United States Department of Agriculture
NATURAL RESOURCES CONSERVATION SERVICE
Economics Technical Note No. MT-9
November 2007

ECONOMICS TECHNICAL NOTE

Energy Conservation on Irrigated Land in Eastern Montana

by
Gerald M. Schaefer, State Economist

Producers looking for ways to reduce inputs on irrigated land can realize significant savings by changing tillage systems. Changes can occur in fertilizer, fuel, machinery cost and labor. Information from research conducted in Montana by Montana State University (MSU) Experiment Stations and the Agricultural Research Service (ARS) station in Sidney and information obtained from producers allows some comparisons.

Fertilizer Savings

Research in Montana has shown that split applications of nitrogen does not significantly affect yields if the early season nitrogen application was adequate for the grain yield potential. Irrigated spring wheat grain protein can be increased by 0.5 to 2.0% with the application of late-season nitrogen when early-season nitrogen application is adequate. Research in 1988 showed no difference in yields between deep-banded fertilizer and top-dressing fertilizer. No more than 30 pounds of nitrogen should be applied with the seed when applying ammonium nitrate (34-0-0) or urea (46-0-0).

An on-going "Strip Till Study on Sugar Beets" at the United States Department of Agriculture (USDA), ARS, Northern Plains Agricultural Research Laboratory in Sidney, Montana uses two different methods of fertilizer application. Conventionally-tilled sugar beets had the fertilizer broadcast in the fall before fall conventional tillage operations were performed. In the strip till beets, the fertilizer was shanked into the tilled strips in the fall.

Prices for different nitrogen formulations are significantly different.

Ammonium nitrate	34-0-0	$366/ton	$.54/lb
Anhydrous ammonia	82-0-0	$521/ton	

Fuel Savings

The Strip Till Study on Sugar Beets at Sidney uses six conventional tillage operations before planting versus one operation for the strip till before planting. The field operations and fuel requirements for each are shown in the table below. The fuel, machinery and labor requirements for each implement listed were obtained from producers in the Sidney area using farm-sized implements common to the area.

Table 1. Fuel Use for Various Tillage Operations with a Chisel Plow as the First Conventional Tillage Operation

Conventional Tillage	Fuel Use (Gallons/Acre)
Chisel Plow	.36
Mulcher	.27
Mulcher	.27
Level	.70
Level	.70
Cultivator with rolling baskets	.80
Total Fuel Usage	3.1
Strip Till	
Ripping Shank with Packer	2.0
Total Fuel Usage	2.0
Fuel Savings	1.1

If diesel is valued at $2.70 per gallon the savings in diesel are $2.97 per acre.

Other producers use a moldboard plow rather than a chisel plow for their seedbed preparation. Their fuel requirements for seedbed preparation are shown in the table below.

Table 2. Fuel Use for Various Tillage Operations with a Moldboard Plow as the First Conventional Tillage Operation

Conventional Tillage	Fuel Use (Gallons/Acre)
Moldboard Plow	2.5
Mulcher	.27
Mulcher	.27
Level	.70
Level	.70
Harrow	.16
Total Fuel Usage	4.6
Strip Till	
Ripping Shank with Packer	2.0
Total Fuel Usage	2.0
Fuel Savings	2.6

If diesel is valued at $2.70 per gallon the savings in diesel are $7.02 per acre.

Machinery Cost Savings

There is a reduction in machinery costs per acre when a switch is made for seedbed preparation from conventional tillage of sugar beets to strip till sugar beets (see Table 3).

Table 3. Machinery Costs for Various Tillage Operations

Conventional Tillage	Machinery Cost per Acre
Chisel Plow	$5.81
Mulcher	5.20
Mulcher	5.20
Level	4.63
Level	4.63
Harrow	6.31
Total Machinery Costs	$31.78
Strip Till	
Ripping Shank with Packer	$17.96
Total Machinery Costs	$17.96
Machinery Cost Savings per Acre	$13.82

The machinery cost savings of the strip till seedbed preparation for sugar beets compared to conventional tillage using a chisel plow are $13.82 per acre. If a moldboard plow is used the savings are $18.23 per acre.

Labor Savings

The reduction in number of tillage operations for seedbed preparation for strip till sugar beets also saves time (see Table 4).

Table 4. Labor Requirements for Various Tillage Operations

Conventional Tillage	Hours per Acre
Chisel Plow	.05
Mulcher	.04
Mulcher	.04
Level	.10
Level	.10
Harrow	.02
Total Hours	.35
Strip Till	
Ripping Shank with Packer	.25
Total Hours	.25
Time Savings per Acre	0.10

The time savings per acre of the strip till seedbed preparation for sugar beets using a chisel plow are 0.10 hours. If a moldboard plow is used the time savings are 0.36 hours per acre.

Farm Savings

The 2002 Census of Agriculture shows the average number of acres of sugar beets per farm in Richland County is 268. Dawson County has 157 acres of sugar beets. The average number of acres of sugar beets per farm in Montana is 199 acres. Using 200 acres as the average number of acres of sugar beets the following savings occur for the farm each year:

	Chisel Plow Tillage Switching to Strip Till	Moldboard Plow Tillage Switching to Strip Till
Fuel	$594	$1,404
Machinery	$2,764	$3,646
Time	20 hours	72 hours

Soil Health and Organic Matter

In addition to the economic value of reduced tillage there are also benefits to the soil. Two measurements are the Soil Conditioning Index (SCI) and the Soil Tillage Intensity Rating (STIR). The SCI is used to estimate the effect the tillage sequence has on organic matter. If the value is negative, soil organic matter levels are predicted to decline under that production system. If the value is positive, soil organic matter levels are predicted to increase under that system. The STIR is used to evaluate the effect of tillage on soil health in each of the different systems. A STIR with a low value has a minimal adverse effect on soil health. Over time a system with a low STIR value will have a minimal adverse effect on soil structure and overall soil health. The low STIR will improve organic matter, fertility, productivity and water-holding capacity and soil structure. The table below lists the different SCI and STIR values for the different tillage systems.

Table 5. SCI and STIR values for the different tillage systems

	SCI	STIR
Strip Till	0.63	52
Conventional Tillage with Moldboard Plow	-0.26	161
Conventional Tillage with Chisel Plow	-0.11	125