Sustainable Agriculture
Program of Minnesota

Minnesota Department of Agriculture,
Energy & Sustainable Agriculture Project

Program Directory

Minnesota Sustainable Agriculture Program

Minnesota Department of Agriculture
Energy & Sustainable Agriculture Program

Compiled by

Richard E. Gauger, Program Director
Charlene Chan-Muehlbauer, Research Analyst
Linda Bougie, Program Secretary
David Ball, Loan Officer
Douglas Gunnink, On-Farm Research Coordinator
Tony Anderson, Public Affairs Specialist, Planning Division

Special Thanks to all of the Grantees who have worked so hard on their projects; to the Sustainable Agriculture Program, University of Minnesota; the Minnesota Extension Service; the Land Stewardship Project; Soil and Water Conservation Districts; The Minnesota Food Association; the International Alliance for a Sustainable Agriculture; and the Organic Growers and Buyers Association for technical assistance and support on all of these projects.

Funded in part by:
Exxon Oil Overcharge Funds
administered by
the Minnesota Department of Public Service, Energy Division

"This material was prepared with the support of funds returned to the Minnesota Department of Public Service Energy Division on behalf of Minnesota consumers by court order to effect restitution for oil overcharges by the Exxon Corporation and administered through programs authorized under the U.S. Department of Energy (DOE) Grant No. DE-FG02 86CS69105. However, any opinions, findings, conclusions, or recommendations expressed here-in are those of the author(s) and do not necessarily reflect the views of DOE or the Department of Public Service".

Printed on recycled paper

Table of Contents

1990 Grant Projects

Categorized (by practice)

Sustainable Agriculture Loan Program

Introduction

To promote and encourage the adoption of farming practices which conserve natural resources, the state of Minnesota initiated the Energy & Sustainable Agriculture Program (ESAP) through its Department of Agriculture.

ESAP was initiated in 1987 with EXXON oil overcharge funds. In 1988, the Minnesota legislature provided ESAP with additional funding for a Sustainable Agriculture Grant and Loan program. In 1989, the Minnesota legislature continued its support of ESAP by providing funding for two additional positions within ESAP. ESAP now consists of five full-time employees.

Wendell Berry, the noted Kentucky essayist and Professor, describes a sustainable agriculture as "one which depletes neither the people nor the land."[1] This definition is the starting point for describing the meaning of a sustainable agriculture in Minnesota. "For an agriculture to be truly sustainable, it must be ecologically sound, economically viable, socially just and humane."[2] The agricultural development we are witnessing is moving towards a more sustainable agriculture by developing alternatives to conventional farming methods. The Minnesota Department of Agriculture, ESAP, has established the following goals to direct the development of sustainable farming systems:

- Maintain and Improve Soil Productivity and Tilth
- Avoid the Entrance of Agri-Chemicals into Groundwater
- Minimize the Use of Agri-Chemicals, Where Possible
- Produce Safe and Wholesome Food, Free of Residues
- Reduce the Use of and Reliance on Non-Renewable Resources
- Reduce Farmers' Economic and Health Risks
- Increase Both Short and Long-Term Farm Profitability
- Maintain or Increase Farm Numbers.

The management of natural resources and farming practices for sustainability revolves around three critical areas: environmental protection, farm profitability, and social acceptance. In order for sustainable agriculture practices to make a significant difference they must be at least environmentally benign, and preferably environmentally positive or enhancing, and at the same time profitable for the farmer and acceptable to the general public.

Farmers will not adopt any practice that does not provide them with a profitable return (unless it is subsidized by the government). The public is increasingly concerned with health risks associated with residues in foods, and with the protection of its soil and water resources. The goal of ESAP and other organizations to formulate practices that are both profitable and environmentally sound is challenging, but is possible given local, state and federal support.

Methods for Achieving Project Goals

To achieve the adoption of farming practices which encourage the incorporation of the above goals, ESAP uses a multi-programmatic approach. This approach is designed to:

1. Evaluate current farm sustainability;
2. Recommend alternatives for future farm sustainability;
3. Demonstrate and research practical farming alternatives;
4. Inform farmers about sustainable techniques from both experiment station and on-farm research/demonstrations;
5. Grant funds to farmers and researchers capable of performing on-farm research/demonstrations;and
6. Loan funds to farmers for purchase of equipment that will speed the adoption of sustainable practices.
7. Listen to farmers; work with, and learn from them.

To these ends, the following programs have been developed.

---

[1] Berry, Wendell, Wes Jackson and Bruce Colman, editors. Meeting the Expectations of the Land: Essays in Sustainable Agriculture and Stewardship. San Francisco: North Point Press, 1984

[2] Gips, Terry. "What is Sustainable Agriculture?" Manna, Vol.1, No.4, July/August 1984, p.2.

Energy Audit Program. The purpose of this program is to assist farmers in calculating farm energy use. Energy is defined for the sake of this program to mean, both direct inputs (fuels and electricity) and indirect inputs (fertilizers and pesticides). The program allows farmers to compare their use of non-renewable inputs with their associated costs of production. Farmers are encouraged to consider input reduction in areas where energy use and/or production costs exceed the norm for a sustainable farm.

On-Farm Research/Demonstration Program. The purpose of this program is to both research and demonstrate alternative farming practices. Farmers want to see alternative practices demonstrated on their farms or nearby farms before they will adopt them .[4] This program establishes these demonstrations on farms, at farm scale, and within the farmers management system. Plots are established in a randomized replicated side by side (RRSS) design with a minimum of 4 replications.

Sustainable Agriculture Education Program. The purpose of this program is to provide education materials to farmers interested in sustainable agriculture. These materials are generated by using a combination of land grant university research, and successful farmer implementation of sustainable techniques. Publications being produced include conference proceedings, communication meeting findings, results from a survey of farmers using alternative management techniques, a manual for the transition from high input to low input farming, and management guidelines for sustainable techniques.

Sustainable Agriculture Farmer Communication. The purpose of this program is to provide researchers, extension agents, regulators, agri-professionals, and farmers with information regarding sustainable agriculture in a discussion group format. Informal meetings with small groups of farmers using alternative practices are conducted in the winter to encourage idea exchanges regarding sustainable agriculture. Information regarding the process for farmer adoption of new farming techniques and the need of farmers for research are some of the topics previously discussed at these meetings.

Sustainable Agriculture Grant Program. The purpose of this program is to provide funding for farmers, researchers, extension agents, and crop consultants to conduct on-farm experimentation of sustainable techniques. Grant funding is contingent upon meeting sustainable agriculture criteria, and cooperation with county agents, conservation districts, extension specialists, private consultants, and non-profit groups. In 1989, 17 grants were awarded averaging $16,500 and in 1990 14 grants were awarded averaging $13,500 for 2 to 3 year projects.

Sustainable Agriculture Loan Program. The purpose of this program is to provide low interest financing to farmers interested in farming more sustainably. Loans up to $15,000 per farmer, at a fixed six percent interest rate, are made for the purchase of equipment that will help farmers reduce inputs and environmental contamination, and speed the adoption of more sustainable farming practices. By May 1990 over $ 500,000 in loans have been made to a total 40 farmers.

Organization Partnerships and Cooperation

ESAP has established partnerships with organizations traditionally known for providing information to farmers, namely, the Minnesota Extension Service and Experiment Station. On-farm research/demonstration plots are coordinated with local county extension agents, state extension specialists, and non-profit group agronomists. Information generated from these plots is shared and disseminated by the various organizations at conferences, meetings, and in publications. The partnership with the University of Minnesota is successful because of concerted efforts to coordinate all ESAP programs with local and state agents. This relationship includes equal access to all research activities, information and reports.

ESAP has also established partnerships with organizations that are advocating changes for Minnesota's agriculture such as the Land Stewardship Project, The Organic Growers and Buyers Association, The Minnesota Food Association, the Minnesota Project, and the International Alliance for a Sustainable Agriculture. These relationships keep ESAP on the cutting edge of changes that will move Minnesota agriculture toward sustainability over the next decade.

---

[4] Martinez, J.C. and J.R. Arauz. 1984. Developing appropriate technologies through on-farm research: The lesson from Caisan, Panama. Agricultural Administration, 17:93-114.

On-Farm Demonstrations and Research

Minnesota Sustainable Agriculture Program

ON-FARM RESEARCH AND DEMONSTRATION
An Explanation

by Charlene Chan-Muehlbauer & Richard E. Gauger

Widespread public interests and concerns about the impact of conventional agricultural practices on the environment, on the safety of the food supply, and on the health of farm workers has prompted many farmers to consider using alternative farming techniques. For farmers who wish to reduce the amounts of chemical inputs (ie. pesticides and fertilizers) in their farming operations, there is a shortage of information on viable alternatives.

Most agricultural research studies are conducted on experiment stations, university research plots, or some other site specifically designated for research purposes. These plots are situated on relatively small areas in which the researcher attempts to control environmental conditions as much as possible. While such an approach is excellent for the researcher to assess the exact effect of a treatment under very specific conditions, it is less useful in evaluating a treatment in a cropping system.

On-Farm Research, agricultural experiments performed on commercially-operated farms on plots that are farm scale, offer an additional tool for examining sustainable agriculture methods.

ADVANTAGES OF ON-FARM RESEARCH

1. Because environmental factors on farm-scale research cannot be manipulated to the degree that smaller plots allow, the yields and results obtained by these studies are more realistic to what a grower can expect to see on a commercial farm, which adds credibility to the study from the perspective of the grower.
2. Farmers play a critical role in managing on-farm research by: planning the treatments, applying the treatments, maintaining the experimental field, and harvesting and collecting data.
3. Neighboring farmers are more willing to adopt the techniques demonstrated by this research when they have seen a successful execution on a commercial farm.
4. Researchers can use on-farm studies to evaluate the feasibility of an agricultural system using prototypical farm equipment. This is not possible on standard-sized plots, which are too small to accommodate the operation of normal farm equipment.[1]
5. Researchers, farmers, and extension personnel are interacting in a "give and take" basis avoiding the "top down" syndrome.
6. Research information is usually published and useful for years following.

DISADVANTAGES OF ON-FARM RESEARCH

1. Since there is more field and environmental variation in large plots, the resulting data from on-farm research studies generally can be expected to contain higher variability than that of typical agricultural studies. However, studies by Fleming et al.[2] and Shapiro et al.[3] suggest that "long narrow strips, when replicated, increase statistical precision as a result of representing the population of inference better."
2. The management decisions made by the farmer participating in the study may contribute a source of experimental error (variability) to the research.
3. For these reasons, researchers are skeptical of the scientific merit of on-farm studies. They have been reluctant to embrace the findings of these experiments, and rarely use these methods on their own research projects.

Despite the logistical difficulties present in on-farm studies, many agri-professionals believe that these investigations play an important role in agricultural research and may provide valuable information to the benefit of farm growers and producers.

---

[1]Lockeretz, W. 1987. Establishing the proper role of on-farm research. Am. J. of Alternative Agriculture 3:132-136.

[2]Fleming, A.A., T. Hayden Rogers, and T.A. Bancroft. 1957. Field plot technique with hybrid corn under Alabama conditions. Agron. J. 49:1-4.

[3]Shapiro, C.A., W. L. Kranz, A.M. Parkhurst. 1989. Comparison of harvest techniques for corn field demonstrations. Am. J. of Alternative Agriculture 4:59-64.

HOW IS ON-FARM RESEARCH DONE?

Some guidelines for setting up statistically reliable on-farm research designs were presented by Rzewnicki et. al.[4]:

1. Long, narrow plots from 125 to 1320 feet, wide enough to accommodate one to two passes of farm equipment.
2. Few treatments (2 to 3 treatments) per experiment.
3. Randomized, replicated treatments with six to eight replicates per treatment - using several different farms and cooperators if necessary.
4. Farmer participation in planning, planting, maintaining, and harvesting plots, and collecting data, using standard farm equipment.

EFFECTIVENESS OF ON-FARM RESEARCH

Evaluating the effectiveness of on-farm research is similar to evaluating standard research, in many respects. It is important to conduct appropriate statistical analyses on soil, agronomic, and yield data.

The Coefficient of Variation (C.V.):

$$C.V. = sd/y \times 100$$ where sd = Standard deviation of experimental data
y = Grand or overall mean of experiment

shows the statistical power of the experiment. The higher the C.V. value, the less effective the experiment is in determining true differences between treatment effects.

Other relevant parameters of evaluating on-farm research include: analyzing the economics of the system - whether it compares favorably to the corresponding conventional system; assessing the magnitude of input reduction; and determining the amount of labor and time necessary to implement the system.

ON-FARM DEMONSTRATION

On-farm demonstrations are similar to on-farm research in many ways, and are also useful for presenting new farming techniques to growers. On-farm demonstration, like on-farm research, are studies conducted on a farm, on a large-scale field, using standard farm equipment. Farmer participation, again, is crucial in conducting a demonstration.

Unlike on-farm research, however, demonstrations do not meet the requirements for statistical design. The "treatments" are not randomized and the replication is incomplete. Usually, on-farm demonstrations present contrasting farming systems in side by side comparisons.

EFFECTIVENESS OF ON-FARM DEMONSTRATION

Since statistical analyses are inappropriate for on-farm demonstrations, the effectiveness of a demonstration is evaluated based on its ability to draw public interest as measured by the number of persons attending farm tours and/or field days, and by the amount of media coverage generated.

RESEARCH AND DEMONSTRATION

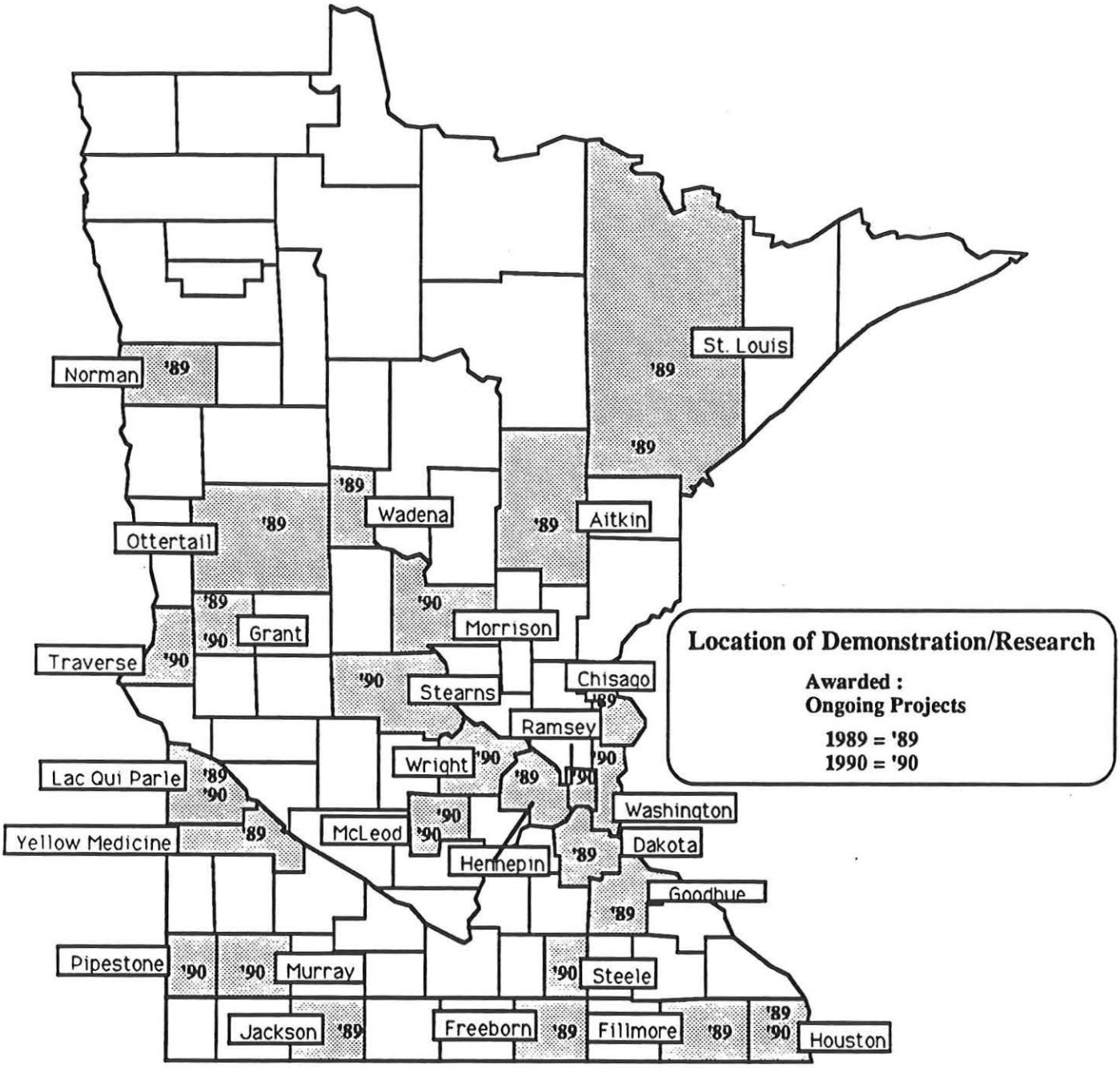
Research, as described above, performed on farms inherently becomes a demonstration because it is easily viewed by neighboring farmers and talked about in coffee shops. Demonstrations, as described above, cannot be classified as research because they will never meet the necessary statistical rigor. Therefore, unless field size will not allow replication, all on-farm work should be set up in the research design. This will help ensure generation of information that is useful to a wider audience.

---

[4]Rzewnicki, P.E., R. Thompson, G.W. Lesoing, R.W. Elmore, C.A. Francis, A.M. Parkhurst, and R.S. Moomaw. 1988. On-farm experiment designs and implications for locating research sites. Am. J. of Alternative Agriculture 3:168-173.

Sustainable Agriculture Grant Program

Project Directory



Sustainable Agriculture Program of Minnesota
Minnesota Department of Agriculture

Project Title:	**Benefits of Crop Rotation in Reducing Chemical Inputs and Increasing Profits in Wild Rice Production**	*Time Span:*	August 89 to August 92
Principal Investigator:	George Shetka	*Tel:*	218-927-6617
Address	Fleming Route, Box 6402 Aitkin, MN 56431	*County:*	Aitkin
Cooperators:	Ervin Oelke - Dept. of Agronomy, U of M	*Enterprise*	wild rice, small grains

Project Description: The normal practices of applying a fungicide and a herbicide on continuously cropped wild rice will be compared to rotating wild rice with winter rye or sweet clover/buckwheat without applying these chemicals during the years wild rice is grown. The economics of these two systems will be calculated and the water quality will be monitored for each system. Six two-acre paddies will be utilized and the treatments will be replicated three times. The feasibility of reducing fungicides and herbicides by using rotations will be measured.

Project Objectives:

1. To demonstrate that rotating wild rice with winter rye or sweet clover/buckwheat could reduce use of fungicides, herbicides and/or nitrogen fertilizer on wild rice production.
2. To monitor water released into rivers from wild rice paddies before harvest for possible pesticides and nutrients.
3. To obtain economic data for the two production systems to see which results in more profit over a 3 or possibly 4 year period.

Publicity Report:

	Number
Visitors	
Field Days	
Newspaper Articles	
Radio Reports	
TV Reports	
Workshops	

Summary of Results:
Not available until 1991 due to the crop rotation .

Most Significant Finding:

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Friday, July 20	10:00 A.M. to 12:00 noon

Location of Project: 10 miles north of Aitkin on Hwy 169. 1 1/2 miles east on 210th. North side of road.

Project Title:	**Improving Groundwater Quality and Agricultural Profitability in East Central Minnesota**	*Time Span:*	April 89 to November 91
Principal Investigator:	Rod Elmstrand, Chisago County Extension	*Tel:*	612-674-4417
Address	6 Sunshine Boulevard North Branch, MN 55056	*County:*	Chisago
Cooperators:	Dr George Rehm - Extension Soil Scientist Dr Michael Schmidt - Extension Soil Scientist	*Enterprise*	corn

Project Description: The Chisago/Isanti County Cluster is located in the Anoka Sand Plain area, one of the two major regions in Minnesota where nitrate-nitrogen (NO_3-N) in the groundwater is a major concern because this material can easily move through the root zone and into the water table. We propose to research a field nitrate testing kit for farmers to do an "on-the-spot" analysis of their nitrogen (N) need, therefore, eliminating excessive nitrogen use and maximizing economic inputs.

The demonstration plots will include four different locations in the two-county area. Each demonstration plot will contain four (4) replications of seven (7) different nitrogen rates. The individual replications will be 15 feet X 40 feet.

The four replications are necessary to provide enough measurements for a statistical analysis by University of Minnesota personnel. Soil samples will be collected at five (5) different times of corn growth: two weeks before planting, after planting but prior to emergence, the 2-3 leaf growth stage before side dressed N application, the 6-7 leaf growth stage, and after harvest. This sample will also be taken from six (6) different depths. From this we can determine the best time to sample and determine where the various forms of nitrogen are coming from.

Plant samples will be analyzed at the 5-6 leaf growth state for NO_3-N. Individual soil and plant analysis of combinations of measurements will be related to the fate of nitrogen that produces the most profitable yield.

Project Objectives:

1. To field test and evaluate the early spring soil nitrate test for east central Minnesota soils.
2. To reduce excessive nitrogen use and reduce guess work in fertilizing corn fields, especially for corn following manure application and legumes.
3. To reduce ground water pollution through the responsible use of nitrogen fertilizers.
4. To improve farm profitability by reducing fertilizer input costs while realizing an economical corn yield.

Publicity Report:

	Number
Visitors	100
Field Days	2
Newspaper Articles	6
Radio Reports	4

Summary of Results: Soil tests taken at the 6 leaf stage of corn growth showed 2 ppm (parts per million) to 198 ppm of nitrate nitrogen (NO_3-N). In the field with 2 ppm soil nitrates, corn yield responded to a maximum nitrogen application of 60 lbs. nitrogen per acre (N/A). In the field with 198 ppm soil nitrates, corn yield responded to a maximum nitrogen application of 150 lbs. N/A. This indicates that there are inconsistencies with the use of the soil test.

Most Significant Finding: Several east-central Minnesota farmers used a spring soil test to save $5 per acre in fertilizer compared to the fertilizer recommendation based on previous crop history.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Tues., July 10	12 Noon to 2:30 P.M.

Direction to Tour: 60 miles north on I35 from St. Paul to Rush City. Exit at Rush City and go east into downtown Rush City. At intersection of Co. Rd. 30 take a right and go south about 1 3/4 miles, take a right go west 1/2 mile, plot is on left side of road.

Project Title:	**Minnesota Integrated Pest Management Apple Project**	*Time Span:*	January 89 to December 91
Principal Investigator:	John Jacobson & Bill Kidd	*Tel:*	612-429-8026
Address	Pine Tree Apple Orchard 450 Apple Orchard Road White Bear Lake, MN 55110	*County:*	Dakota
Cooperators:	Bill Kidd - Horticulturist Carpenter Nature Ctr. Dr Emily Hoover - Extension Specialist	*Enterprise*	apples

Project Description: Apple production is the leading fruit production industry in Minnesota. Apple Scab (*Venturia inaequalis*) is the most serious fungal disease affecting apple production both in Minnesota and across the United States. Present control measures involve the spraying of fungicides at 5-7 day intervals as protectant sprays during the primary infections stage. This frequency is reduced to 10-14 day intervals later in the season. Growers are forced to use this rigid schedule, which probably includes excessive spraying, because there is a lack of information to predict when sprays should be applied. Using techniques to predict scab infection periods can reduce or totally eliminate the need for fungicide application.

We would like to establish baseline information, gathered from apple orchards throughout the apple growing regions of Minnesota, on apple scab sporulation and infection.

Information on the conditions which are ideal for infection would be made available weekly or biweekly to help growers decide whether or not fungicide application is necessary. If this project is successful, a similar system could be researched and established for other disease and insect problems. This project would be not only economically beneficial for all Minnesota apple growers, but also environmentally beneficial for all Minnesotans since agri-chemical use could be greatly reduced.

Project Objectives:

1. To provide a method whereby growers can reduce fungicide applications.
2. To show that with careful monitoring fewer fungicidal sprays need to be applied.

Publicity Report:

	Number
Visitors	250
Field Days	
Newspaper Articles	2
Radio Reports	
TV Reports	1

Summary of Results: This project had seven growers who prepared and sent leaf samples from their orchards to St. Paul where the sample was analyzed for apple scab spore maturity. Growers were only to spray when spore maturity reached 5%. Growers were then instructed to spray on a calendar basis.

Table 1

Orchard Number	Scab Infestation IPM plots %	Number of Sprays*	Scab Infestation Normal Plots %	Number of Sprays*
1	0.3	4	7.3	7
2	1.1	0	1.6	2
3	19.8	5	18.1	5
4	0.0	4	0.2	11
5	0.6	3	0.2	8
6	0.9	5	0.4	7
7	0.0	1	0.0	5

* Fungicide

On the seven plots the average number of times the trees were sprayed with a fungicide was cut in half (Table 1). The percent of scab infected fruit on the monitored (IPM) plots and the normal sprayed plots were about equal (Table 1).

Most Significant Finding: That an IPM approach to Apple Scab could reduce costs, reduce environment and human health concerns and still result in an equal or better quality product for the consumer.

Field Tours for 1990 Growing Season:

Date	Time
Thurs. July 19	9:00 A.M. to 3:00 P.M.

Directions to the Project: From Hastings on the north side of the Mississippi River, take Highway 10 southeast about 3 miles. On the Minnesota side of the bridge into Wisconsin, turn left (north) on St. Croix Trail (Co. Rd. 21). Go about 3 miles to John Leadholm's Croix Farm Orchard 12971 St. Croix Trail South on the east side (the St. Croix River side) of the road. At 12:00 noon, the tour will continue at the Carpenter Nature Center at 12805 St. Croix Trail South.

Project Title:	**Hairy Vetch and Winter Rye as Cover Crops**	*Time Span:*	April 89 to October 90
Principal Investigator:	Mark Ackland	*Tel:*	507-826-3358
Address	Route 2 Albert Lea, MN 56007	*County:*	Freeborn
Cooperators:	Jim Tjepkema, Rodale Institute	*Enterprise*	corn, soybeans

Project Description: This study is testing the usefulness of hairy vetch, hairy vetch plus winter rye, or winter rye alone as cover crops after oats and preceding corn. A randomized, replicated experiment will include the cover crops plus a no cover crop control. Effect on weed control, soil moisture, and yield in corn following the cover crops will be measured. Nitrogen fertilizer rates for corn will be reduced where hairy vetch grew. Either herbicide plus light tillage or tillage alone will be used to kill the cover crops. Only mechanical and cultural means will be used to control weeds in the corn.

Project Objectives:

1. To use cover crops to improve weed control and reduce need for herbicide.
2. To reduce the use of nitrogen fertilizer where hairy vetch is used.
3. To maintain or increase corn yield when using cover crop.
4. To protect the soil from erosion with cover crops and build soil by adding organic matter and improving soil structure.
5. To reduce the risk associated with handling herbicides and minimize environmental contamination due to herbicides and nitrogen fertilizer.

1989 Publicity Report:

	Number
Visitors	
Field Days	
Newspaper Articles	1

Summary of Results: The 1989 oats were harvested in late July and yielded 100 bu/A. The ground was disked and prepared for seeding of fall cover crops on August 26th. The plots were planted to: 1) Hairy Vetch 2) Rye 3) Rye and Vetch 4) Control. By late November there was a good ground cover established to protect the soil. In the spring we will determine the amount of nitrogen produced by the vetch and compare the moisture availability of all three treatments compared to the control.

Most Significant Finding: Available next year.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Sat., Sept. 8	1:30 P.M.

Directions to the Project: First farm north of Manchester on Hwy 13 on east side.

Project Title:	**Mechanical Mulching of Tree Seedlings**	*Time Span:*	April 89 to October 91
Principal Investigator:	Timothy and Susan Gossman	*Tel:*	507-867-3129
Address	Route 1, Box 110 A Chatfield, MN 55923	*County:*	Fillmore
Cooperators:	John Kelly - DNR Forester Carl Vogt - University of Minnesota Tammy Keith-Wellstone - Land Stewardship Proj.	*Enter-prise*	Trees

Project Description: The purpose of this project is to demonstrate a method of improving the survival rate of tree seedlings. It involves cutting existing vegetation surrounding the trees and using the cuttings to mulch the trees. The plan uses the mulch to decrease weed competition, and reduce evaporation to increase soil moisture. These factors are directly related to the number of trees that live through the first three critical years after planting. The project will utilize a power take off flail mower and a grain swather modified for use as a mechanical mulcher. The goal of the project is to demonstrate through statistical and financial analysis that mulching is not only more environmentally sound, but also a viable alternative in economic terms to the conventional chemical control of weeds in tree seedlings or to a non-chemical program where weeds are not suppressed.

Project Objectives:

1. To eliminate the purchase of herbicides resulting in an indirect energy savings with the mowing - mulching alternative.
2. To evaluate the use of fuel for the mowing-mulching system compared to applying herbicides.
3. To replace the unknown environmental effects of chemical herbicides with naturally decomposing vegetation, replacing an adverse environmental effect with a positive one.
4. To save costs on purchased herbicides and increase the net income to the farmer.
5. To increase survival rate of tree seedlings resulting in additional tree sales, increasing net income to the farmer.

Publicity Report:

	Number
Visitors	24
Field Days	1
Newspaper Articles	1
Radio Reports	
TV Reports	
Workshops	

Summary of Results: Mulching needed to be repeated as the grass grew. Herbicide application was completed by placing a 4" PVC pipe around seedlings to avoid herbicide contact, but trees were later killed by herbicide soaked grass.

Economic estimates of the advantages to mulching were as follows:

- 500 mulched trees compared to 500 herbicide treated trees indicated a 190 dollar advantage to mulching;
- 500 mulched trees compared to 500 sod planted trees indicated a 105 dollar advantage to mulching

Most Significant Finding: Overall survivability in the sod control was 46%, the herbicide control showed 44% survivability and the mulch treated area 66%. Also, individual tree species reacted differently to the treatments.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Saturday, Sept 22	1:00 P.M. to 3:00 P.M. Just drop in.

Directions to the Project: Southwest of Chatfield on the east side of Fillmore County Road 101, 1.5 miles south of Fillmore County Road 2.

Project Title:	**Demonstration of Tillage Effects on Utilization of Dairy and Hog Manure in Southeastern Minnesota**	*Time Span:*	April 89 to January 91
Principal Investigator:	John Moncrief	*Tel:*	612-625-3737
Address	Soil Science Department University of Minnesota St. Paul, MN 55108	*County:*	Goodhue
Cooperators:	Brian Schreiber - Goodhue County Ext. Agent Ken Ostlie - Extension Entomologist Dave Andow - Entomologist	*Enterprise*	hog, dairy, corn

Project Description: Typically, when animal manures are used for fertilizing soils, neither the rates of manure application nor the nitrogen concentration and form are known. In some cases, high rates of manure are applied close to the barn and intensive tillage is used for incorporation. These practices cause leaching losses of manure nitrogen into groundwater and erosion on vulnerable soils. In this project, a range of rates of hog and dairy manure will be evaluated under commonly used forms of conservation tillage for corn production. The response of the crop and plant pests during the year of application and the following two years will be evaluated. By establishing the effects of residual nitrogen, credit for nitrogen available to the crop from manure can be assessed. This will reduce contamination of the fractured limestone aquifer in this area of Minnesota by over application of supplemental commercial nitrogen. In addition, by establishing the effect of manures on plant pests, the potential for pesticide reduction can be assessed.

Project Objectives:
1. To reduce energy inputs for corn production in the form of direct fuel consumption and indirectly by reducing tillage and the other inputs associated with less tillage.
2. To reduce energy inputs for corn in the form of reduced pesticides.
3. To reduce energy inputs for corn in the form of nitrogen fertilizer.
4. To make farming in southeastern Minnesota more profitable by reducing tillage and ag chemical inputs.
5. To protect the vulnerable aquifer in southeastern Minnesota from nitrate contamination from excessive use of chemical fertilizers.

Publicity Report:

	Number
Visitors	160
Field Days	5
Newspaper Articles	3
Radio Reports	1

Summary of Results: Injected livestock manure had similar corn yields when compared to commercial fertilizer, but the nitrate nitrogen concentration at the five foot (5') level underneath the manure application was less, suggesting less nitrate leaching.

The chisel plow plots had greater runoff and less infiltration of water when compared with the ridge tillage.

There is a tendency for western corn rootworm to survive better under chisel than under ridge tillage.

Most Significant Finding:
1. Ridge till/no till systems with annual application of dairy manure compared to equivalent applications of commercial fertilizer had one half to one fourth the concentration of nitrate nitrogen in the soil water at 5 feet throughout the season,
2. Corn yields were higher with one half the amount of dairy manure nitrogen as compared to nitrogen from commercial sources, and
3. Tillage did not affect grain yields on either farm.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
June 13	All Day

Location of Project: From the Twin Cities, take Hwy 61 down to Red Wing downtown. Turn right on Hwy 58. Drive past Red Wing Tech. Institute and Casey's. Turn left on Hwy 45. Stay on Hwy 45 four (4) to six (6) miles. Tillage plots on right side of road. Dale Flueger farm on left side of road. (Note: on Hwy 45, you will reach a point where the road forks. Be sure to take the road on the right and continue on Hwy 45 until you reach the farm.)

Project Title:	**Modified Ridge Till System for Sugar Beet Production**	*Time Span:*	September 88 to December 91
Principal Investigator:	Alan Brutlag	*Tel:*	218-458-2112
Address	Route 1, Box 41 Wendell, MN 56590	*County:*	Grant
Cooperators:	Dr Gerald Smith - Private Consultant Randy Larson - Private Consultant Dr Alan Cattanach - Ext. Sugarbeet Specialist Marv Jensen - Grant County Extension Agent	*Enterprise*	sugar beets, wheat, soybeans, corn

Project Description: In this project, we will modify the ridge till system and make it adaptable to sugar beet production. The system will reduce winter soil erosion through an established cover crop and ridges which will be built in the fall on small grain stubble. De-ridging and planting into a moist, well drained, warm seed environment should net higher yields and profits because of increased stand, emergence, and seedling vigor. Residue from last falls' cover crop should reduce spring erosion while aiding and protecting the growing sugar beets. Herbicide and fertilizer will be reduced by more efficient use of these inputs.

Project Objectives:

1. Reduce fuel consumption by 20-40% during primary and seed bed tillage.
2. Reduce fertilizer application rate by 33% by utilizing band application.
3. Reduce herbicide use by 10-33% by utilizing band applications and causing uniform weed germination.
4. Increase sugarbeet yield by 5-25%.
5. Reduce indirect costs by eliminating 2-3 trips across sugar beet fields.
6. Improve the environment by eliminating wind erosion by maintaining cover crop on sugar beet acres.
7. Improve the environment by reducing the application rates for herbicides and fertilizer thus reducing ground and surface water pollution.

Publicity Report:

	Number
Visitors	150
Field Days	1
Newspaper Articles	1

Summary of Results: The first year results showed:

1. Fuel usage was reduced from 6.74 gallons/acre to 3.91 gallons/acre or 42%, while labor was reduced from 0.5 hours/acre to 0.41 hours/acre or 18 %.
2. Reductions in herbicide use by 81% netted a savings of $35.43/acre.
3. Increase in sugar content and yield because of less erosion was worth an additional $74.00 per acre.

Table 1 (8 replications -12rows wide-length of field)

Treatment	Net ton/acre	Sugar %	Plants per acre	Return/acre $
Conventional	16.44	16.22	17638	627
Ridged	17.58	16.71	21019	701
Mean	17.01	16.47	19328	664
CV (%)	7.49	1.99	22.13	11.57
F value	9.63	3.35	7.50	10.99
Significance	**	*	**	**

Most Significant Finding: A sugarbeet grower in Grant County increased his profits by over $111 per acre with a ridge till system modified for sugarbeets, significantly reducing herbicides and soil erosion.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Wed., June 20	7:30 P.M.

Workshops or Meetings for 1990:

Date	Location	Time
January 1991	Fargo, N.D.	

Directions to the Project:
1-1/2 miles south of Wendell (18 miles south of Fergus Falls) on County Road 11.

Project Title:	**Strip-Cropping Legumes with Specialty Crops for Low-Cost Mulching and Reduced Fertilizer/Herbicide Inputs**	*Time Span:*	April 89 to November 92
Principal Investigator:	Mark Zumwinkle	*Tel:*	612-625-8114
Address	Department of Soil Science University of Minnesota St. Paul, MN 55108	*County:*	Hennepin
Cooperators:	Dr. Carl Rosen - Department of Soil Science	*Enterprise*	peppers, broccoli, alfalfa

Project Description: A living mulch of alfalfa will be strip cropped between ridges of a specialty crop (peppers, broccoli). The alfalfa will be cut 4 times each growing season and blown into the base of the ridge containing the cash crop. Two methods of mulch utilization will be investigated. One treatment will allow the mulch to remain on the surface to slowly decompose. The second treatment will be to incorporate the mulch into the surface soil by disking the base of the ridge and "hilling" soil over the mulch. Strips of alfalfa will measure 3.5 feet. Ridges will measure 3 feet. Ridges will contain single rows of peppers and double rows of broccoli.

The above cut living mulch plots will be compared to plots with standard application rates of fertilizer and herbicide. All plots will be irrigated.

The three methods of production (conventional, legume strips with surface mulch, legumes strips with cultivated mulch) will be monitored specifically with respect to:

- rate of nutrient release (most importantly nitrogen)
- water utilization
- weed control
- yield
- estimated cost of production

Project Objectives:

1. To show that a cut living mulch can reduce synthetic fertilizer inputs.
2. To show that weed control can be accomplished with a continual supply of mulch.
3. To show that the proposed system would be less prone to leaching of nitrogen.
4. To show that yield and quality of specialty crops can be enhanced by stabilization of soil temperature, water and nutrient availability.

Publicity Report:

	Number
Visitors	23
Field Days	1
Newspaper Articles	1

Summary of Results: Producing broccoli using a non-herbicide mulch system saved $43/acre as compared to conventional broccoli production methods. The demonstration also showed there was good availability of nitrogen from the alfalfa mulch. The alfalfa's weed suppression capabilities greatly reduced weed problems.

Most Significant Finding: Broccoli is bio-chemically compatible with both living and dead alfalfa mulch. The potential problem of reduced moisture availability and nitrogen tie up due to the mulch were not a problem this year!

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Friday, June 29	1:00 P.M.
Tuesday, Sept. 18	1:00 P.M.

Directions to the Project: Located 3.5 miles north of Rockford on Hennepin County Hwy 10, on the Crow River.

Project Title:	**A Demonstration of an Intensive Rotational Grazing System for Dairy Cattle**	*Time Span:*	April 89 to November 91
Principal Investigator:	Ken Tschumper	*Tel:*	507-894-4248
Address	Route 1, Box 194 LaCrescent, MN 55947	*County:*	Houston
Cooperators:	Dan Patenaude - Dairy Farmer Jim Tjepkema - Rodale Institute	*Enterprise*	dairy, pasture

Project Description: For this project, I will demonstrate my transition from a year-round stored feeding system to one using intensive rotational grazing (IRG). IRG is a system whereby livestock graze a small area of pasture (paddock) until all the forage is removed. They are then rotated into a new paddock. The animals are rotated in such a way that the forages have enough time to fully recover. Research has found that one can greatly improve both animal and pasture productivity with the system. This project will demonstrate the following: 1) How the pastures will be divided up into paddocks. We will use two different pasture areas, 13 acres for cows and 13 acres for heifers. The paddocks, (approximately 13 for each area) will be arranged so that cows are close to the barn and heifers can easily be viewed. 2) Latest fencing technology. What makes IRG a viable option for today's farmer is innovative fencing materials. An important part of the project will be to demonstrate to farmers how these materials make it possible to: a) put up or move temporary fence in minutes, b) build permanent fence without the use of barrier type materials, c) charge fence for the whole farm with little electricity use and no shorting out by weed growth, and d) various other aspects of high tech fences which make building, moving and maintaining them less labor intensive. 3) A low cost method of pasture renovation. We will demonstrate how one can increase the legume content of permanent pasture by over seeding different species at early spring when the ground is still frozen (frost seeding).

Project Objectives:

1. To show energy savings of using IRG techniques by comparing fuel and electricity bills of past three years with those of next three years.
2. To show a system of forage production without the use of herbicides, commercial fertilizers, little or no erosion, and reduced soil compaction.
3. To demonstrate the profitability of IRG by comparing energy bills and fencing costs vs. machinery maintenance and replacement.

Publicity Report:

	Number
Visitors	65
Field Days	1
Newspaper Articles	3
Workshops	2

Summary of Results: The New Zealand style lightweight portable fencing was very easy to move and manipulate while grazing young stock. The young stock grazed for 205 days, until November 23, and gained 1.5 pounds per day.

Most Significant Finding: A Houston County dairy farmer doubled the number of days on pasture in a dry year and still got a respectable gain of 1.5 pounds per day for the young stock by intensively rotating the herd around paddocks. This lessened the need for growing row crops in a region prone to erosion.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Saturday, June 2	10:00 to 11:30 A.M.
Saturday, July 7	10:00 to 11:30 A.M.
Sat. , August 4	10:00 to 11:30 A.M.

Directions to the Project: County Highway 25 west from LaCrescent for 3 miles to Channel 19 TV tower. Turn left on Tschumper Road, 1 mile on Tschumper Road.

Project Title:	**Alternative Methods of Weed Control in Corn**	*Time Span:*	February 89 to February 91
Principal Investigator:	Sister Esther Nickel	*Tel:*	507-847-5498
Address	Route 3, Box 79 Jackson, MN 56143	*County:*	Jackson
Cooperators:	Dr. Jeffrey Gunsolus - Extension Specialist Dr. Harlen Ford - Southwest Exp. Station Rod Hamer - Jackson County Agent	*Enter-prise*	corn, soybeans

Project Description: This two-year on-farm demonstration study will evaluate alternative methods of weed control for row cropped corn. Treatments will be banded herbicide and no herbicide , rotary hoeing, 0, 1, or 2 cultivations or a legume intercropped between rows to provide a 'living mulch'. Parameters measured will be yield, plant populations for crop, mulch and weeds, insect populations, soil fertility and organic matter. Records will be kept on costs, income, hours of labor, number of cultivations, emergence dates, plant heights, maturity notes, deficiency symptoms, rainfall, temperature range, and all planting and harvesting notes.

Project Objectives:

1. The herbicide band vs. no herbicide with rotary hoe (either on a schedule or by observation i.e. 4 days after planting, by observation) 0, 1, 2, cultivations will show the option of changing herbicide use, thereby reducing an external input of herbicides.
2. The living mulch study will demonstrate its effectiveness for weed control, thereby eliminating cultivation, and reducing fuel use; a direct energy saving.
3. The herbicide reduction study will provide information that may help create a sustaining environment.
4. The living mulch study will show the effect of increased soil coverage on decreasing soil erosion, increasing natural soil fertility (green manure), and decreasing herbicide use.
5. The economic analysis of all studies will provide information for cost saving options for farmers by reducing input costs for herbicides, fuel and fertilizer.

Publicity Report:

	Number
Visitors	250
Field Days	2
Newspaper Articles	9
Radio Reports	2
TV Reports	1

Summary of Results: In all treatments the use of the rotary hoe raised the crop yield compared to the non-rotary hoed counter parts (Table 1). The second cultivation did increase yields, but the first cultivation increased yields dramatically by 10-30 bushels per acre and reduced weeds by 66 %. Use of the banded herbicide increased yields and profits consistently.
The living mulch alfalfa plot yielded low this year because it used some of the moisture needed for the corn crop in this dry year.

No.	Rotary Hoe	Culti-vations	Herbicide	Cost of treatment	Yield (bu/acre)
1	yes	0	yes	$4.58	77
2	yes	0	no	4.70	77
3	yes	1	yes	18.08	101
4	yes	1	no	8.20	92
5	yes	2	yes	21.58	106
6	yes	2	no	11.70	97
7	yes	alfalfa	yes	51.58	60
8	yes	alfalfa	no	41.70	55
9	no	0	yes	9.88	65
10	no	0	no	0.00	50
11	no	1	yes	13.38	98
12	no	1	no	3.5	88
13	no	2	yes	16.88	98
14	no	2	no	7.00	94

Herbicide: Lasso II (granular); banded 12.5 lb/acre
Cost: Rotary Hoe: $ 4.70 / acre
Cultivation: $ 3.50 / acre
Alfalfa (Nitro) 20lb / acre - $ 37.0 / acre

Most Significant Finding: The integration of several weed control methods into a system seemed to be of most value. Alfalfa as a living mulch failed to establish quickly and reduce weed pressure, and was a competitor with corn for moisture. The Gandy was very effective for seeding of the living mulch as an inter-crop.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Sat., June 23	1:00 to 5:00 P.M.

Directions to the Project: Take interstate 90 to Jackson exit, and go south. The first street to the right is Springfield Ave. Take it at least 4 miles until you come to a Y in the road with Scott's Body Shop, bear right. Go 1 mile north of the interstate overpass. Take first gravel to the left and go 1 mile to Sisters of Mercy mailbox.

Project Title:	**Herbicide Ban? Could You Adapt on a Budget?**	*Time Span:*	Fall 88 to Fall 91
Principal Investigator:	David Michaelson	*Tel:*	612-769-4683
Address	Route 2, Box 157B Dawson, M N 56232-9574	*County:*	Lac Qui Parle
Cooperators:	John Olson - L.Q.P. County Extension Agent John Moncrief - U of M, Soils, Tillage Audrey Arner - Land Stewardship Project	*Enter-prise*	soybeans, corn

Project Description: This project will demonstrate the effectiveness of ridge tillage. In particular the project will compare herbicide to mechanical weed management, reduced rates of fertilizers to conventional rates and test the effect of these practices on several corn and soybean varieties.

Project Objectives:

1. To show farmers that they can raise soybeans and corn while reducing external inputs (such as herbicide and fertilizer).
2. To demonstrate that many farmers already own the equipment that they need to realize an indirect (no herbicide) energy savings.
3. To demonstrate a positive effect on the environment of eliminating herbicide by using ridge tillage. Ridge tillage reduces erosion compared to most other herbicide alternatives.
4. By comparing input costs, yield, test weight, and moisture, we will be able to evaluate the input reduction alternative with the most potential profitability.

Publicity Report:

	Number
Visitors	100
Field Days	2
Newspaper Articles	2

Summary of Results: The addition of 150 pounds of 0-0-60 fertilizer on ridge tilled soybeans reduced yield 1.8 bu/acre (95% probability) compared to no fertilizer. Chemical weed control (bean bar with Roundup) was compared to 2 rotary hoeings for weed control. There was a 98% probability that the rotary hoe resulted in a 2.2 bu/acre greater yield.

Table 1

Herbicide	Yield bu/acre
Yes	45.4
No	47.6*

* Significant at the .05 level

Most Significant Finding: Soybeans yielded 2.2 bushels per acre more with mechanical control than with berbicide, resulting in a $4.10 per acre increased profit. The reduced input weed treatment actually cost more than the herbicide treatment, however. Due to lack of weed pressure, the field was not sprayed with Poast and Basagran.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Thurs. June 14	1:00 P.M.
Friday Sept. 14	1:00 P.M.

Directions to the Project: 1 1/4 miles east of Dawson on Hwy 212; 1/2 mile north side of road just beyond the river.

Project Title:	**Demonstration of Land Stewardship Techniques in the Red River Valley**	*Time Span:*	April 89 to January 92
Principal Investigator:	Donald H. Ogaard	*Tel:*	218-784-7183
Address	11 East 5th Avenue Ada, MN 56510	*County:*	Norman
Cooperators:	Kenneth J. Pazdernik - Norman County Agent Dr John F. Moncrief - Extension Soil Scientist	*Enterprise*	sugar beets, soybeans, spring wheat

Project Description: Conventional sugar beet production requires several tillage operations to incorporate herbicides and prepare a suitable seedbed. Fields that are prepared for sugar beets are responsible for much of the erosion by wind in northwestern Minnesota and northeastern North Dakota. A technique is developed to establish standing spring wheat strips that are about 18 inches wide at 20 foot intervals diagonal to the sugar beet planting direction to prevent wind erosion. Rather than have a negative effect on sugar beet production there was a decided yield advantage in 1988 due to increased snow catch and subsequently more soil moisture and much less damage to the sugar beets. There is virtually no erosion with this system. The major effort is to demonstrate three tillage systems in a replicated comparison for sugar beet, pinto beans, spring wheat, and soybean production. The systems will be the conventional approach by the majority of farmers on these soils, a reduced form that eliminates the moldboard plow and also minimizes traffic effects, and a no till approach that eliminates tillage altogether.

Project Objectives:

1. To reduce energy inputs for small grain, pinto beans, sugar beets, and soybean production in the form of direct fuel consumption and indirectly by reducing tillage and the other inputs associated with less tillage.
2. To make farming in northwestern Minnesota more profitable by reducing tillage, energy and ag-chemical inputs.
3. To improve soil stewardship and protect the long term productivity of the soils in northwestern Minnesota.

Publicity Report:

	Number
Visitors	50
Field Days	1
Newspaper Articles	3
Radio Reports	1

Summary of Results: Non-chemical pinto beans yielded as well as those raised conventionally.
In wheat, reducing herbicide applications by 20 to 40 % did not change yields significantly when very high management was used.

On sugarbeets the highest yields were achieved with herbicide and fumigants, but the return per acre was about equal. The minimum-till system with standing stubble between the rows reduced wind erosion.

Table 1. Pinto Beans (Non-Replicated)*

	Cost of Production $/acre	Yield lbs/acre	Net Profit $/acre
Conventional	155	673	-.96
Reduced Chemical[1]	152	860	46
Non-Chemical	158	1000	67

* 12.6 acre plots [1] No preplant Treflan. Poast applied.

Table 2. Spring Wheat (Non-Replicated)*

Postemergence herbicide	Cost of Production $/acre	Yield lbs/acre	Net Profit $/acre
Full rate [1]	146	62	91
Full rate +	153	63	87
80% rate	143	63	98
80% rate +	151	72	126
60% rate	139	59	89
60 % rate +	147	64	97

* 11.25 acre plots + = fungicide applied [1] Full rate = 2 pt Hoelon + .7 pt Buctril

Table 3. Sugarbeets (Non-Replicated)*

	Cost of Production $/acre	Yield lbs/acre	Net Profit $/acre
Poast/Betamix /Labor	258	17.9	444
Poast/Betamix/Labor / Fungicide	269	16.4	338
Poast/Betamix	226	15.0	400
Poast/Betamix / Fungicide	237	16.0	382
Non-chemical/Labor	237	16.7	419
Non-chemical/Labor / Fungicide	248	17.4	413

* 6.5 acre plots

Most Significant Finding: The minimum tillage of sugar beet fields is a major soil conservation break through.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Thurs. July 12	8:00 A.M.

Directions to the Project: 4 miles west of Ada on Hwy. 200, 2 miles south on Co. Rd. (no county road number).

Project Title:	**Alternative Mulch Systems for Intensive Specialty Crop Production**	*Time Span:*	April 89 to October 91
Principal Investigator:	Lindentree Farm/Ron Roller	*Tel:*	218-495-3235
Address	Route 2, Box 133 Underwood, MN 56586	*County:*	Ottertail
Cooperators:	Del Christianson - Spec. Crops Detroit Lakes AVTI Ken Rose - Extension Agent Ottertail County Patrick Moore - Land Stewardship Project	*Enterprise*	everlasting flowers, tomatoes, kale, squash/pumpkin

Project Description: The practices to be demonstrated are alternative mulching practices to replace or supplement conventional systems. In conventional specialty crop production, the major weed control practices used today are either 1) no-mulch, cultivation, and herbicide, or 2) plastic mulch and herbicide. Both of these conventional systems create a number of problems, both for production and for the environment.

The alternative systems will be demonstrated on 4 crops of major importance to specialty crop growers in Minnesota; tomatoes, squash/pumpkin, kale/broccoli, and everlasting flowers. These practices will include the use of rye mulch, live legume intercropping, and straw mulch to replace or complement the conventional practices. Advantages and disadvantages of each system will be demonstrated.

Three mulch systems will be compared to no-mulch (bare ground) using 3 different crops. The systems include plastic/bare ground, plastic/live mulch, and live mulch/straw. The 4 sections of the plot will receive the same treatment over the 3 year demonstration, but the 3 crops will be rotated.

In another plot, two mulch practices will be compared to bare-ground. There will be no rotation on this plot.

Observations/measurements to be taken on this demonstration are:
- soil temperatures/soil moisture levels
- soil sample analysis/organic matter levels
- weed count evaluation
- crop yield - especially percentage of high grade vs low grade products yield
- erosion/soil loss evaluation
- labor costs estimates of each system

Project Objectives:
1. To show effects of decreased herbicide, fungicide, and chemical fertilizer application, decreased irrigation and in-season labor costs.
2. To decrease soil erosion, water loss, and ground water contamination, and increase soil organic matter levels..
3. To show higher net return due to higher quality products, and labor shift from maintenance to harvest and marketing.

Publicity Report:

	Number
Visitors	150
Field Days	2
Newspaper Articles	6
Radio Reports	2

Summary of Results: In this first year, all of the mulches drastically increased production in most crops. Mulches decreased water loss, decreased soil erosion and weed control costs and improved the quality of the crops.

The straw mulch was the most expensive (straw costs doubled due to drought) but it did increase soil tilth and organic matter, as compared to the plastic mulches.

The living mulch showed real potential for ease of maintenance and season long erosion and weed control.

Most Significant Finding: All mulching systems used on this farm net dramatically higher profits than the conventional bare ground system, while also reducing soil erosion.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Sat. , July 21	1:00 P.M.
Sat. , Aug. 25	1:00 P.M.

Location of Project: 18 miles northeast of Fergus Falls, 9 miles north of Underwood on County Road 35.

Demonstration

Project Title:	**Using Sheep and Goats for Brush Control in a Pasture**	*Time Span:*	April 89 to November 91
Principal Investigator:	Alan and Janice Ringer	*Tel:*	218-848-2475
Address	Star Route, Box 19 Brimson, MN 55602	*County:*	St. Louis
Cooperators:	Janet McNally - Pine Technical Instructor Kendall Dykhuis - St. Louis County Ext. Agent Mike Oja - SCS	*Enter-prise*	livestock, pasture

Project Description: This proposed project will demonstrate that sheep and goats can be used as biological controls to suppress woody brush growth so that a sustainable permanent pasture can be established. It is our intent to do this without chemicals as we believe too much dependence has been placed on the use of chemicals. Because our soil is very sandy with a high permeability rate we are concerned about polluting groundwater.

As there is no research or practical experience for this area of the state we will also demonstrate that high producing, paddock grazing areas can be feasible and practical here.

Project Objectives:

1. Suppress woody vegetation in establishment of pasture without use of chemicals or extensive mechanical means.
2. Develop a permanent pasture which does not need reestablishment every 4 to 5 years.
3. Show how high tensile electric fencing can be used to stop predator losses.
4. Demonstrate feasibility of above objectives to area farmers.

Publicity Report:

	Number
Visitors	40
Field Days	1
Newspaper Articles	2
Radio Reports	
TV Reports	

Summary of Results: The pasture area had been logged off and would have been either sprayed with herbicide or chopped off with a brush cutter. The animals came off the pasture this fall in very good shape and the plans are to increase the stocking rate next year.

Most Significant Finding: The total tons of dry matter forage that was available even the first year of the project was impressive.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
August 18	1:00 to 4:00 P.M. Drop in.

Location of Project: 1 1/2 miles s.w. of Hellmans store on Co. Rd. 44.

Project Title:	**Benefits of Weeder Geese and Composted Manures in Commercial Strawberry Production**	*Time Span:*	April 89 to November 91
Principal Investigator:	Joan Weyandt-Fulton	*Tel:*	218-624-3971
Address	3680 Sandberg Road Duluth, MN 55810	*County:*	St. Louis
Cooperators:	Dell Christianson - Detroit Lakes AVTI Frank Skaff - Detroit Lakes AVTI Bob Olin - St. Louis County Extension Agent	*Enterprise*	strawberries, geese

Project Description: This project will demonstrate that geese are an economical and practical alternative to pre-emergent herbicides for keeping a pick-your-own (PYO) strawberry field clean of weeds. It will also demonstrate the benefits of using composted manure blends as the basic foundation for a well balanced fertility program. One method of composting and blending manures will be shown. This demonstration will show actual side by side comparisons between a geese weeded/compost fertilized field and a field farmed in the conventional manner.

Project Objectives:

1. Demonstrate the use of weeder geese to maintain a clean field while decreasing expensive hand weeding and use of herbicides.
2. Reduce potential environmental hazards by reducing pesticide and commercial fertilizer applications.
3. Demonstrate the potential for improving the value of manure through composting.
4. Demonstrate the benefits of composted manures on sandy loam soil: improved fertility (increased cation exchange capacity), improved soil structure, and increased water holding capacity

Publicity Report:

	Number
Visitors	586
Field Days	3
Newspaper Articles	3
Radio Reports	2

Summary of Results: The geese controlled most of the weeds in the plot. Wild buckwheat and woodsorrel were the primary problem weed, but the geese also reduced quackgrass, annual grasses, smartweed, lambsquarter, pigweed, chichweed and dandilion. The geese reduced labor needs by 1/3 when compared to hand weeding and preplant herbicides, saving $159.00 per acre.

Plant analysis done in August showed no difference in the Ammonium Sulfate and compost applications.

Most Significant Finding: The geese did a good job of controlling weeds while damaging the strawberries very little. This practice saved money and provided an additional product to sell on this diversified operation.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Saturday, June 16	10:00 A.M.

Directions to the Project: Highway 2 west out of Proctor to Midway Rd. Go south on Midway Rd. to Morris-Thomas Rd. (#56). Go west on Morris-Thomas Rd. 1.5 miles to Sandberg Road. Go north half mile on Sandberg Rd to farm.

Project Title:	**Intensive Rotational Grazing in Sheep Production**	*Time Span:*	April 89 to December 91
Principal Investigator:	James M. Robertson	*Tel:*	218-631-4618
Address	Route 3, Box 182 Wadena, MN 56482	*County:*	Wadena
Cooperators:	Bill Blaha - Instructor, Wadena AVTI Neal Martin - Forage Extension Specialist	*Enterprise*	sheep, pasture

Project Description: This project will demonstrate how to implement an intensive rotational grazing system on a farm which has used a conventional cool season low-intensity grazing system. The project will show what environmental benefits can be expected, what energy and production cost savings can be realized by a reduced dependence on harvested forages, what production levels can be obtained with lambs in an intensive grazing system utilizing a variety of forage species, and whether the necessary investment in time and capital can be justified by the actual return on investment.

First, we will demonstrate the effectiveness of bringing animals to forages for self harvesting rather than harvesting and carrying the forage to the animal. This will show direct fuel savings, reduction in dependence on purchased fertilizer, and savings in manure handling, storage, and movement to fields.

Second, we will demonstrate that lambs can be raised efficiently utilizing forages as a major part of their diet. By keeping lambs on pasture, the potential impact of concentrated numbers in a "feedlot" environment will be reduced.

Third, by putting more of the farm land into permanent pastures, as opposed to row crops, erosion will be reduced.

Fourth, we will describe what returns on investment in capital and labor costs may be expected by a farmer who is utilizing a non-intensive grazing system with predominantly cool season species (such as bluegrass and quackgrass) if he decides to shift his production to a more intensively managed system.

Project Objectives:

1. To show the level of production efficiency and positive economic growth which can be realized through intensive pasture management.
2. To disseminate the information obtained to sheep producers in central Minnesota, other sheep producers throughout Minnesota, and livestock producers.
3. To reduce dependency on purchased fertilizers and other chemicals by making the sheep/livestock production provide a greater degree of farm fertility needs.
4. To show that efficient pasture management can provide a forage feed source for lambs which can provide a greater percent of the nutritional requirements than is possible by the conventional management technique of sending sheep out to pasture and forgetting them until fall.

Publicity Report:

	Number
Visitors	22
Field Days	1
Newspaper Articles	4

Summary of Results: By using moveable electric fencing and rotational grazing lambs after weaning, $12.20 per lamb was saved on feed cost to market weight. Lambs on pasture for 107 days and fed 1 lb of concentrate a day gained .46 lb/lamb/day. Cost/lb of gain for concentrates was 12.7 cents. Pasture cover was maintained which reduced potential erosion problems.

Most Significant Finding: The intensive pasture management provided forage which would not have been available due to the drought. This system can be profitable even in the first years of pasture improvement because of the modest investment needed and the quality of forage in a rotational system.

Management Tip: Do not use a "pie shaped" cell arrangement with all cells leading toward a central water source. Too much pasture is damaged by sheep traffic to and from the water.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Mon., Sept. 10	1:00 P.M.

Workshops or Meetings for 1990:

Date	Location	Time
7/20 to 7/22/90	Sheep Barn of Wadena County Fair, Wadena, MN	All Day

Location of Project: From Wadena, take U.S. Hwy. 71 north approximately 7 miles to Wadena Co. Rd. 6. Turn west and go 2 miles to stop sign. At stop, turn north and go 1 mile. Turn west and go 0.2 mile. Farm is the first place on the south side of the road.

Project Title:	**Transition Soil Building and Maintenance**	*Time Span:*	January 89 to December 91
Principal Investigator:	Larry H. Olson	*Tel:*	612-564-2571
Address	Route 1, Box 136 Granite Falls, MN 56241	*County:*	Yellow Medicine
Cooperators:	Richard Kuols - Y.M. County Extension Agent Don Hovland - Soil Conservation Service Roger Larson - Chippewa County Agent Audrey Arner - Land Stewardship Project	*Enterprise*	corn, soybeans, small grain, green manures

Project Description: We will use three 25 acre plots divided into five 5 acre sub plots. Two legume systems and two livestock manure systems will be compared to a check for the following: 1) soil fertility, 2) weed development and control, 3) environmental benefits and 4) yield effects and cost effectiveness. As we are presently not using herbicides and are using ridge tillage for row crops and chisel plow for small grains, we will use these methods for crop production. We will use soil testing and observation to track the fertility and environmental effects of each system.

Project Objectives:

1. To show it is possible to maintain yields while cutting input cost by using livestock manure and legume soil building systems.
2. To show that there are environmental benefits which reduce potential pollution and contamination and increase soil structures at the same time.
3. To show that there are several systems which can reduce inputs regardless what your present system is.
4. To show that fertility of the soil and weed control can be done cost effectively with these systems.

Publicity Report:

	Number
Visitors	112
Field Days	2
Newspaper Articles	7
Radio Reports	2
Workshops	2

Summary of Results: There was only 3.9 bushel yield advantage in crops fertilized with commercial fertilizer compared to turkey manure. But financial analyses indicated that there was a $35.40 return per acre advantage to the turkey manure fertility program. The weed pressure under the herbicide and the rotary hoe were both rated slight by the crop consultant.

Under the dry condition this year (10.4 inches for the growing season) the ratio of more than 2 tons per acre of turkey manure did not increase yields.

Most Significant Finding: Even in medium to low soil fertility, low rates of manure can provide profitable returns per acre. Secondly, under this years' weather conditions, mechanical weed control can perform as well as herbicides in row crops without the potential for chemicals remaining in the environment.

Field Tours for 1990 Growing Season:

Date	Time (A.M. or P.M.)
Weds. Sept. 5	1:00 to 5:00 P.M.

Directions to the Project: Go northwest of Granite Falls on Hwy. 212 pass "Lee-Mar" Ranch to a Y in the road and turn left on Co. Rd. 34, go 5 1/2 miles (last mile is gravel) turn right and go 1/3 mile. Farm is on the left side of the road.

Project Title:	**Nitrogen Utilization from Legume Residues in Western Minnesota**	*Time Span:*	April 90 to November 92
Principal Investigator:	Arvid Johnson	*Tel:*	612-677-2450
Address	Route 1 Herman, MN 56248	*County:*	Grant
Cooperators:	Robert Peters - Consultant, Land O Lakes Marvin Jensen - Grant County Extension Agent	*Enterprise*	wheat, corn, soybeans, navy beans, alfalfa

Project Description: Western Minnesota has less rainfall than other parts of Minnesota. The farms in Western Minnesota typically have larger cash grain operations with more acres in small grain production than farms in other parts of the state. The objectives of this project are to examine forage legumes as sources of Nitrogen for subsequent crops in western Minnesota. Specifically we would examine 1) annual alfalfa as a forage and nitrogen source, and 2) wheat followed by underseeded alfalfa and rye/vetch/oats.

1. ANNUAL ALFALFA AS FORAGE AND NITROGEN SOURCE.
"Nitro" alfalfa would be seeded early in the spring with a preplant herbicide. Two cuttings of alfalfa would be harvested through the summer. The alfalfa would be allowed to grow in the fall and would be incorporated into the soil, following a killing frost, either by chisel plowing or mold-board plowing.

Corn will be grown the following year with treatments of 0, 40, 80 lbs. of nitrogen plus forage incorporation vs. conventional corn production following wheat or soybeans to evaluate amount of N recovered from the alfalfa forage and crowns. This project would be done twice over a three year period.

2. LEGUME FORAGES IN A WHEAT-CORN PRODUCTION SYSTEM.
An early maturity HRS spring wheat would be seeded followed by a)an underseeded conventional alfalfa, b) late July planting of rye/hairy vetch/oats, c) mid-August planting of rye/hairy vetch/oats. The forages would be allowed to grow through the fall and early spring. A decision would be made to either incorporate the residues with tillage or to kill the forages with a herbicide and plant with a no-till planter. Corn would be either grown with 0, 40, 80 lbs. N plus forage or with conventional fertilizing systems.

Project Objectives:
1. Investigate various legume management techniques principally as sources of nitrogen for cereal grains and secondarily as forage for livestock.
2. Compare and combine legume treatments with commercial nitrogen applications to evaluate amount of N recovered from legumes.
3. Examine reduced tillage and no-till techniques following legume establishment for corn/wheat production.
4. Reduce weed competition and herbicide use following annual alfalfa.

Field Tours for 1990 Growing Season:

Date	Time
Thurs., Oct. 18	10:00 A.M.

Location of Project: 1 mile north and 1 mile west of Herman.

Demonstration

Project Title:	**Controlled Grazing of Ewes on Improved Pastures, and Lambs on Birdsfoot Trefoil**	*Time Span:*	April 90 to October 92
Principal Investigator:	Leatrice McEvilly	*Tel:*	507-724-2505
Address	P.O. Box 67 Caledonia, MN 55921	*County:*	Houston
Cooperators:	Richard Ness - Land Stewardship Project Russell Krech - County Ext. Director	*Enterprise*	alfalfa, birdsfoot trefoil, sheep

Project Description: This project will demonstrate the feasibility of intensive rotational grazing on extremely fragile hilly ground in southeast Minnesota. Sheep will be put on pasture for 6 to 7 months in an intrinsically managed operation. Part of this project will include improving these pastures with birdsfoot trefoil.

Project Objectives:

1. To facilitate 7 months of forage harvest by a ewe flock.
2. Demonstrate intensive rotational grazing with sheep on very fragile pasture ground.

Field Tours for 1990 Growing Season:

Date	Time
Sat. June 16	1:00 to 3:30 P.M.

Location of Project: 2-1/2 miles northwest of Caledonia on State Highway #76; farm is located on west side of Highway, mid-way between County Trunk 10 and County Trunk 20. Look for the only farm with a long driveway.

Project Title:	**NITRO Alfalfa, Hog Manure, and Urea as Nitrogen Sources in a Small Grain, Corn, Soybean Crop Rotation**	*Time Span:*	March 90 to December 92
Principal Investigator:	Carmen M. Fernholz	*Tel:*	612-598-3010
Address	Route 2, Box 9A Madison, MN 56256	*County:*	Lac Qui Parle
Cooperators:	Jim Tjepkema - Rodale Research Coordinator Audrey Arner - Land Stewardship Project Craig Sheaffer - Professor, U of M	*Enterprise*	grain, hogs

Project Description: NITRO is a nondormant alfalfa developed to supply nitrogen in crop rotations in Upper Midwestern United States. A crop rotation of small grain interseeded with NITRO to supply nitrogen followed by corn in the next year and soybeans in the third year would be compared to the same rotation with NITRO left out and either hog manure or urea used to supply nitrogen. Soil moisture, soil compaction, pest populations, and crop yields would be measured and nitrogen levels in the crops and the soil would be monitored. Economic analysis and public education would be included in the project.

Project Objectives:

1. Compare NITRO alfalfa to hog manure and urea as nitrogen sources in a crop rotation.
2. Analyze the economics of using NITRO alfalfa to supply nitrogen in a crop rotation.
3. Inform and educate farmers and others in agriculture about the uses of NITRO alfalfa.

Field Tours for 1990 Growing Season:

Date	Time
Thursday, Sept. 20	1:00

Location of Project: 2-1/2 miles east of Madison, MN on Highway 40.

Project Title:	**A Comparison Study of Intensive Rotational Grazing vs Dry-Lot Feeding of Sheep**	*Time Span:*	April 90 to December 92
Principal Investigator:	R & K SHEPHERDS	*Tel:*	612-587-6094
Address	Route 3, Box 90 Hutchinson, MN 55350	*County:*	McLeod
Cooperators:	Doug Rathke Connie Karstens	*Enterprise*	pasture, forage, sheep

Project Description: This project will compare the conventional confinement-feeding to the Voisin System of grazing management in terms of time, effort, nutritional value of feed, health and parasite problems, body conditioning of the sheep including leanness of the marked lambs, fleece conditions, and overall cost per animal. In addition a carefully selected mixture of forages will be planted in a 15-acre pasture which will be divided into 10 paddocks for the purpose of grazing 75-100 ewes and lambs from May 1 - December 1.

The system will ration a selected mixture of planted forage according to the needs of the animal, rest the plants according to their needs, and keep forage waste to a minimum. The forages will be: existing grass, reed canary, brome, white clover, birdsfoot trefoil, red clover, and alfalfa. Oats will be used as a cover crop for early grazing.

A control group of animals (10-20 Dorset ewes and lambs) will be maintained under confinement-feeding to determine a comparison of actual feed cost per animal, body conditioning and leanness of lamb carcasses for private sales. Health and parasite problems will be monitored. Other comparisons included will be: nutritional value of feed stuffs, labor and fleece conditions.

Project Objectives:

1. To increase the number of animal units per acre beyond the standard pasture growing season by at least doubling plant productivity.
2. To match the quality and quantity of feed stuffs to meet the nutritional need of sheep during various physiological stages of production while reducing feed costs and ultimately increasing profit per each animal unit.
3. To show both direct and indirect energy savings with reduced hay-making and the use of natural (sheep-made) fertilizer and minimal insecticide.
4. To reduce the long term labor unit hours per animal.
5. To produce a higher quality product (lamb and wool) that are produced largely from renewable resources and in harmony with the natural environment.

Field Tours for 1990 Growing Season:

Date	Time
July 14	1:00 P.M.

Location of Project: Highway 7 west, 1-1/4 miles west past last stop light, take first gravel road going north and go 1/4 mile. First farm on west side of road.

Demonstration

Project Title:	**A Common Harvest Farm Bio-Dynamic Produce**	*Time Span:*	January 90 to November 91
Principal Investigator:	Mark Schultz and Dan Guenthner	*Tel:*	612-864-6220
Address	151 South Lexington Parkway St. Paul, MN 55105	*County:*	McLeod
Cooperators:		*Enterprise*	organic vegetables

Project Description: Vegetables will be raised on 18 acres using the French biointensive method. This system will make use of double-dug raised beds, beneficial plants and insects, mulching, composting to improve soil tilth and fertility, companion planting, rotations and the preservation of plant diversity.

Part of our program will involve "subscription farming" building long-lasting sales relationships with groups of people interested in buying directly from the producer. Farm sales records for the season will show the consistency of these contracts and the volume and related costs involved. The potential for opening new markets is high, and we hope to demonstrate that a personal connection between the farmer and the buyer will offer more stability and a better profit margin for smaller operations. We also hope that this relationship will allow an ongoing dialogue, making the farmer more responsive to the consumers' interests, and the consumer in turn more aware of rural issues and more certain of the quality of their produce.

Project Objectives:

1. To show that small scale production of vegetables using organic methods and reduced dependence upon fossil fuels is economically viable, and ecologically and socially sustainable.
2. To increase farm profitability, and to establish a direct link between buyers and their food source, by introducing "subscription farming" to the area.
3. To add to the understanding of organic and biointensive farm management.
4. To emphasize the socially responsible farm, by creating or inviting gleaner groups to harvest and transport surplus or "seconds" without cost to food shelves, shelter, soup kitchens or other community-service organizations.

Field Tours for 1990 Growing Season:

Date	Time
July 14	10:30 A.M.
Sept. 8 (tentative)	1:00 P.M.

Location of Project: From Minneapolis, take 494W to Highway 5W until you reach 212. Follow 212W, exit at Plato, County 9N. 1.5 miles to County 3W. 2.5 miles to MN 261N. 2.0 miles to County 74W. 0.5 miles to the farm, a light green house off the road to the left.

Demonstration

Project Title:	**Chemical Free Double-Cropping**	*Time Span:*	April 90 to December 92
Principal Investigator:	Jeff Mueller	*Tel:*	612-547-2288
Address	Route 1, Box 85 Swanville, MN 56382	*County:*	Morrison
Cooperators:	David Stish - FBM Instructor Jim Carlson - Morrison County Agent	*Enterprise*	corn, dairy, alfalfa

Project Description: This is a demonstration to help determine the feasibility of double cropping. Demonstration 1 will be a continuous double cropping system of fall triticale/vetch blend seeded in Sept. and harvested in June. This will be followed by a grain sorghum/forage soybean blend seeded in June and harvested in September. All seeding will be in conjunction with no till drill liquid manure application through injection. Demonstration 2 will begin with plowed down alfalfa/clover in September and seeded with fall triticale. The triticale will be harvested in June, followed by sorghum/soybean mix. The second year, corn will be grown for grain (no-till). Oats/peas will be grown in the third year as a companion mixture to clover/alfalfa, which will be plowed down in the fourth year. In the fourth year, we will include hay production with fall-seeded triticale to begin the rotation again.

Project Objectives:

1. Reduce row crop acreage - reduce trips over field/crop, begin no-till planting practice.
2. Reduce (eliminate) herbicides through increased rotation and solid seeding.
3. Reduce purchased nitrogen (improve efficiency of manure applications).
4. Reduce protein purchases by improving protein quantity in forages.
5. Reduce soil erosion and improve water quality.

Field Tours for 1990 Growing Season:

Date	Time
Friday, Sept . 14	1:00 P.M.

Location of Project: 12 miles west of Little Falls on Highway 27 and intersection of Morrison Ct. #28 southwest Corner.

Project Title:	**Cooperative Manure Composting Demonstration and Experiment**	*Time Span:*	June 90 to November 93
Principal Investigator:	Rich Van der Ziel	*Tel:*	507-879-3541
Address	Route 1, Box 133 Chandler, MN 56122	*County:*	Murray
Cooperators:	Robert Koeler, Murray County Agent People For A Responsible Agriculture Members	*Enterprise*	livestock, crops

Project Description: Four demonstration-research plots will be set up on four farms to determine the value of on-farm composting of animal manures. Treatments will include compost, commercial fertilizer and raw manure. Information obtained from these farms will be used to compare soil fertility, soil tilth, weed levels, soil microbial changes, yields, profitability and nitrate movement.

Project Objectives:
1. Determine the feasibility of on-farm composting of animal manures.
2. Determine the effect of compost on soil fertility, structure, water holding capacity & weed levels.
3. Determine the usefulness of compost as a management practice for handling raw manure.
4. Determine the effect of integrating composting operations onto a working farming system.

Field Tours for 1990 Growing Season:

Date	Time
Tuesday, Aug. 7	1:00 P.M.

Location of Project: 2-1/2 miles northwest of Chandler, located on the north side of County Highway #5.

Demonstration

Project Title:	**Improving Permanent Pastures for Beef Production in Southwest Minnesota**	*Time Span:*	February 90 to December 92
Principal Investigator:	David Larson Southwestern Technical College Pipestone Campus	*Tel:*	507-825-5471
Address	Box 250 Pipestone, MN 56164	*County:*	Pipestone
Cooperators:	Glenn Eikmeier Dr. Ed Twidwell, South Dakota State University	*Enterprise*	beef feeders, beef cow/calf, native prairie pasture

Project Description: This project will focus 3 different pasture systems utilizing 2 beef cow/calf herds and 1 beef feeder farm. The cow/calf farms will be used to compare rotational and continuous grazing methods. The beef feeder farm will be used to compare cell and continuous grazing methods. Each farm will have a comparison of forage production and quality. In this project, we will not only look at grazing systems, but at environmental and livestock management issues related to different grazing systems.

Project Objectives:

1. Increase beef production per acre without decreasing the pasture.
2. Better manage the native grasses to improve animal productivity and forage production.
3. Decrease production costs per pound of gain.
4. Maintain livestock management techniques such as herd health and artificial insemination.
5. Reduction in the use of herbicides and fertilizer.

Field Tours for 1990 Growing Season:

Date	Time
Saturday, Sept. 8	9:00 A.M.- 12:00 noon

Location of Project: Meet at the Southwest Technical College which is 1 mile north of Pipestone on Hiawatha St.

Project Title:	**Economically and Environmentally Sound Management of Livestock Waste**	*Time Span:*	February 90 to February 92
Principal Investigator: *Address*	Fred G. Bergsrud University of Minnesota Extension Service 209 Ag Eng., 1390 Eckles Avenue St. Paul, MN 55108	*Tel:* *County:*	612-625-4756 Ramsey
Cooperators:	Mike Schmitt - Extension Soil Scientist, Fertility Tim Wagar - Extension Agent, crops and soils Chuck Clanton - Asst. Professor, Ag Engineering	*Enterprise*	corn, dairy, hogs

Project Description: Livestock wastes vary substantially in their nutrient content. Some of the factors that affect nutrient content are: animal species, type of manure handling system, livestock housing and bedding system, diet, temperature, moisture, soil and miscellaneous contamination. Tables of average nutrient concentration exist but the use of these tables for soil fertilization assumes "average" manure which is not accurate enough to get optimum benefit. In addition the application amount may not be accurately known and the manure not applied uniformly either within a field or between fields. The combination of these factors results in a very poor utilization of the resources and an increased potential for ground and/or surface water pollution. The project will demonstrate to producers how to make accurate estimates of the nutrients available; how to determine accurately the amount and uniformity of application; and how to minimize pollution potential while maximizing the use of these on-farm produced nutrients and resultant profitability.

Project Objectives:

1. Demonstrate the need to have waste samples analyzed to obtain proper nutrient credit.
2. Develop and demonstrate the proper technique for obtaining a waste sample to get accurate results.
3. Demonstrate the proper calculation of nutrients from the wastes based on the analysis and time and method of application.
4. Demonstrate proper techniques for calibrating liquid and solid manure spreaders and how to monitor application uniformity.
5. Develop educational materials to extend the demonstration results to other project cooperators and other producers.

Field Tours for 1990 Growing Season: Manure workshops and testing clinics will be held throughout the summer. To receive manure testing clinic information, please **contact Tim Wagar,** Area Extension Agent, Crops and Soils at 507-285-8153 or 507-296-1306.

Location of Project: Various farms throughout the southeast part of Minnesota.

Project Title:	**Research and Demonstration of Rotational Grazing Techniques for Dairy Farmers in Central, Minn.**	*Time Span:*	January 90 to December 92
Principal Investigator:	Francis Januschka	*Tel:*	612-255-6169
Address	Stearns County Extension Office 2700 First St. North #205 St. Cloud, MN 56301	*County:*	Stearns Benton Wright Sherburn
Cooperators:	Ken McNamara- Univ. of Minn., Sustainable Ag. Prog. Dr Craig Scheaffer - Forage Researcher Dr James Linn - Dairy Scientist	*Enterprise*	dairy, pasture, forages

Project Description: This project will demonstrate and provide research data on rotational grazing (RG) systems for the "dairy belt" area of Central Minnesota. A network of dairy farmers in Stearns, Benton, Wright, and Sherburn counties will adopt RG techniques for their cattle. The overall goals are to examine the environmental and economic impacts of RG by farmers in this area and demonstrate effective means of applying RG practices. Researchers from the Dairy Science and Agronomy Departments will be involved with data collection while county agents will cooperate in the outreach efforts.

Five Central Minnesota farmers will demonstrate a transition from a year-round stored feeding system to one using intensive rotational grazing (RG). RG is a system whereby livestock graze a small area of pasture (paddock) until all the forage is removed. They are then rotated into a new paddock. The animals are rotated in such a way that the forages have enough time to fully recover. Research has found that one can greatly improve both animal and pasture productivity with the system as compared to conventional pasture systems. This project will demonstrate: 1.) How the pastures will be divided up into paddocks. 2.) The latest fencing technology which can make RG a viable option for today's farmer. An important part of the project will be to demonstrate to farmers how these materials make it possible to : a) put up or move temporary fencing in a short time. b) charge the fence for the whole farm using low impedance energizers, and , c) various other aspects of high tech fences which make building, moving and maintaining them less labor intensive, 3.) A low cost method of pasture renovation. We will demonstrate how one can increase the legume content of permanent pasture by over seeding different species at early spring when the ground is still frozen (frost seeding). We will also do some overseeding in the fall using different legumes or legume/grass mixtures. Use of a zip seeder in RG systems will also be demonstrated.

Project Objectives:

1. To show energy savings of using RG techniques by comparing fuel and electricity bills of past three years with those of next three years.
2. To show a system of forage production with reduced amounts of herbicides, commercial fertilizers, and little or no erosion.
3. To demonstrate the profitability of RG by considering energy bills, fencing costs, labor inputs, changes in machinery maintenance and replacement, forage and milk yields, etc.
4. To conduct an effective outreach program with information on RG for dairy farmers in Central Minnesota.
5. To maintain accurate records which give a meaningful picture of what it means for farmers to go through the transition of conventional feeding to RG.

Field Tours for 1990 Growing Season:

Date	Time
Thursday, Sept. 6	12:30 P.M.

Location of Project: Joe Molitor's Farm. 2 1/2 miles west of Rockville on County Road 47.

Project Title:	**Using Nitro Alfalfa in a No-Till Corn and Soybean Rotation**	*Time Span:*	Spring 90 to Fall 94
Principal Investigator:	Jeff Johnson	*Tel:*	507-451-1409
Address	Route 2, Box 148 Owatonna, MN 55060	*County:*	Steele
Cooperators:	Tim Arlt - County Extension Agent	*Enterprise*	corn, soybeans, alfalfa

Project Description: This demonstration is designed to investigate the use of non-dormant alfalfa as a source of nitrogen in a no-till corn/soybean rotation. The treatments (rotations) will include a standard corn/soybean rotation, an oats/alfalfa/corn/soybean rotation and an alfalfa/corn/soybean rotation. Each treatment will be replicated four times in a randomized complete block design. All plots will be 60 ft. x 425 ft. to accommodate planting equipment. The corn will be planted with an IH Early Rise Planter, soybeans and oats will be seeded with a JD no-till drill, all cultivation will be done with a JD no-till cultivator. Herbicides will be applied in pre-emergence and post-emergence applications, appropriate for the particular crop each year. All crops will be harvested, weights and yields recorded, and economics of production calculated. At the end of the three years, we will be able to calculate economics for the rotations.

Project Objectives:

1. To reduce spring and fall labor demands in a corn/soybean rotation.
2. To diversify the cropping sequence for a cash grain farm.
3. To reduce use of chemical nitrogen in a corn/soybean rotation.
4. To evaluate the use and profitability of using a non-dormant alfalfa, to supply the nitrogen needs in a corn/soybean rotation.
5. To evaluate this rotation as a viable way to meet the Conservation Compliance provisions of the 1985 Farm Bill.

Field Tours for 1990 Growing Season:

Date	Time
Tuesday, July 24	1:00 P.M.

Location of Project: From Owatonna, take 35W south to Hope exit. Go west on County Road 14. (Between 35W and Hope on north side of road.)

Project Title:	**Intensive Rotational Grazing**	*Time Span:*	April 90 to October 92
Principal Investigator: *Address*	Chad Hasbargen Route 2, Box 101 Wheaton, MN 56296	*Tel:* *County:*	612-563-8066 Traverse
Cooperators:	Randy Anderson - Stevens County Agent Lee Johnston - Animal Scientist, West Central Exp. Station, U of M Ken Nichols - Traverse County Agent	*Enterprise*	sheep, beef

Project Description: The four main areas of the project (Livestock, Forage, Fence Design, and Rotation) and the practices or techniques that will be used in each:

Livestock: The grazing season will begin May 15 and end October 15. Cows, calves and ewes will be weighed and individually recorded for both the intensive and conventional systems on May 15 and October 15. In addition, the cows will be condition scored by 3 people both on May 15 and October 15. From this data average daily gain, gain per acre and stocking rates will be calculated.

Forage: Forage samples will be taken weekly from a representative area before and after grazing to determine amount of forage produced, consumed and remaining. Random samples will be taken with a 1/4 meter quadrant. The forage will be dried and weighed to determine tons per acre.

Fence: The pasture will have a five-wire, high tensile electric fence around the perimeter, alley and lounge area (working yards and H_2O). Two three-strand polywire reels will be used to construct the daily paddocks.

Rotation: The cows with calves and dry ewes would be split into two groups according to their different nutritional requirements. Cows with calves have a higher nutritional requirement and would therefore be allowed to graze each paddock first. Cows and calves would graze from noon till 6 a.m. the following morning. At that time, the cows and calves would be locked in their lounge area and the ewes would be turned out to graze the remaining forage from 6 a.m. till noon. At noon the fence would be moved, the ewes locked in their lounge area, and the cows turned into a fresh paddock.

Project Objectives:

1. Energy Savings: Eliminate daily feeding of ewes in drylot for 5 months a year and therefore reduce production and harvesting of feedstuffs. Reduce machinery, fertilizer and chemical costs due to less required feedstuffs.

2. Environment: Reduce adverse effect on environment by reducing chemical use and the risk of residue leaching resulting in ground water pollution. Reduce dust, odor and waste pollution by eliminating drylotting of ewes in the summer, thus improve flock health. Reduce erosion due to decreased tillage.

3. Profitability: Improve profitability by increasing animal units per acre compared to conventional grazing and decreasing inputs compared to drylot.

Field Tours for 1990 Growing Season:

Date	Time
Thursday, July 26	2:00 P.M.

Location of Project: 5 miles north of Wheaton on Highway #75, turn right at Monson Town Hall, 1/2 mile on left hand side of road.

Project Title:	**Fine-Tuning Low-Input Weed Control**	*Time Span:*	March 90 to December 92
Principal Investigator:	David Baird	*Tel:*	612-433-5198
Address	Wilder Forest 14189 Ostlund Trail North Marine, MN 55047	*County:*	Washington
Cooperators:	Craig Cramer - Farm Education Specialist Land Stewardship Project Staff	*Enterprise*	corn, soybeans, oats, hay, cattle, sheep

Project Description: The trials will compare the effectiveness two different methods of weed control without herbicides in ridge-till and conventional tillage systems. One treatment will rely on a combination of rotary hoeing and cultivation with a ridge-till cultivator. The second treatment is directed to improve weed control, especially in the crop row, by supplementing rotary hoe and ridge-till cultivator passes with Bezzerides-style cultivation equipment. Two additional trials comparing single and double pre-emergence rotary hoeing will also be conducted.

Project Objectives:
1. To fine-tune weed control without herbicides in ridge-tilled soybeans and ridge-tilled and conventionally tilled corn using only rotary hoeing and cultivation with a ridge-till cultivator.
2. To improve the effectiveness of weed control especially within the crop row by using Bezzerides-style cultivation equipment and double pre-emergence rotary hoeing.
3. To demonstrate mechanical and cultural weed control practices that are as effective as herbicides, but lower in costs and with no potential for the adverse environmental and health effects associated with herbicides. While added cultivations use more energy than herbicides, overall the ridge-till system consumes less energy than conventional tillage and weed control.

Field Tours for 1990 Growing Season:

Date	Time
Thursday, Aug. 23	1:00 P.M.

Location of Project: Take Route 36 east from St. Paul to County Route 15. Take 15 north to County Route 7. Take 7 east to T intersection just beyond Square Lake County Park. Turn left at T and continue on 7 one mile to Ostlund Trail. Turn left (west) on Ostlund Trail, and go one mile to Wilder Forest entrance (on right).

Demonstration

Project Title:	**Early Tall Oat and Soybean Double Crop**	*Time Span:*	March 90 to October 92
Principal Investigator:	Charles D. Weber	*Tel:*	612-485-2566
Address	Route 2, Box 175 Howard Lake, MN 55349	*County:*	Wright
Cooperators:		*Enterprise*	oat, soybeans

Project Description: This project will demonstrate the feasibility of interplanting soybeans with oats. Double cropping should reduce soil erosion and herbicide use.

1) Oats to be planted with drill interseeded with soybeans in 30" rows.
2) Oats will be planted first and soybeans planted 10 and 20 days later.

Project Objectives:

1. Evaluate oats for control of weeds in later emerging beans.
2. Evaluate soybeans for complementary effect on oats via nitrogen production.
3. Evaluate the overall effectiveness of a double crop system.
4. Evaluate the effect of oats on soil erosion and loss of top soil.

Field Tours for 1990 Growing Season:

Date	Time
Friday, June 8	1:00 P.M.

Location of Project: From Highway 12 to Howard Lake, take #6 south 4-1/2 miles. Turn right (west) 1 mile to four way stop, turn left (south) 1/2 mile to plot.

1990 Sustainable Agriculture Grant Program

Technical Review Panel
Review Team 1

Mr. Bob Olson
Bob is one of two agricultural agents with the Dakota County Extension Service. He has been with the Minnesota Extension Service for 10 years.
B.S. in Agricultural Education M.S. in Agricultural Economics

Mr. Mark Ackland
Mark farms 260 acres in Freeborn County outside of Albert Lea. He began reducing inputs in his farming operation in 1985. He raises 100 sheep, and finishes 700 hogs annually.
B.S. Biology

Mr. Doug Gunnink
Doug is the On-Farm Research Coordinator for the Sustainable Agriculture Program at the Minnesota Department of Agriculture. Doug also farms 200 acres organically in Sibley County, just north of Gaylord. Formerly, Doug had been employed by the Minnesota Extension Service Adult Farm Management Program, Albany Schools, and Rural Ventures/ Control Data.
B.S. in Agricultural Education

Dr. Richard Goodrich
Dick is the Department Head of Animal Science at the University of Minnesota.
B.S. M.S. Ph.D in Animal Science

Mr. Steven Schwen
Steven is an small scale diversified organic farmer from the Lake City area. Steve and his family are founding members of the Full Circle Organic Foods Cooperative marketing association which sell organic produce to Twin Cities markets. They also operate a small cooperative store in in the town of Oak Center.
B.S. in Chemistry

Mr. Richard Ness
Richard is the agronomist for the Land Stewardship Project in Lewiston. Previously, he worked as an Extension Agent for Iowa State University, and for the Center for Rural Affairs in Nebraska. Richard's specialty is intensive rotational grazing and holistic farm managment.
B.S. in Animal Science M.S. in Animal Science

Dr. David Andow
David is an entomologist with the University of Minnesota. David has performed extensive research in sustainable agriculture systems including: intercropping, insect interaction in alternative systems, and biological control.
B.S. M.S. Ph.D in Entomology

1989/90 Sustainable Agriculture Grant Program

Technical Review Panel
Review Team 2

Mr. Craig Murphy
Craig farms 370 acres near Morris raising wheat, corn, soybeans, sunflowers, and buckwheat. Craig is a core grower for Farm Verified Organic, Inc., and a charter member of the Northern Plains Sustainable Agriculture Society.
B.S. in Animal Science

Dr. Steven Simmons
Steve is a full time instructor in Agronomy at the University of Minnesota. He was recently awarded the Outstanding Teacher of the Year award for his work. His research concentrates mainly on small grains
B.S. M.S. Ph.D in Agronomy

Mr. Craig Cramer
Craig is a consultant and contributing editor to the New Farm magazine. Craig travels around the midwest researching and writing articles on sustainable agriculture.
B.S. in Botany

Dr. Richard Cates
Dick is the On-Farm Research Coordinator for the Wisconsin Sustainable Agriculture Program at the Wisconsin Department of Agriculture and a part-time beef farmer.
B.S. M.S. Ph.D in Soil Science

Mr. Ken McNamara
Ken is the Coordinator of the Sustainable Agriculture Program at the University of Minnesota. Formerly the On-Farm Research Coordinator for the Rodale Institute in 7 states, Ken has extensive experience with on-farm trials.
B.S. in Agronomy M.S. in Agronomy

Mr. Wayne Monsen
Wayne ridge tills corn and soybeans, and raises sheep on his farm outside of St. James. He has been working on reducing his inputs and conservation tillage for 7 years.
B.A. in Biology

Mr. David Ball
David has several years of experience in agricultural lending. He is currently the Loan Officer for the Sustainable Agriculture Program at the Minnesota Department of Agriculture.
B.S. Agriculture Business

Mr. Richard Gauger
Rick has directed the Sustainable Agriculture Program at the Minnesota Department of Agriculture since its inception. He has had experience in private crop consulting, and the Minnesota Extension Service.
B.S. in Agronomy/ Soil Science M.S. in Soil Science

On-Farm Research in Weed Management

ON-FARM RESEARCH IN WEED MANAGEMENT

by Richard E. Gauger, Charlene Chan-Muehlbauer, and Douglas Gunnink

INTRODUCTION

One of the barriers to adopting sustainable farming techniques is the ability of the farmer to obtain sound management information. Farmers cite weed control or management as one of their first concerns when considering sustainable systems.

Effective weed management in non-chemical or reduced chemical systems requires manipulation of the following factors: planting date, crop rotation, crop selection/type, preplant tillage, pre-emergence tillage, cultivation, and appropriate herbicides.

Objectives:

1. To examine the effectiveness of pre-emergence and post-emergence mechanical weed management on working farms.

2. To compare the economic and agronomic effectiveness of managing weeds under mechanical and chemical systems.

MATERIALS AND METHODS

This study was conducted in Minnesota over the 1988 and 1989 growing seasons.

Experimental Design: randomized, replicated side-by-side design (RRSS)
Crops: Corn and Soybeans. Each crop was planted on 3 different fields.
Treatments: (2) mechanical (rotary hoe) and chemical (herbicide)
Replication: 4 to 7 replicated treatments on each field
Plot size: Ranged from 0.48 acres to 2.34 acres per treatment.

The data were statistically analyzed using the paired T-test. An economic analysis was used to account for the direct and indirect costs. Economic estimates for machinery costs were obtained from the University of Minnesota.

Data obtained from each individual plot:

Weed counts: broadleaf and grass weeds per square foot; 4 locations per plot
Stand counts: 0.001 acre; 4 locations per plot
Soil analysis: Composite of 10 cores per plot
Yield: Combine yields - length of plot - 4-6 row width

Weed and stand counts were taken following application of all treatments. Yields were measured using an electronically calibrated weigh wagon.

The farmer plays a critical role in on-farm research. In this study, the farmer was responsible for the management and application of the treatments, using appropriate herbicides to control weeds, and operating the rotary hoe when necessary. Depending on the severity of the weeds, the number of rotary hoe passes made ranged from three to five.

RESULTS AND DISCUSSION

SOYBEANS

Weeds

Weed control under the two systems indicated that the grasses were more numerous than the broadleaves, and that the systems statistically differed only in the level of broadleaf weed control (Table 1). The mechanical systems had better broadleaf control.

Table 1. Weed Management Experiment Results in Soybean 1989

	Mechanical Treatment	Chemical Treatment
Yield (Bu/A)	42.14	42.26
Stand Counts[a]	124.50	137.43****
Broadleaf Weeds[b]	0.52	1.43*
Grass Weeds[b]	4.88	6.13

*, ****Significant at 0.05 and 0.0001 levels, respectively

[a]Plant number/0.001 Acre; [b]Plant number/ft^2

Stand

Stand loss in the mechanical system ranged from 8 to 17 % (Table 1).

Yield

There was less than one bushel difference in yield between the two treatments for both 1988-1989 growing seasons (Table 2).

Table 2. Soybean Yield 1988-89

Year	Cooperator	Mechanical Treatment	Chemical Treatment
		---(Bu/Acre)---	
1988	Jutz	34.05	33.51
	Grisham	34.46	38.01**
1989	Jutz	49.06	47.16**
	Grisham	45.46[a]	47.46
	Monsen	33.00	33.90
1988-89	Overall	38.78	39.64

[a]Problem with combine plugging at harvest of one of the replicates

**denotes significance between the means at 0.01 level

Profitability

Total direct and indirect expenses were $13/acre less under the mechanical system compared to the chemical system which translated into a $7/acre greater return (Tables 3 and 4).

Table 3. Economic Analysis of Soybean Trials 1988-89

	Mechanical Treatment	Chemical Treatment
Yield (bu/acre)	39.21	40.01
Total Costs Per Acre[a]	$145.03	$157.77
Return Per Acre[b]	$98.01	$90.88

[a]Includes direct and indirect costs

[b]Calculated as a return to capital, labor, and management

A closer look reveals that 2 out of the 3 farms had slightly higher returns with the chemical system (Table 4).

Table 4. Estimated Returns for Soybean 1988-89

Cooperator	Mechanical Treatment	Chemical Treatment
	----Return Per Acre*----	
Grisham	$97.02	$97.92
Jutz	$126.72	$104.28
Monsen**	$42.57	$50.01

*Return Per Acre is calculated as a return to capital, labor, and management

**Data available for 1989 only

Weeds

Weed levels were 3.52 per square foot in the mechanical system as compared to 1.59 per square foot in the chemical system (Table 5).

Table 5. Weed Management Experiment Results in Corn 1989

	Mechanical Treatment	Chemical Treatment
Yield (Bu/A)	140.10	145.86**
Stand Count[a]	22.13	24.99****
Broadleaf Weeds[b]	0.75	0.41*
Grass Weeds[b]	2.77	1.18*

*, **, ****Significant at 0.05, 0.01, and 0.0001 levels, respectively

[a]Plant number/0.001 Acre; [b]Plant number/ft^2

Stand

The mechanical treatment reduced the corn plant population by 12 % (Table 5).

Yield

Overall, yields were reduced by 6 bushels/acre in the mechanical system (Table 6). Two out of 3 farms exhibited no significant reductions in yield from using the mechanical system. The Jutz farm had an 11 bushel/acre yield reduction in the mechanical treatment.

Table 6. Corn Yields 1989

Cooperator	Mechanical Treatment	Chemical Treatment
	-----(Bu/Acre)------	
Jutz	136.43	148.27**
Grisham	145.50	148.99
Mosel	137.77	140.73
Overall	140.10	145.86**

** denotes significance between means at 0.01 level

Profitability

Total direct and indirect expenses were $13/acre less under the mechanical system, but the chemical system had a $7/acre greater return (Table 7).

Table 7. Economic Analysis of Corn Trials 1989

	Mechanical Treatment	Chemical Treatment
Yield (bu/acre)	139.91	145.99
Total Costs Per Acre[a]	$198.76	$205.91
Return Per Acre[b]	$123.04	$129.86

[a]Includes direct and indirect costs

[b]Calculated as a return to capital, labor, and management

Further economic analysis indicated that for two out of the three farms, the difference in return was less than $1/acre between mechanical and chemical systems.

Table 8. Estimated Returns for Corn 1989

Cooperator	Mechanical Treatment	Chemical Treatment
	----Return Per Acre*----	
Grisham	$118.42	$119.11
Jutz	$147.63	$166.62
Mosel	$124.45	$125.23

*Return Per Acre is calculated as a return to capital, labor, and management

EXPERIMENTAL CONFIDENCE

The Coefficient of Variation (C.V.) indicates the degree of precision with which treatments are compared and is used by researchers to evaluate results from different experiments involving the same character. The C.V.'s for these trials ranged from:
50 to 200 % for weed counts
6 to 11 % for stand counts
3 to 11 % for yields

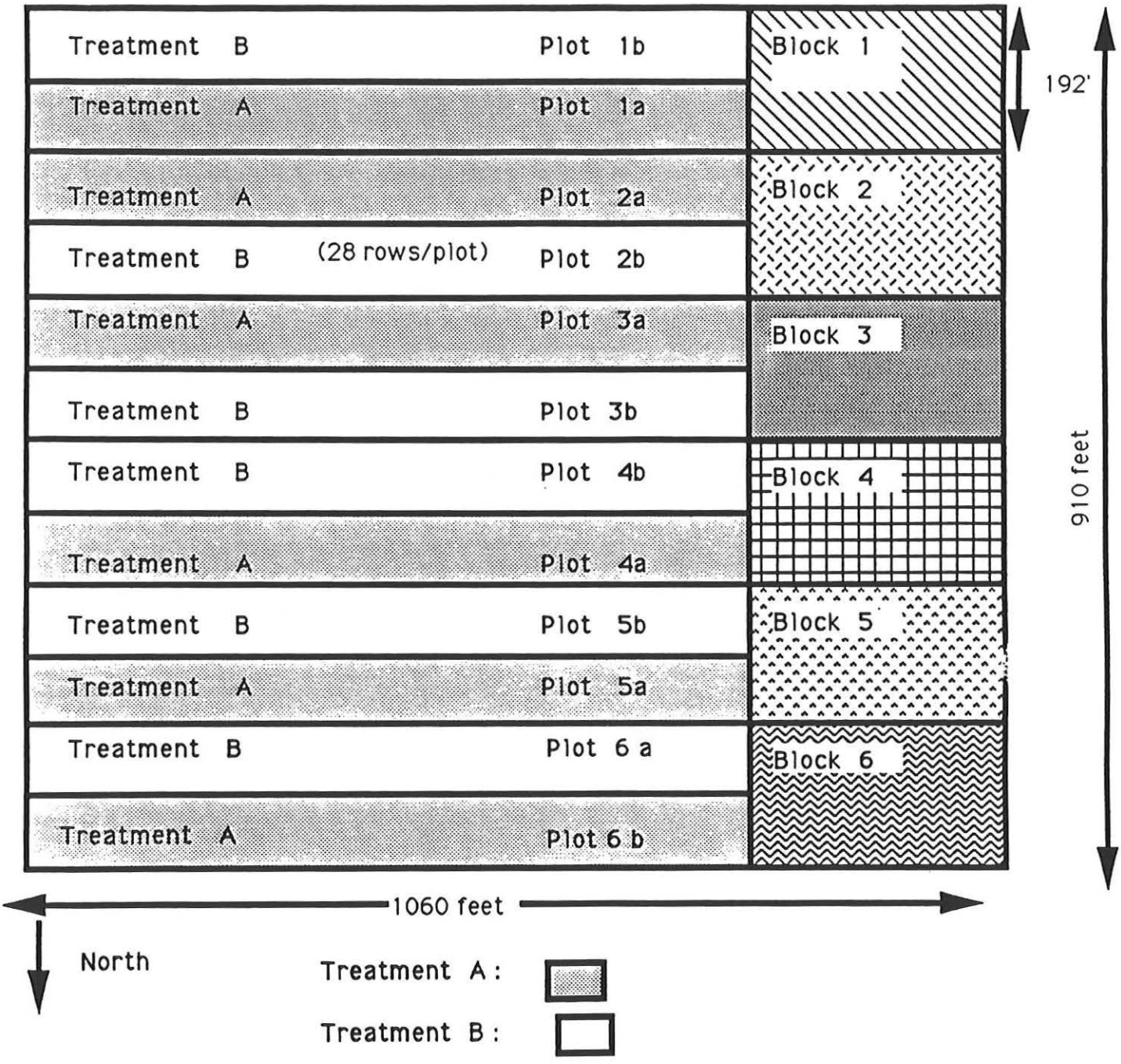
SUMMARY

The results from the first two years of this three-year study suggest that [in drier years] mechanical weed management using a rotary hoe in corn and soybeans can be a viable alternative to herbicides. Weed control in the mechanical system was comparable to conventional weed control.

Stand losses did occur in both the corn and soybeans due to the mechanical treatment. These losses affected yields only in the corn plots due to lack of compensation for the plant losses.

Coefficients of variation indicate that the experimental design is satisfactory for obtaining statistical confidence.

Example of
On-Farm Research Plot Design



Sustainable Agriculture Loan Program

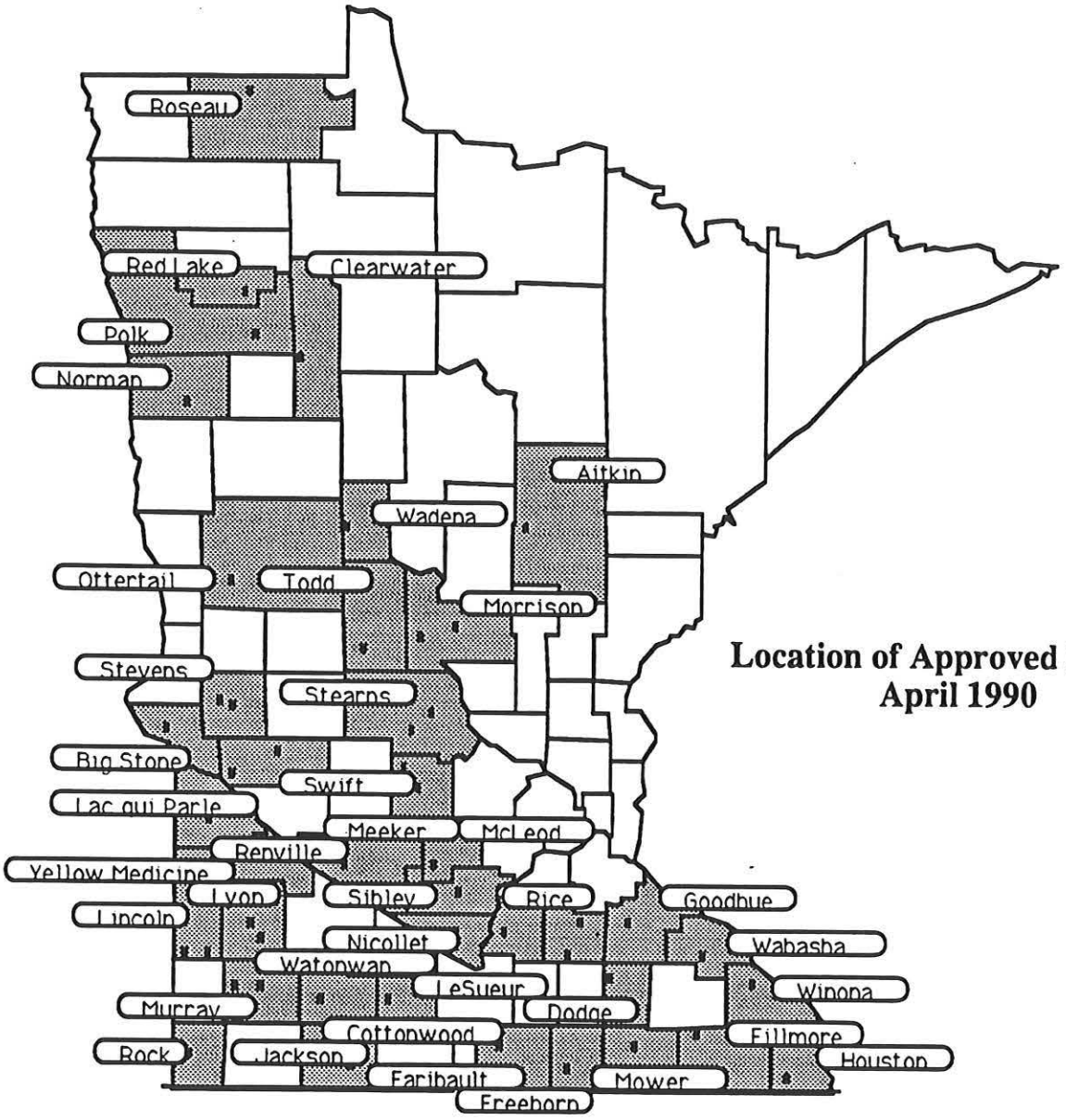
Project Directory

The Minnesota Legislature appropriated funds ($1 million) for the Sustainable Agriculture Loan Program. The purpose of this loan program is to facilitate the adoption of alternative management practices that will enhance farm profitability and benefit the rural environment. The appropriation has been set up as a "revolving fund." As the outstanding loans repay principal to the State these accumulated funds will revolve back out to farmers in the form of new loans. In this way many farmers will benefit from this program for years to come.

The loans are used to purchase new or used machinery, installation of equipment and other various projects. Projects may include equipment for alternative fertilizer management, alternative manure management, alternative weed management, alternative pasture/forage management, alternative tillage management and alternative energy devices. The loans under this program are made only to residents of the State of Minnesota who are actively engaged in farming.

The Sustainable Agriculture loans are made on the merits of the proposed project not on the farmers' financial status. The maximum loan per farm family is $15,000. Borrowers are charged a fixed interest rate of 6% for a term of 5 to 7 years.

The first group of loans were awarded in June of 1989. To date, there have been 53 loans granted for a total of $546,478. The map on the next page indicates the location of the loan recipients throughout the state. The summaries which follow are partial listings of the current loans.



Location of Approved Loans
April 1990

Sustainable Agriculture Program of Minnesota
Minnesota Department of Agriculture

The following is a partial listing of loans approved with brief descriptions.

Listed alphabetical by county.

County: Big Stone
Items purchased: Banding and side-dressing equipment installed on existing planter and cultivator.
Project cost: $3,500
Loan amount: $3,500
Project description: Borrower converted both his planter and cultivator to allow banding of fertilizer. He can now tailor his fertilizer use according to weather. He hopes to achieve maximum profit per acre and reduce chances of over-application. By utilizing his farm shop and used equipment he was able to accomplish the conversion for approximately half the cost of new equipment.

County: Dodge
Items purchased: Hiniker ridge till cultivator with nitrogen side-dress attachment.
Project cost: $9,120
Loan amount: $9,120
Project description: Borrower was looking for an alternative to broadcasting chemicals. He chose to start banding which would allow him to cut the amount of chemical applied in half. To accomplish adequate weed control with this new system a cultivator was needed. The cultivator was also adapted to side-dress anhydrous ammonia. Previously anhydrous had been applied in the fall.

County: Fillmore
Items purchased: Minimum till planter with banding equipment, saddle tanks for tractor, cultivator.
Project cost: $13,700
Loan amount: $13,700
Project description: Borrower is updating from his current planter to a planter with minimum to no till capabilities and banding equipment. The spray tanks will be mounted on the tractor. A cultivator will be necessary to control weeds between the rows.

County: Goodhue
Items purchased: Spray equipment for banding herbicide, conservation style cultivator.
Project cost: $9,500
Loan amount: $9,500
Project description: Unsatisfactory herbicide performance and concern for the environment have been the major factors influencing this borrowers decision to farm lower input. Both the planter and the cultivator will be adapted to band herbicide. The conservation cultivator will be used to control weeds as well as side-dress nitrogen when necessary.

County: Houston
Items purchased: Kewanee conservation cultivator.
Project cost: $4,900
Loan amount: $4,900
Project description: Borrower has been reducing herbicide and insecticide rates, and experimenting with alternative crop rotations since 1986. Higher residue field conditions and a greater dependence on mechanical weed control made the purchase of an aggressive conservation cultivator a requirement.

County: Jackson
Items purchased: High residue field cultivator, chisel plow, rotary hoe.
Project cost: $23,000
Loan amount: $11,500
Project description: Chisel plowing corn stalks in the fall will leave adequate crop residue on the field to reduce the rapid loss of soil due to wind erosion. The high residue field cultivator is needed to prepare the field in the spring. Borrower is also attempting to reduce herbicide rates by mechanically controlling the weeds with the rotary hoe.

County: LeSueur
Items purchased: Manure containment and storage facility for farrow to finish hog operation.
Project cost: $7,500
Loan amount: $7,500
Project description: Borrowers plan to expand their operation by constructing a new building and a manure containment and storage facility. They wish to improve their waste handling methods and reduce the need to purchase commercial fertilizer. Through testing and proper management waste products will be utilized in a manner more beneficial to the farm operation and the environment.

County: Lyon
Items purchased: Ridge till attachment for planter, banding sprayer, rotary hoe.
Project cost: $22,157
Loan amount: $15,000
Project description: Borrowers are changing their corn and soybean farm over to ridge till. They hope to reduce both water and wind erosion as well as cutting their fertilizer cost. Chemical costs will be cut in half by banding and the timely use of the rotary hoe in the spring.

County: Lyon
Items purchased: Hiniker ridge till cultivator with navigator guidance system.
Project cost: $17,350
Loan amount: $15,000
Project description: Borrower farms with the above operator. The cultivator will provide the weed control needed. They project substantial savings to come from reduced use of herbicides, fertilizer and fuel. With less equipment needed replacement purchases will decrease as well as machinery repair costs.

County: Meeker
Items purchased: Fencing for rotational grazing, 2 way plow, truck.
Project cost: $14,284
Loan amount: $14,284
Project description: Fencing will allow access to 56 acres of permanent pasture and 200 acres of tillable land. A total of 3.8 miles of permanent fence and 1.5 mile temporary fence will be installed. The two way plow will be used on contour strips to plow uphill and eliminate dead furrows. The used truck with hoist will be used to haul and stockpile poultry manure to be used as fertilizer.

County: Meeker
Items purchased: Ridge pre-plant conditioner, ridge cultivator.
Project cost: $18,825
Loan amount: $15,000
Project description: Borrower experimented for a year then chose to convert to ridge till for corn and soybeans. He was interested in lowering his investment in machinery and lowering his cost of production. Fewer field passes and reduced herbicide rates contributed most to the savings.

County: Morrison
Items purchased: Rotary Hoe
Project cost: $3,000
Loan amount: $3,000
Project description: Borrowers major objective is to cut back on chemical rates. He calculates a savings due to reduced chemical rates and environmental benefits as well.

County: Murray
Items purchased: Ridge till planter
Project cost: $13,600
Loan amount: $8,500
Project description: Borrower is switching over to ridge till. Herbicides will be banded instead of broadcast. He feels his efficiency and profitability will increase due to reduced fuel, labor and herbicide cost. The soil will be less susceptible to wind and water erosion.

County: Murray
Items purchased: Band-equipped sprayer, cultivator, rotary hoe.
Project cost: $20,000
Loan amount: $15,000
Project description: Borrower cites the following key practices as objectives in moving toward a more environmentally sound and economically viable farm. Early rotary hoeing of row crops, post emergence herbicide band applied and precision cultivation with a late model cultivator.

County: Nicollet
Items purchased: Mulch tiller and stalk cutter.
Project cost: $24,000
Loan amount: $15,000
Project description: Fall soil and residue management is a top priority for this borrower. The mulch tiller will tack down residue to prevent wind and water erosion. The stalk cutter is used to even out plant debris and prepare a field for a crop that is to be drilled.

County: Norman
Items purchased: Chisel plow and harrow
Project cost: $4,400
Loan amount: $4,400
Project description: Borrower is concerned about the continued erosion of soil by the wind. He plans to chisel more and moldboard plow less this fall. He cites fuel and labor savings as direct cost savings.

County: Red Lake
Items purchased: Conversion of existing grain storage (26,400 bu.) to a full floor natural air drying system.
Project cost: $15,975
Loan amount: $11,932
Project description: Existing grain storage bins will be modified by adding a full floor, vents and larger fans. Valuable time will be saved by not having to wait for the batch dryer during harvest. Advantages of the conversion include a substantial reduction in fuel and labor, and less damaged grain by drying at lower temperatures.

County: Rice
Items purchased: Disc chisel plow, high residue field cultivator, minimum till/no till planter.
Project cost: $30,000
Loan amount: $15,000
Project description: Borrower is converting his tillage system to a combination of minimum tillage and no tillage to avoid wind and water erosion on his farm. Efficiency will increase due to fewer trips across the field. A combination of mechanical and chemical weed control will continue to be used.

County: Rock
Items purchased: Minimum tillage cultivator, rotary hoe.
Project cost: $7,364
Loan amount: $4,750
Project description: Borrower discontinued moldboard plowing in order to conserve soil moisture and avoid erosion from wind and water. With increased crop residue on the soil surface, it was necessary to use a cultivator and rotary hoe designed for these conditions to work the field. Borrower will use these devices for weed control along with limited herbicides.

County: Roseau
Items purchased: 10,000 bushel bin with natural air drying.
Project cost: $10,600
Loan amount: $9,000
Project description: Borrower is a grain and legume seed producer. Higher quality crops sold at a premium price will be the primary benefit of this system over the present high temperature system. Areas of cost savings include fuel, both LP and diesel, and labor hours.

County: Sibley
Items purchased: 15' Yetter rotary hoe, fencing for rotational grazing.
Project cost: $7,500
Loan amount: $6,500
Project description: Borrower wishes to purchase a used rotary hoe instead of continuing to lease. He has been using mechanical weed control successfully in corn and soybeans. Because he has no herbicide carryover he is able to sow an aftermath crop to provide short term pasture for lambs. A 5-wire permanent, perimeter fence will be built with temporary fencing used to divide paddocks for grazing.

County: Steams
Items purchased: Manure storage area and animal feedlot.
Project cost: $31,800
Loan amount: $7,952
Project description: This borrower was concerned about his animal waste runoff problem and plans to better utilize manure as an on farm fertilizer resource. The project was specifically designed to eliminate or permanently reduce runoff of animal waste into the nearby river.

County: Steams
Items purchased: Rotary hoe
Project cost: $5,000
Loan amount: $4,600
Project description: Borrower is conservation-minded and has been practicing minimum tillage since 1972. He is purchasing a used rotary hoe. He wants to reduce his herbicide costs.

County: Stevens
Items purchased: Hiniker ridge till cultivator with guidance system, equipment to adopt sprayer for wide banding.
Project cost: $18,060
Loan amount: $15,000
Project description: Borrower is steering his operation toward less tillage, better utilization and placement of fertilizer and targeting specific areas for weed control. Profitability will be most affected by the reduced levels of fertilizer and chemicals. Fuel and labor will also be affected due to fewer trips across the field.

County: Todd
Items purchased: Manure handling and storage system.
Project cost: $25,800
Loan amount: $15,000
Project description: Borrower's barnyard has a severe water runoff problem. With technical and financial assistance from his county ASCS and SCS offices, a manure handling system was designed to minimize further pollution of nearby designated wetlands. This system will also allow for better management of manure, thus reducing dependence on commercial fertilizer.

County: Wadena
Items purchased: Central wood hot water heating system.
Project cost: $18,223
Loan amount: $15,000
Project description: This outdoor system heats water by burning wood. The hot water will heat two dwellings, the milk house, calf barn, machine shop and all the hot water consumed on the farm. Borrower has over 100 acres of wooded land on his farm to be used for fuel. He expects to recapture his investment in less than 4 years.

County: Winona
Items purchased: Minimum till planter, nitrogen side-dress equipment for cultivator, used rotary hoe.
Project cost: $18,500
Loan amount: $15,000
Project description: This equipment will assist borrowers in moving toward their goal of using less chemicals and commercial fertilizers on their farm. The planter will allow planting in fields with more crop residue. The rotary hoe will be used to control early emerging weeds. The side-dress equipment will allow nitrogen to be applied timely at the appropriate rate.

County: Yellow Medicine
Items purchased: 30' minimum till rotary hoe.
Project cost: $9,000
Loan amount: $4,500
Project description: Borrowers are ridge till operators and have been banding pre-emergent herbicides. They will attempt to eliminate herbicides by using the rotary hoe twice before cultivating. If necessary they will band spray post-emergence herbicide on only the fields that have weed pressure.

The following case studies were prepared to demonstrate how the equipment purchased through the Sustainable Agriculture Loan Program are assisting the farmers in their transition from conventional to more sustainable farming practices. The figures cited were provided by the farmers. In most cases, these figures are estimates and no field trials were run to verify them. The case studies presented are not intended to promote any one farming concept but merely to provide information on how the Sustainable Agriculture Loans can be used.

Sustainable Agriculture Loan Program
Actual Case #1

Address: Roseau, MN. 56751 *County:* Roseau

Purpose of loan: Natural air drying bin for grain, 10,000 bushel capacity

Projected cost of the project: $10,600
Size of loan requested and received: $9,000

Terms: Semi-annual installments of $800 payable May 1 & November 1 each year for 7 years. Collateralized loan at 6% simple interest. No penalty for early repayment.

Projected savings to the borrower by participating in the Sustainable Agriculture Loan Program vs. a conventional loan at 12% interest.

The difference between a 6% interest rate loan through the Sustainable Agriculture Loan Program and a 12% interest rate conventional loan with the same terms would save the borrower $1,812 in *present value dollars.

**assuming an 8% opportunity cost interest rate*

Operation: This farm is located in rural Roseau, Roseau County in northwestern Minnesota. This producer farms 1127 tillable acres of which 920 acres are owned and 207acres rented. The primary crops are spring wheat, barley, clover, oats and corn. There are no livestock raised on this farm. The clover is sold as seed and much of the barley is sold for malting. This farmer is in the process of purchasing the real estate and farm machinery from his father. He supplements his income by working off season as a part-time township assessor. His wife works as a school teacher in a nearby town.

Project description:

The loan through the Sustainable Agriculture Loan Program was used to finance the construction of a 10,000 bushel capacity natural air grain drying system. This producer wanted to replace the use of a high temperature recirculating system with the natural air grain drying system on part of his crop. He anticipates drying about 5,000 bushels of barley in the bin then transferring it out for storage. The bin will then be filled to capacity with wheat at time of harvest. The wheat can then be dried and stored in this drying bin until sold. Grain quality is usually better when dried in a lower temperature system. The system was designed following the recommendations of Dr. Harold Cloud of the University of Minnesota.

Benefit due to the project: The below partial budget worksheet is used to estimate the monetary savings due to the implementation of this natural air grain drying project. The major areas of improvement are in savings of labor hours, better quality grain and reduced energy cost.

Partial Budget Worksheet

** Of the 5,000 bushels of barley dried in this drying bin 2,500 bushels are expected to be sold as malting barley at a premium price.

Added costs

Item	Dollars
electric fan on bin 15 HP motor, 145 hours drying time for barley and 200 hours on the wheat 345 x x.044=	170
interest cost $9,000 x 6% =	540
depreciation cost $10,600 / 10 years =	1,060
Total added costs	*$1,770*

Added returns

Item	Dollars
premium price for malting barley ** 2,500 bushels x $.20 per bushel =	500
Total added returns	*$500*

Reduced returns

Item	Dollars
none	
Total reduced returns	*$0*
Income decreasing	**$1,770**

Reduced costs

Item	Dollars
LP fuel that will not have to be used on the 15000 bushels of grain. 1500 gal.x $1.00 =	1,500
50 tractor hours not needed 50 hours x $7 per hour =	350
50 man hours not need to run the dryer 50 x $5 per hour =	250
Total reduced costs	*$2,100*
Income Increasing	**$2,600**

Net Annual Change $830

What makes this a Sustainable system?

Conservative cost figures indicate that this grain drying system has a beneficial effect on profitability while reducing overall input expenditures. As LP fuel prices rise this less energy intensive system becomes increasingly attractive. This farmer cites time savings and better quality grain as factors influencing his decision. As additional markets open up in the future for quality grain, farms like this will be in a position to market accordingly.

Sustainable Agriculture Loan Program
Actual Case #2

Address: Clinton, MN. 56225 *County:* Big Stone

Purpose of loan: Conversion of existing planter and cultivator to band and side-dress fertilizer.

Projected cost of the project: $3,500
Size of loan requested and received: $3,500

Terms: Semi-annual installments of $410 on November 1 and May 1 of each year for 5 years. Collateralized loan at 6% simple interest. No penalty for early repayment.

Projected savings to the borrower by participating in the Sustainable Agriculture Loan Program vs. a conventional loan at 12% interest. The difference between a 6% interest rate loan through the Sustainable Agriculture Loan Program and a 12% interest rate conventional loan with the same terms would save the borrower $530 in *present value dollars.
**assuming an 8% opportunity cost interest rate*

Operation: This farm is located in rural Clinton, Big Stone County in western Minnesota. This producer crop farms 970 acres of which 240 acres are owned and 730 acres are rented. Rented land is obtained through a combination of cash and share rent arrangements. The primary crops are soybeans, corn and spring wheat. He also finishes about 300 head of feeder pigs per year. Borrower's wife works in town at a nursing home which helps pay family living expenses. This farm is typical of farms located in Big Stone County.

Project description: This producer has the essential equipment for the production of the soybeans, corn and wheat. His request through the Sustainable Agriculture Loan Program was to modify his existing equipment to make better use of his fertilizer dollars. Both the corn planter and the cultivator were modified. The planter was modified to band fertilizer and the cultivator to side-dress fertilizer. The loan was used to purchase the pumps, knives, hoses, tanks, valves and mounting materials for the equipment. Much of the added materials were adapted from other farm machinery. For example, the new fertilizer knives were mounted to used plow coulters with fabricated brackets. The total cost of modifying the planter and cultivator was $3,500. Cost of these modifications using all new parts and completed by a dealer would have been over double this figure or about $8,000. These modifications will allow him to apply fertilizer as needed by the crop.

Benefit due to the project: The below partial budget worksheet is used to estimate the monetary savings due to the implementation of this fertilizer banding project. The amount of fertilizer can be reduced by applying only the amount that can be utilized by the crop. A test will be run at the time of cultivation to determine the amount of additional fertilizer needed. Additional fertilizer will be supplied to the crop through side-dressing with the cultivator only if needed. Flexibility of this system will allow the farmer to fine tune his fertilizer inputs to achieve maximum profits with minimum inputs.

Partial Budget Worksheet

Added costs

Item	Dollars
interest cost $3,500 x 6% =	210
depreciation cost $3,500 / 5 years =	700
* additional labor during planting 100 hours x $5 per hour =	500
Total added costs	*$1,410*

* Additional labor hours during planting were estimated by the Dept.

Added returns

Item	Dollars
additional yield: The farmer indicated that his yield increased by 10 to 20 bushels per acre. A side by side comparison was not run so a dollar figure was not attached.	
Total added returns	*$0*

Reduced returns

Item	Dollars
none	
Total reduced returns	*$0*

Reduced costs

Item	Dollars
reduction in fertilizer rates over previous levels by fine-tuning applications:	
corn was $30/acre cost now $15/acre cost, for a $15/acre savings x 200 acres =	3,000
soybeans was $10/acre now with banding $5/acre for a $5/acre savings x 300 acres =	1,500
Total reduced costs	*$4,500*

Income decreasing	**$1,410**
Income Increasing	**$4,500**

Net Annual Change $3,090

What makes this a Sustainable system?

This transition to a lower input system has had a very beneficial effect on profitability. Better utilization of commercial fertilizer through banding has cut costs, increased yields and is reducing the chance of excess nitrogen leaching into the groundwater.

1990 Sustainable Agriculture Loan Program

Technical Review Panel

Mr. Dell Christianson
Dell has been a full-time instructor of Specialty Crop Management since 1975 at Detroit Lakes Technical College. Previous to teaching agriculture, Dell spent 2 years in the Peace Corps and then 5 years in banking.
B.S. in Horticulture M.S. in Agricultural Economics

Mr. Randy Krzmarzick
Randy grows corn and soybeans, and raises feeder pigs on his farm in Brown County. He has been working to diversify his farm and reduce inputs since 1980.
B.S. in English

Mr. Craig Cramer
Craig is a consultant and contributing editor to the New Farm magazine. Craig travels around the midwest researching and writing articles on sustainable agriculture.
B.S. in Botany

Mr. Jim Kusilek
Jim is the Senior Product Officer at the First Bank of Wilmar. He is primarily involved with agriculture and small business loans.
B.S. in Agriculture Business

Mr. Tim Gossman
Tim is the vice-president of the Root River State Bank in Chatfield. He and his wife Susan live on a 200 acre farm in rural Chatfield. Tim is also president of the Filmore County Forest Association.
B.A. in Business Administration

Dr. Ian Moore
Ian is a Professor and an agricultural engineer at the University of Minnesota. Ian specializes in water quality.
B.S. M.S. Ph.D in Agricultural Engineering

Mr. Wayne Monsen
Wayne ridge tills corn and soybeans, and raises sheep on his farm outside of St. James. He has been working on reducing his inputs and conservation tillage for 7 years.
B.S. in Biology