals include: 1) boosting natural immunity to minimize parasite loads; 2) recording overall health condition during testing to verify changes; and 3) determining what effect parasite load has on reproduction.

Tillage, Green Manure, and Cover Cropping to Control Spotted Knapweed

Paul Conklin
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martonklin@alumni.duke.edu
Beltrami County

Spotted knapweed is an invasive pasture weed. Organic growers must find alternatives to conventional chemical control methods. This project will test three combinations of tillage, green manure, and cover crops to see what is effective in destroying established plants, and in preventing establishment of new ones from the soil seed bank.

Weed Control in Organically Grown Vegetables: Techniques for the Small Acreage

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Shafer, MN 55074
651-257-9162
foxtailcsa@yahoo.com
Washington County

Weed control in high value vegetable crops can present labor challenges to growers. This project will test the efficacy and economic return of two different weed control techniques: acetic acid (vinegar) and transplanting. Various concentrations of vinegar will be evaluated for their ability to control weeds in onions and carrots. Transplanting will be evaluated as a weed control strategy in sweet corn to compare whether there are advantages for stand establishment and ability to outcompete weeds and concomitantly reduce the need for cultivation.

Winter Wheat Fertilization Using Turkey Manure

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pgregor@hickorytech.net
Waseca County

Including small grains in an organic crop rotation can be important to pest management and soil structure. Many growers stress that the crop must be profitable in the marketplace as well. This project will evaluate the use of turkey manure on grain yield, grain quality, and straw yield of winter wheat as well as the effect on soil organic matter and overall fertility for the following crop.

Sustainable Agriculture Loan Program

Loan Technical Review Panel

Laura Bihl
Farmer

John Hobert
Farm Management Specialist

Tim Klassen
Ag Lender

Mark Moulton
Farmer

Dennis Schentzel
Farm Management Specialist

Lynn Sorenson
Farmer

John Wegmann
Ag Lender

Program Purpose

The Sustainable Agriculture Loan Program was created to accelerate the adoption of sustainable farming information and technology in Minnesota. Loans up to $25,000 per farmer or up to $100,000 for joint projects are made at a fixed 6% interest rate for a term of up to seven years. These low-interest loans are made to farmers for purchasing new or used equipment, or breeding livestock that helps 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 1980's. 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 determine 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. A total of 308 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

Project Type	Number of Accounts
Energy Savings	31
Livestock Management	103
Conservation Tillage	73
Weed Management	33
Nutrient Management	45
Alternative Crops	23
Total Loan Accounts	**308**

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 and clerical support to the staff.

Jean Ciborowski - Integrated Pest Management (IPM) 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 currently 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), serves on the Alternative Swine Production Task Force, 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 - Agricultural Diversification Specialist, joined the Minnesota Department of Agriculture in 2002. She educates about and promotes crop, livestock, management and marketing options, including organic. Meg came to MDA from Michigan, where she directed a community-based integrated farming systems program. 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 staff in 1993.

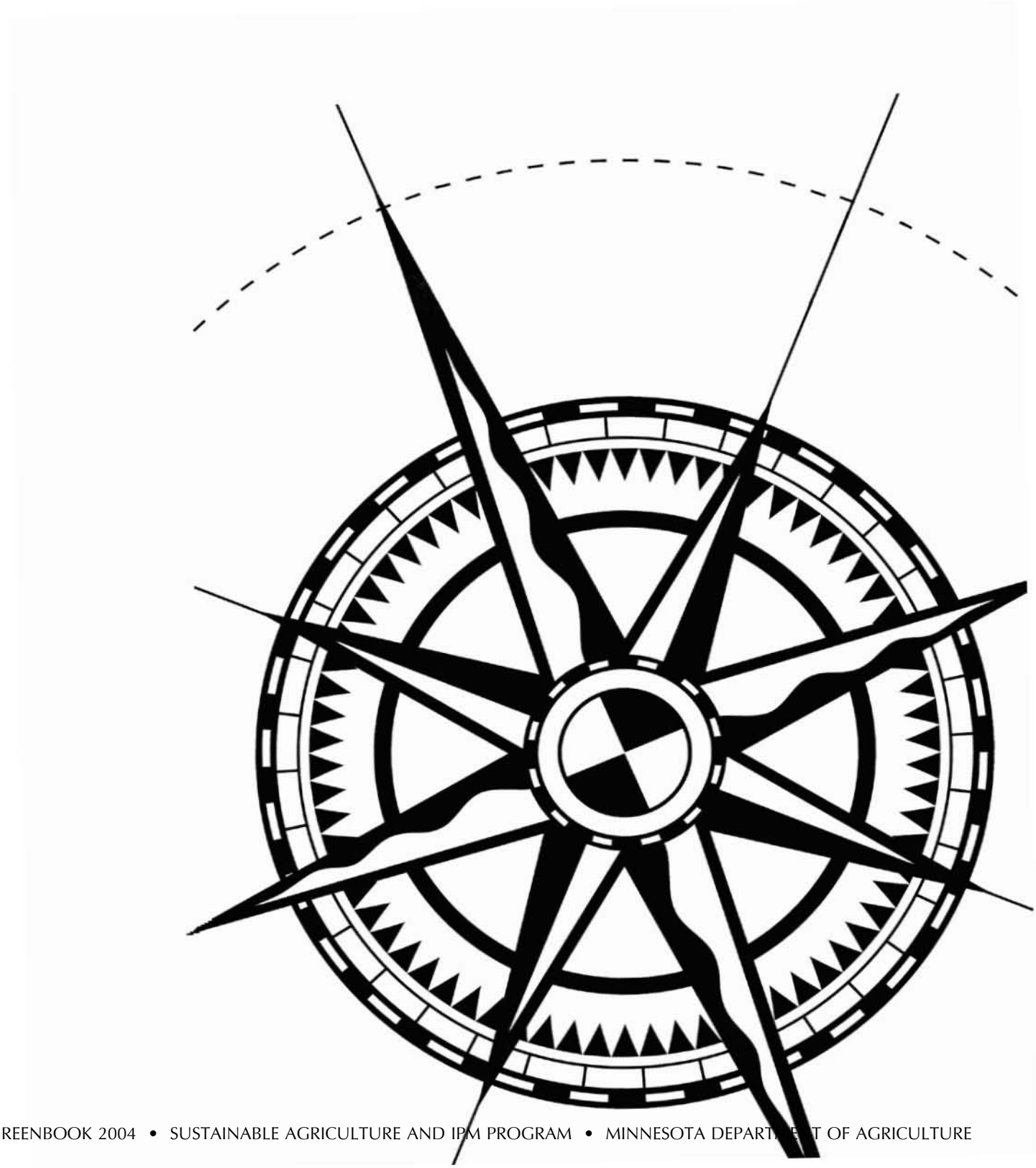
Staff Resource Directory

	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					•
Management Intensive Grazing		•	•		
Manure Management					•
Organic Production/Livestock,Vegetables, Grain, Fruit				•	•
Organic Rules and Certification		•		•	
Plant Diseases/Insects	•	•			
Rotational Grazing Planning			•		
Soil Quality and Soil Fertility, Composting					•
Vegetable Production					•

APPENDIX A

Agriculture Diversification Compass

— A Guide to Choosing New Directions for Your Farm —



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To request additional copies call or write to:

Minnesota Grown Opportunities
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90 West Plato Boulevard, Rm 211
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Phone: 651-296-7686 Fax: 651-297-7678

This publication is also available at: www.mda.state.mn.us/mgo

June 2004

Agriculture Diversification Compass

— A Guide to Choosing New Directions for your Farm —

Contemplating changes or additions to your farm operation can be exciting and a little daunting. There are many things to consider in determining whether a change is right for your family and your farm. This guide is intended to help you think about some of the key issues involved as you consider diversification options that may fit your farm.

These issues include:

- your family's personal interests and goals;
- available management skills and resources;
- available labor skills and resources;
- available physical and natural resources;
- expected profitability of a proposed enterprise; and
- impact the proposed enterprise will have on your local community.

Some of these issues may be higher priorities for you than others. This guide uses a point system that allows you to compare different options. After you answer all of the questions, you will decide which issues are most important to you and your family, and give special consideration to your responses on these issues.

This guide will be most helpful if you do some ongoing research and careful thinking on each issue before you begin and as you're filling it out. It is intended as a *starting point* that will help you hone in on a few promising options to explore in more depth. For it to be most effective, you'll need to know some of the basic requirements of the crop, livestock, or enterprise you're considering – things like growing degree day, soil fertility, rainfall, labor, and/or equipment requirements. The guide is *not* a substitute for a detailed feasibility study or business plan. You'll find it helpful to revisit your answers down the road, after you've done some more investigating.

What you will need:

- a pen or pencil;
- a separate copy of the tool, or a separate piece of paper, for each option; and,
- a calculator.

Step 1: Choose an option to test

If you already have one or more diversification options you are interested in, you are ready to begin. If you are looking for ideas, a list of many possible options can be found on the USDA National Agriculture Library website at: www.nal.usda.gov/afsic/AFSIC_pubs/altlist.htm#list. For other ideas, consult the Minnesota Grown Opportunities website at: www.mda.state.mn.us/mgo or call 651-297-8916.

The guide is designed to allow you to compare as many options as you wish. Each option must be run through the guide individually. To compare two or more options, run each one through the guide separately and compare the respective scores. Once you have identified the options that you would like to look into further, choose one and proceed to Step 2.

Issue #1: Interests and Goals

The questions in this section will help you identify your interests and those of your family to determine how compatible the proposed diversification option is with those interests. Your enthusiasm for a proposed option is important in determining the likelihood of its success.

Before you begin:

- Sit down with family members to discuss their interests in the proposed option. Identify existing conflicts as well as commonalities in the family's goals and interests. How is the enterprise likely to affect these conflicts and commonalities?
- **Familiarize yourself with the ins and outs of the proposed enterprise by talking with someone who has experience with it.** Talk to more than one grower if possible. If not, do some preliminary reading to get a sense of what's involved. In answering this section, it is important to have a reasonably good idea of the tasks involved with this option.
- Talk to potential customers to get a sense of what people want. They might influence the way you think about the potential product.

1) How *excited* are you and your family about this option?

Not at All	Slightly	Somewhat Excited	Very Excited
0	1	2	3

2) How much do some or all of you enjoy the *kind of work* it will require?

Not at All	A Little	Somewhat	Very Much
0	1	2	3

3) How much would the proposed option *take you away from* an activity or activities that you currently enjoy and value?

A Lot	Somewhat	A Little	None
0	1	2	3

4) How much time would the proposed option involve you or your family in activities that you are *not* interested in spending time on?

A Lot	Somewhat	A Little	None
0	1	2	3

5) Overall, how compatible would the proposed enterprise be with your family's *personal goals* for the farm?

Not Compatible	A Little	Somewhat	Very Compatible
0	1	2	3

Add the total score for all of the questions for Issue #1:_____

Divide by 5 *(the number of questions for this issue)* _____

Issue #1 Total *(Round to the nearest hundredth)* =_____

This is your Issue #1 Score. Record this score on page 8.

If any of the questions in Issue #1 received a rating of 0, this is probably not the best option to pursue at this time.

Issue #2: Business Management Skills

You don't have to be an expert before you begin a new enterprise. However, regardless of what diversification option you are considering, business management skills will be critical to your chances of success. This section is intended to evaluate these skills with regard to the option under consideration.

Before you begin:

- As you fill out this section, consider your own business management skills (things like accounting, record keeping, time management, sales, marketing, etc.) as well as those of other people involved with the farm.
- Consider the ways that new management tasks could be incorporated into current operations. For example, you might take on additional tasks, replace some current tasks with new tasks, or hire additional staff for the new enterprise.

1) How much *experience* do you have working with this or a similar enterprise?

None at All	A Little	Some	A Lot
0	1	2	3

2) To what extent do you have the *planning and organizing skills* to accomplish any new tasks required to effectively manage the new enterprise?

Not at All	A Little	Somewhat	A Lot
0	1	2	3

3) To what extent do you have *time* to incorporate any additional tasks required for the new enterprise?

Not at All	A Little	Somewhat	A Lot
0	1	2	3

4) To what extent are you willing to put in extra effort to learn *new business management skills* required for this enterprise?

Not at All	A Little	Somewhat	A Lot
0	1	2	3

Add the total score for all of the questions for Issue #2:_____

Divide by 4 *(the number of questions for this issue)* _____

Issue #2 Total *(Round to the nearest hundredth)* =_____

This is your Issue #2 Score. Record this score on page 8.

If any of the questions in Issue #2 received a rating of 0, this is probably not the best option to pursue at this time.

Issue #3: Production-related Skills and Resources

Labor resources and skills are as important as business management skills in a successful enterprise.

Before you begin:

- Take into account the seasonality of new labor requirements.
- Be aware that existing employees may have underutilized skills related to the proposed enterprise. Be sure to check whether any of your existing employees have relevant experience.
- Consider whether you are willing and able to hire outside help if it is needed, and whether the needed help is available.
- Find out whether there are special regulatory requirements connected to this enterprise. Will you need licenses, permits, or inspections?

1) To what extent does your current workforce have the *time and skills* to accomplish the tasks required for the proposed enterprise?

Not at All	A Little	Somewhat	A Lot
0	1	2	3

2) If you will need *additional labor*, how easy will it be to find and retain?

Impossible	Difficult	Fairly Easy	Very Easy
0	1	2	3

3) If *extra workers* will be needed, how easy will it be to train them?

Impossible	Difficult	Fairly Easy	Very Easy
0	1	2	3

4) How thoroughly have you explored *regulatory requirements* that might impact you?

Not at All	A Little	Somewhat	A Lot
0	1	2	3

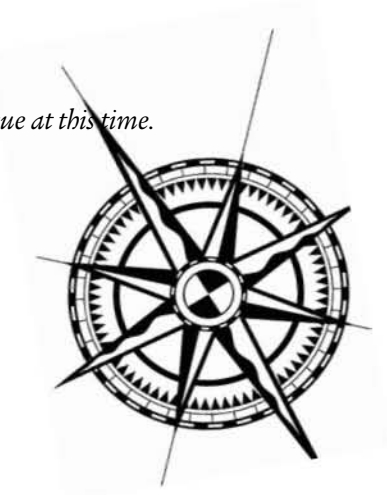
Add the total score for all of the questions for Issue #3:_____

Divide by 4 *(the number of questions for this issue)* _____

Issue #3 Total *(Round to the nearest hundredth)* =_____

This is your Issue #3 Score. Record this score on page 8.

If any of the questions in Issue #3 received a rating of 0, this is probably not the best option to pursue at this time.



Issue #4: Physical and Natural Resources

This section will help you figure out whether you currently have the physical and natural resources you need for this new venture. In some cases, you may find that there are insurmountable obstacles. In other cases, you may be able to acquire the necessary resources or adapt existing resources to the needs of the proposed enterprise.

Before you begin:

- Talk with someone knowledgeable about the farm conditions and resources that would be required for the proposed enterprise.
- Determine whether there are any obvious environmental resources that your farm does not possess and cannot acquire.
- Find out what kind of machinery will be required and when.

1) Would the proposed enterprise fit (or can it be adapted to fit) the *physical and natural resources* of your farm (i.e., soil qualities, climate, land base, water quality, well capacity, etc.)?

Not at All	A Little	Somewhat	A Lot
0	1	2	3

2) Will the proposed enterprise make use of existing *on-farm physical resources* (i.e. land, buildings, machinery, and by-products)?

Not at All	A Little	Somewhat	A Lot
0	1	2	3

3) How easily could the proposed enterprise be incorporated into *existing operations*?

Impossible	Difficult	Fairly Easily	Very Easily
0	1	2	3

4) How comfortable are you with any *short- or long-term changes* to your farm that are likely to occur as a result of this operation?

Not at All	A Little	Somewhat	Very Comfortable
0	1	2	3

Add the total score for all of the questions for Issue #4:_____

Divide by 4 *(the number of questions for this issue)* _____

Issue #4 Total *(Round to the nearest hundredth)* =_____

This is your Issue #4 Score. Record this score on page 8.

If any of the questions in Issue #4 received a rating of 0, this is probably not the best option to pursue at this time.

Issue #5: Profitability

When considering any new enterprise, profitability is a central concern. **An accurate assessment of the potential profitability of any option requires careful financial analysis that is beyond the scope of this guide.** This section relies on you to make conservative and informed estimates of the perceived investment costs as well as the potential sales of the option you are considering.

Before you begin:

- Remember: the initial financial projections you make for the purposes of this guide are only preliminary. This section is *only* intended to help you decide whether it is worth your time to take a more detailed and accurate look at the financial considerations involved.
- Consider costs over at least the first few years of operation. Some investments and costs may occur at the start-up phase. Others will come down the road. Consider all of the financial investments required (including labor, equipment purchase and depreciation, loan payments, fuel and electricity, storage/conditioning, packaging, and other costs related to production and marketing) to pursue this option.
- Carefully consider how much income will be required and when during the season it will be required (to balance income against labor and investment needs).
- Consider possible sources of investment capital as well as operating capital.
- Consider whether there are any custom services (i.e., processing) available to offset initial capital requirements.
- Bear in mind current and future competition for your enterprise.

1) How confident are you in your ability to *raise the initial capital* required and to sustain the added financial burden over time?

Not at All Confident	A Little	Somewhat	Very Confident
0	1	2	3

2) How comfortable are you with the possibility that you could *lose* a substantial portion of this investment should the enterprise fail?

Not at All Comfortable	A Little	Somewhat	Very Comfortable
0	1	2	3

3) How thoroughly have you researched the *potential total revenue* (i.e., total yield x expected price) and expected expenses this option would generate?

No Research	A Little	Somewhat Thorough	Very Thorough
0	1	2	3

4) How thoroughly have you researched the *expected expenses* (i.e., labor, equipment, processing, marketing, and other costs) required for this option?

No Research	A Little	Somewhat Thorough	Very Thorough
0	1	2	3

5) How confident are you that the total revenue minus all expected expenses will result in a *profit* that you consider worth the effort?

Not at All Confident	A Little	Somewhat	Very Confident
0	1	2	3

6) How comfortable are you with the expected amount of *time* before the enterprise becomes profitable?

Not at All Comfortable	A Little	Somewhat	Very Comfortable
0	1	2	3

7) How strong is the *demand* for the proposed product?

No Demand	A Little Demand	Some Demand	High Demand
0	1	2	3

8) How much *effort* are you willing to invest in marketing the proposed product?

No Effort	A Little	A Fair Amount	A Lot of Effort
0	1	2	3

9) What is the *potential* for market demand in the foreseeable future?

No Demand	A Little Demand	Some Demand	High Demand
0	1	2	3

Add the total score for all of the questions for Issue #5:_____

Divide by 9 *(the number of questions for this issue)* _____

Issue #5 Total *(Round to the nearest hundredth)* =_____

This is your Issue #5 Score. Record this score on page 8.

If any of the questions in Issue #5 received a rating of 0, this is probably not the best option to pursue at this time.

Issue #6: Potential Community Impact

Many proposed enterprises may be invisible to neighbors and the surrounding community. Others may have impacts – on traffic patterns, natural resources, or the local economy, for example – in ways that neighbors consider as positive or negative.

Before you begin:

- Talk with someone who has experience with the proposed enterprise and find out whether the enterprise had any effect—positive or negative—on relationships with neighbors. Consider whether these effects are likely to be similar in your own venture.
- Consider how important community impact is to you, and whether it should be a determining factor in whether or not to pursue a diversification option.

1) To what degree do you expect the proposed enterprise to *benefit* the local community?

No Benefit	Little Benefit	Some Benefit	Much Benefit
0	1	2	3

2) To what degree do you foresee a *negative* reaction to the proposed enterprise from the community?

Very Negative	Somewhat Negative	A Little Negative	Not Negative at All
0	1	2	3

Add the total score for all of the questions for Issue #6:_____

Divide by 2 *(the number of questions for this issue)* _____

Issue #6 Total *(Round to the nearest hundredth)* =_____

This is your Issue #6 Score. Record this score on page 8.

If any of the questions in Issue #6 received a rating of 0, this is probably not the best option to pursue at this time.

Step 3: Consider your priorities

While each of the issues above is important when looking at the feasibility of a new enterprise, *this guide does not pretend to know what is most important to you and your unique farm*. To get a better idea of how this option fits into your own goals and priorities for your farm, mark the three issues that are *most* important to you. Look over your answers to the questions in these three sections and give them special weight.

Step 4: Calculate total score

Now that you have completed all of the questions, you are ready to calculate the total score for this option. To do this, add together the Issue Scores. Record this score to compare with other options.

Name of Option: _____

SCORES ▸

1: Interests and Goals *(from page 2)* . . . . . _____
2: Business Management Skills *(from page 3)* . . . . . _____
3: Production-related Skills/Resources *(from page 4)* . . _____
4: Physical and Natural Resources *(from page 5)* . . . . . _____
5: Profitability *(from page 7)* . . . . . _____
6: Potential Community Impact *(from page 7)* . . . . . _____

TOTAL score for this proposed option . . . . . _____

Step 5: Compare with other options

You can use the Diversification Compass to compare as many options as you would like. *Remember: the score for each option should serve only as a guide in making your decisions. The process of filling out these worksheets may ultimately be more valuable to you as you consider your next steps.*

Next Steps

Whatever option or options you decide to look into further, you'll have to do a good deal more research and legwork before you decide whether or not to make the financial and time commitments necessary to make your ideas happen.

Ideas for further research and considerations:

- Make contacts with other people who are already involved in the kind of enterprise you are considering. Their practical experience can be invaluable.
- Can you test this option on a small scale to get a feel for what is involved, and to see whether the enterprise can be grown at a pace you are comfortable with?
- Contact your nearest Extension, Small Business Administration, or Farm Financial Management office for more information about how to get business planning help.
- Contact your state department of agriculture for more information on resources available for a particular diversification option, and for resources related to business planning help.
- Attend conferences and workshops in your own and neighboring states to learn about new ideas and to meet entrepreneurial growers.
- Scan newspapers and magazines (both agricultural and non-agricultural) to learn about new consumer trends.

Additional Resources

Websites, organizations, and publications available to help you plan.

Publications and Guidebooks

"A Primer for Selecting New Enterprises for Your Farm" by Tim Woods and Steve Isaacs of University of Kentucky Cooperative Extension Service. Available at: www.uky.edu/Ag/AgEcon/

"Building a Sustainable Business: A Guide to Developing a Business Plan for Farms and Rural Businesses" by the Minnesota Institute for Sustainable Agriculture and the Sustainable Agriculture Network. Available at: www.misa.umn.edu

"Evaluating a Rural Enterprise" by Preston Sullivan and Lane Greer, Appropriate Technology Transfer for Rural Areas (ATTRA). Available at: www.attra.ncat.org

"Farming Alternatives: A Guide to Evaluating the Feasibility of New Farm-Based Enterprises" by the Natural Resource, Agriculture and Engineering Service of Cornell University. Available at: www.nraes.org

"How to Write a Business Plan" by Verlyn K. Anders, Center for Industrial Research and Service. Available at: www.ciras.iastate.edu

"Starting a Value-Added Agribusiness: The Legal Perspective" by Mark J. Hanson, Illinois Institute for Rural Affairs. Available at: www.iira.org/pubsnew

"Your Plan: A Step-by-Step, Start to Finish Business Plan Guidebook" by the Small Business Advancement Center at the University of Central Arkansas. Available at: www.sbaer.uca.edu

Organizations and Agencies

Agricultural Innovation Center (Missouri Department of Agriculture) at: www.aginnovationcenter.org

Agricultural Utilization Research Institute (Minnesota) at: www.auri.org

Appropriate Technology Transfer for Rural Areas at: www.attra.ncat.org

Center for Industrial Research and Service (Iowa) at: www.ciras.iastate.edu

Center for New Crops and Plant Products (Purdue University) at: www.hort.purdue.edu/newcrop

Farm Planning and Practices Page (Minnesota Department of Agriculture) at: www.mda.state.mn.us

Minnesota Grown Opportunities (Minnesota Department of Agriculture) at: www.mda.state.mn.us/mgo

Missouri Alternatives Center at: www.agebb.missouri.edu/mac

New Farm Options (University of Wisconsin Extension) at: www.uwex.edu/ces/agmarkets/

Small Business Advancement National Center (University of Central Arkansas) at: www.sbaer.uca.edu

Community Outreach and Assistance
Partnership Program