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STEWARDSHIP PAYS ON MONTANA GRAIN FARMS

— BY DAVID GRANATSTEIN, SUSTAINABLE AGRICULTURE COORDINATOR AT WASHINGTON STATE UNIVERSITY —

Montana grain farmers who are adapting more sustainable farming practices also are enjoying higher profits, according to recent economic studies in the state.

As part of a western region effort to develop enterprise budgets for alternative farming systems that are funded by the USDA-SARE program, Montana State University (MSU) agricultural economists (Johnson et al., 1992) compared the performance of a generalized farm in the Golden Triangle region of north central Montana under "conventional" and "sustainable" management. The main difference between the systems was the use of a crop management service in the sustainable system that led to significant reductions in fertilizer use.

During the same period, a study of dryland producers using cereal-legume rotations was proceeding under the leadership of the Alternative Energy Resources Organization (AERO) with cooperation from land grant university researchers (Matheson et al., 1991). Their study evaluated the production practices and gross margins of nine producers in the Northwest, including two Canadians. Two Montana growers who participated in the study are situated in the Golden Triangle area. The economic results from these two studies are described here.

MSU WHOLE FARM BUDGETS

The data for the MSU study came from interviews with four farm managers who were using a crop consulting service. They identified the crop management systems used before and after the advent of the consulting service. Their practices were then used to develop a "conventional" and a "sustainable" production scenario and budget for a generalized farm of 5,300 acres. The generalized farm has a rotation of winter wheat-fallow-barley-fallow-spring wheat-fallow, so nearly 50 percent of the acreage is in fallow each year. About 100 acres of irrigated malted barley is included in the generalized farm system.

Yields for the comparison were based on 10-year weighted averages for each of the crops grown, based on data from the two counties in which the sample farms were located. Prices and costs were based on 1990

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VEGETABLE OIL FUELS GET ANOTHER LOOK

Farmers are always in search of new ways to reduce the need for costly purchased inputs — pesticides, fertilizers and fuel — but some alternatives that could be produced on the farm require extensive processing and so have been ignored as economically unfeasible.

Studies of vegetable oil/diesel blends as a renewable fuel is of particular interest to farmers who customarily spend as much as one third of their energy budgets on diesel fuel. By growing vegetable oil for fuel processing, a group of Montana farmers hopes to enhance self-reliance while keeping energy production costs competitive with what they'd normally spend on fuel off the farm.

With a $300 start-up grant from the Alternative Energy Resources Organization, members of the Diesel Vegetable Oil Combo Club intend to find out if it's feasible to press sunflower oil seeds and add them to diesel fuel. They are not deterred by research that so

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Table 1. Annual whole farm resource totals for a generalized 5,300-acre farm under a six-year rotation.

Item	Conventional System	Sustainable System
Total Labor (hr)		
Machinery	1,430	1,116
Total Fuel (gal)		
Diesel	9,919	9,535
Gas	20,043	17,680
Fertilizer (lb. nutrient)		
Nitrogen	157,330	41,555
Phosphorous	111,590	73,840
Potassium	63,000	0
Economics ($)		
Gross Revenue	323,457	323,457
Variable costs	262,513	192,848
Ownership costs	60,275	58,465
Net Returns	669	72,144

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Whole farm comparisons for the two systems are presented in Table 1. This includes resource use (labor, fuel, fertilizer) and economics calculated for all crops in the rotation for the entire 5,300-acre farm. The "sustainable" system uses fewer resources in all categories. With yields assumed to be equal, the improved profitability of the "sustainable" system is due to lower production costs. The conventional system barely breaks even when net returns to land, risk and management are calculated, while the "sustainable" system shows a $72,000 profit. However, additional costs of consulting and soil testing were not included in the "sustainable" budget.

The researchers estimated relative soil erosion for the two systems. They assumed the "C" factor, used in the Universal Soil Loss Equation to indicate the erosion control potential of the cropping practices, to be the same for both systems (0.215) despite the reduced tillage in the "sustainable" system. A lower value indicates lower erosion potential. Predicted erosion rates (tons/acre/year) were 1.3 and 0.4 for water and wind erosion, respectively.

A more detailed budget of winter wheat (after fallow) production under the two systems is presented in Table 2. The increased herbicide use on the "sustainable" system is due to reduced tillage during the fallow period.

On the sample farms, intensive soil testing led to the significant reductions in fertilizer use that appear in the "sustainable" farm budget. Over time, it is possible that periodic increases in fertilizer would be necessary if the "sustainable" farms are living off the excesses of the past. But improved biological activity in the soil can maintain adequate nutrient levels with reductions in fertilizer inputs, as farmers in other parts of the country have discovered. The budgets for the other crops have the same relative cost composition for the two systems as the winter wheat crop.

AERO CASE STUDIES

Two farms in the AERO case study report are in the same region as the farms in the MSU study. Both are large commercial dryland farms that are entirely certified for organic production. Both farms combine complex and flexible management with innovative marketing to achieve profitability.

Greg Gould manages a 5,000-acre crop and livestock operation just south of Great Falls, Mont. He is in a 12-inch precipitation zone where summer fallow is the norm. But he has been successfully using a combination of annual cropping, no-

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Table 2. Comparison of per-acre production inputs for winter wheat after fallow for MSU study farms.

Input	Conventional	Sustainable
	units/acre	
Seed	1 bu.	1 bu.
Herbicides		
Hoelon	2.33 pt.	2.33 pt.
2,4-D	6 oz.	8 oz.
Ally	—	0.1 oz.
Fertilizer		
Nitrogen	60 lb.	17 lb.
Phosphorous	45 lb.	26 lb.
Potassium	20 lb.	—
Machinery	$17.01	$14.37
Custom combine	$15.00	$15.00
Operating interest	$4.71	$3.65

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till, and grass and legumes in rotation. Seventy percent of the farm's income is from cash grain and specialty crops despite the fact that nearly 80 percent of the land is now in grass pasture for the cattle. A typical rotation would be flax, hard red winter wheat, spring barley, buckwheat, hard red spring wheat, hard red winter wheat, and alfalfa for several years.

The 2,700-acre farm managed by Bob Quinn near Big Sandy, Mont., receives 12 to 14 inches of precipitation. Like Gould, he has virtually eliminated summer fallow in an area where it is considered essential. The farm relies on a nine-year rotation that includes a legume every fourth year. He raises hard red wheat, durum wheat, and "kamut" wheat, a specialty type grown for the health food industry, as his cash crops. A typical rotation would be hard red winter wheat, durum wheat, kamut interseeded with sweet clover, sweet clover green manure, hard red winter wheat, hard red spring wheat, kamut interseeded with alfalfa, alfalfa hay, and alfalfa green manure.

Since both farms are organic, they do not purchase commercial fertilizers or herbicides. The complex rotations appear to be supplying adequate nutrients, as their yields are similar to county averages. The rotations and some additional tillage, such as harrowing after a cereal has emerged, provide adequate weed control. Thus, variable costs consist of seed, labor, machinery, fuel, and interest on any borrowed operating capital.

COMPARISONS OF STUDIES

While farms in the two studies were evaluated by different researchers, there is enough overlap of data to make some initial comparisons (Table 3). The MSU figures are for winter wheat after summer fallow. The Gould budget is for no-till winter wheat after spring wheat. The Quinn budget is for winter wheat after clover green manure/fallow.

It is not possible to know whether the lower yields on the Gould and Quinn farms are due to lower yield potential of their environment or another yield-limiting factor such as nitrogen or moisture deficit due to recropping. However, gross revenue for all the farms is similar. The organic farms achieve this by receiving premium prices for their products. If the MSU market price is used instead, gross margins (the difference between gross revenues and variable costs) drop to $71 per acre and $111 per acre for the Gould and Quinn farms, respectively. This is still comparable or superior to gross margins from the MSU farms.

In additional to acceptable economic returns, the two AERO farms are greatly reducing the use of summer fallow and adding soil-building crops to their rotations. Erosion under continuous cropping is half or less of that under a crop-fallow system. (J.R. Sims, personal communication). This provides a resource conservation benefit to society that is not accounted for in the budgets.

The results of this study should encourage growers who are searching for cost-effective farming alternatives that are also more environmentally sustainable. Whether one chooses intensified soil testing, reduced tillage, or redesigning the farm to meet organic certification, committed farmers can reduce costs, increase profits, and improve stewardship with the knowledge and technology available today.

Table 3. Economic comparison for winter wheat production among MSU and AERO study farms.

	MSU Conventional	MSU Sustainable	AERO Gould	AERO Quinn
Yield (bu/ac)	39	39	28	36
Gross revenue ($/ac)	151	151	148	153
Variable cost ($/ac)	83	65	37	28
Gross margin ($/ac)	68	86	111	125

* Prices for Gould ($5.30/bu) and Quinn ($4.25/bu) include premiums for organic certified product. Prices for MSU are $3.87/bu and do not include government subsidy payments.

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Matheson, N., B. Rusmore, J.R. Sims, M. Spengler, and E.L. Michalson. 1991. Cereal-legume cropping systems: nine farm case studies in the dryland northern plains, Canadian prairies, and intermountain northwest. AERO, Helena, Mont. ❐

HOW TO AVOID DRIVING YOUR SOIL INTO THE GROUND

— FROM A NORTH DAKOTA EXTENSION SERVICE NEWS RELEASE —

Early planting and the availability of larger, heavier farm equipment can combine to increase the risk of soil compaction and reduced crop production.

The main cause of soil compaction is working soil when it is too wet, according to Vern Hofman, extension agricultural engineer at North Dakota State University, who suggests the best way to minimize soil compaction would be to stay out of wet fields. But Hofman acknowledges that staying out of wet fields may be a difficult decision when considering the economics of late seeding.

Several other things can be done to help minimize the effects of packed soil:

- Radial ply tires have some advantage over bias ply tires for reducing soil compaction. First, radial tires produce a larger "footprint," which reduces shallow compaction. The footprint is longer, but not wider, so the tire achieves the larger footprint without compacting a wide track as it passes over the field. Second, radial tires have better traction that may allow them to perform satisfactorily with less operating weight than bias tires. The present ballasting recommendations generally do not distinguish between radial and bias tires; however, present farm practice is to use less ballast with radial tires than with bias tires.

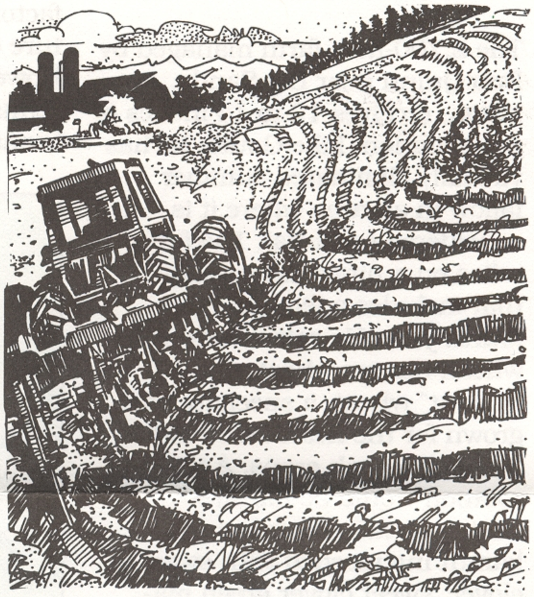
- Large tires and duals have the advantage of increasing the soil contact areas, which reduces shallow compaction. However, due to the larger footprint, more area is compacted and since deep compaction is mainly affected by axle loads, large tires and duals do not reduce this potential.

- Avoid carrying too much tractor weight. Excessive weight creates unnecessary soil loads and uses more fuel. A correctly weighted two-wheel-drive (2WD) tractor should have 8 to 16 percent wheel slip for any field operation. Proper weighting is especially important in tillage operations.

- Do not use oversized equipment. "For example, don't use a 150-horsepower tractor if you have a 75-horsepower tractor that can adequately do the job," Hofman says.

- Eliminate unnecessary field operations so you make fewer passes over the field, Hofman says. Many producers are using reduced tillage in their farming operations, and this practice keeps the number of trips over the field to a minimum when fields are most susceptible to compaction.

- Tandem axles (four-wheel-drive tractors) will also reduce surface soil compaction, compared to a single axle. Tandem axles compact less area than duals because the weight is spread over two axles. Large diameter single tires (tall tires versus wide, squatty tires) on tandem axle tractors are best. This reduces



the width of tire tracks in fields while providing adequate tire-to-soil contact to minimize slippage.

- Use tires large enough to carry the tractor's total weight without overloading, which shortens tire life. Triple tires, which pack a wider area across the field, are usually not needed except for high-horsepower tractors. Also, tracks on tractors have a larger soil contact area than tires and should cause less compaction.

- Mechanical front-wheel-drive (FWD) and four-wheel-drive (4WD) tractors have significant potential for reducing axle load and therefore compaction. However, Hofman warns, their increased traction capability may tempt farmers to use them on wet soils that are subject to compaction. ❐

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far has concluded that vegetable oil blends are best used only in emergencies because of the potential for engine damage.

"We need to conserve fossil fuels because they're non-renewable and their quantities are limited," said Combo Club organizer Robert Boettcher of Big Sandy, Mont. "There's a big potential for oil seed blending, one that large oil companies are likely to take advantage of. I think there should be more consideration given to small, on-farm production – something we can devote five acres to so it doesn't take too much time away from the rest of our operation."

The club purchased an oil expeller from a manufacturer in North Dakota and members are developing a squeezing and filtering system in preparation for actual production next year.

The process of extracting fuel oil from plants is not new. As early as 1920, farmers experimented with methods of producing ethanol to run some of their machines. They've found that although ethanol production has received a lot of attention over the years, vegetable oils might be a better alternative liquid fuel for agriculture. Vegetable oil is much simpler to extract, the fuel is better suited for diesel engines, the by-products are more easily handled and used, and the energy return ratios are greater.

Vegetable oils, however, cannot be used exclusively as a source of fuel. Scientists have found that mixtures of about 20 to 25 percent vegetable oil are most effective in diesel-powered internal combustion engines. Blends with a higher vegetable oil content tend to leave residues that impede engine performance. Likely problems include filter plugging, cold starting difficulties, injector coking, formation of carbon deposits in the combustion chamber, and contamination of the lubricating system.

In one North Dakota study, tractors were operated on farms over a three-year period with alkali-refined, winterized sunflower oil/No. 2 diesel blends. The engines operated a total of 7,617 hours and burned 38,540 gallons of fuel. Three tractors were fueled with 25 percent sunflower oil/75 percent diesel and three others were fueled with a 50/50 mix. All engines were turbocharged, direct injection diesel engines. Two were intercooled and one used a fuel and a lubricating additive.

One engine experienced a camshaft/valve train failure. Most deposits were found on engines fueled with the 50 percent sunflower oil; a significantly lower level of deposits was found on pistons from engines fueled with 25 percent sunflower oil. The lowest average amount of deposits were found on pistons from engines fueled with only No. 2 diesel. No injector coking problems or ring sticking problems were encountered. Bearing wear was normal.

The North Dakota researchers concluded that neither the 25 percent sunflower oil blend nor the 50 percent sunflower blend could be recommended as a substitute fuel. However, under emergency conditions, a 25/75 percent blend of alkali-refined winterized sunflower oil/diesel could be used as a diesel engine fuel, but the operator must be aware that reduced engine life will occur.

Sunflower seeds are one type used in the blending process. Others are soybean, canola (rapeseed), safflower, cottonseed and peanut. Researchers at the University of Idaho have been studying vegetable oils as a fuel replacement since 1979. They have concluded that the oil from one acre of rapeseed would provide enough diesel fuel replacement to farm 10 acres of cropland. The major barrier to widespread use of vegetable oil fuel is land. Experts say there isn't enough of it to grow the rapeseed necessary to supply a major share of U.S. fuel needs. For more information on rapeseed studies, contact Charles Peterson, Department of Agricultural Engineering, University of Idaho, Moscow, ID 83843; (208) 885-7906.

Three methods of removing oil from seeds are currently in use:

- A simple mechanical screw press, which is considered most likely for on-farm use. This is the method chosen by the Montana farmers.
- The solvent extraction process, in which crushed oil seeds are soaked in a solvent such as hexane. The meal is removed and the hexane evaporates, leaving the oil. The complexity and hazards associated with solvent extraction are generally considered undesirable for small on-farm processing plants.
- A third method combines solvent extraction with a light screw press. It is the most likely approach for larger plants and is the general method used by most commercial oilseed plants.

Agriculture needs a backup supply of diesel fuel and this is perhaps where vegetable oil has the best chance of having a positive impact on sustainability. A duel technology strategy could provide a valuable oil cash crop and allow that crop to be turned into a liquid fuel that would enable farm production to continue during an emergency. ❐

Resources

Regional Computer Group Formed

A new electronic mail group named CSANR-L has been started at Washington State University to provide an efficient means of communication about sustainable agriculture research and education activities in the Pacific Northwest. Research results, news items, events and specific questions can all be sent to the mail group for others to learn about and respond to. The mail group is open to the public. Access to INTERNET is required. The mail group will be moderated by David Granatstein, sustainable agriculture coordinator at WSU. To subscribe, send an e-mail note on INTERNET TO: listserv@wsuvm 1.csc.wsu.edu and include SUB CSANR-L FIRSTNAME LASTNAME (substituting your actual name) in the body of the note itself. For more information, call Granatstein at (509) 663-8181 ext. 222. The mail group is supported by the Center for Sustaining Agriculture and Natural Resources, and the Cooperative Extension Service at WSU.

Video Describes Biological Weed Control

Biological Control of Weeds in Montana, a new videotape from the Montana State University Agricultural Experiment Station, describes ways to curb the spread of spotted knapweed, leafy spurge and other noxious weeds without expensive chemicals. It can be viewed at MSU Extension offices or purchased for $25 from MSU Extension Publications Office, 115 Culbertson Hall, MSU, Bozeman, MT 59717. ❐

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Events Calendar

October

24-26: "Reshaping Agricultural Research and Education," a conference on science and sustainability, Red Lion Hotel, Bellevue, Wash. Sponsored by Washington State University and the western SARE program, the conference will focus on quantitative and qualitative methodologies for solving critical production, environmental and social problems associated with establishing and continuing sustainable agricultural systems. The program will feature innovative integrated research projects, non-traditional research and education methods, institutional strategies for increasing interdisciplinary research and a poster session. Contact: Norma Fuentes-Scott at (509) 335-2921

January

8: Agriculture/consumer/environmental alliance conference, Moscow, Idaho. Sponsored by the Palouse Clearwater Environmental Institute to promote the development of farm improvement clubs and community support in eastern Washington and northern Idaho. Contact: PCEI at (208) 882-1444. ❐

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