G80-505 Economics of Energy Used in Fallow Systems for Winter Wheat-Fallow Rotation

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NebGuide

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Economics of Energy Used in Fallow Systems for Winter Wheat-Fallow Rotation

This NebGuide discusses the economic advantages of using a fallow system with winter wheat.

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In 1979, Americans watched gasoline, diesel, and other petroleum products dramatically increase in price. The amount of imported crude oil increased and the demand continued strong despite higher prices. Conservation of energy, either forced or voluntary, seems to be one of the key solutions to the energy crisis.

Agriculture is a small user in the U.S. energy budget. Booz and others (1976)[1] estimate energy consumption for production of farm commodities at 2.9% of the total U.S. energy use.

Farm energy use (1% of all energy used in the U.S.) is in the form of diesel fuel, gasoline, electricity and natural gas to run tractors, pickups, farm machinery and electrical equipment. Energy used in production of chemicals, manufacture of fertilizers, and transportation in agriculture is 1.9%. A 50% reduction in fuel used on the farm would hardly be detectable in the total U.S. energy budget.

Yet individual farmers view their fuel cost as a large input and are seeking ways to reduce energy consumption and energy expenditures. A two or three gallon reduction in fuel consumption per acre on 800 acres of wheat translates into $1,600 to $2,400 saved per year. This assumes diesel fuel costs $1 per gallon. To the individual producer these kinds of savings are worth pursuing.

Fallow Systems

Wheat producers in the 2-year wheat-fallow rotation have been using the bare fallow and the stubble-mulch systems. Alternative fallow systems are now available with the recent development of ecofallow and chemical fallow. *Table I* presents six systems of fallow for which the energy use in tillage and chemical energy investment will be estimated. Two systems were selected to represent conventional, ecofallow, and chemical tillage.

Table I. Six selected fallow systems, including drilling, in a winter wheat fallow rotation.				
Conventional				
System A (Black Fallow)		------	***System B*** (Stubble Mulch)	
Moldboard plow 1×		------	Chisel plow 4×	
Field cultivate 3×		------	Field cultivate 2×	
Rodweed 2×		------	Drill 1×	
Drill 1×				
Chemical[1]				
System C	*lb/a*	------	***System D***	*lb/a*
Paraquat + X-77	.25	------	Paraquat + X-77	.25
Atrazine	.5	------	Atrazine	1.0
Cyanazine	1.5	------	Drill 1×	
Drill 1×				
Ecofallow				
System E[2]	*lb/a*	------	***System F[3]***	*lb/a*
Atrazine	.5	------	Atrazine	1.0
Paraquat + X-77	.25	------	Subsurface sweep 2×	
Cyanazine	2.0	------	Drill 1×	
Subsurface sweep 1×				
Drill 1×				

[1]Herbicide amounts are active ingredient.
[2]System E Atrazine and paraquat are applied in the fall, and cyanazine is applied in the spring.
[3]If weed free at time of application.

Source: Systems C to F are based on research over 10 years conducted by Charles Fenster, Agronomist at the Panhandle Station, Scottsbluff, Nebraska, and Gail Wicks, Agronomist at the North Platte Station, North Platte, Nebraska.

Energy used in manufacture of chemicals cannot be forgotten when computing total energy consumed to complete the fallow tillage requirements. A general rule of thumb is that it takes one gallon of diesel fuel per pound of active ingredient of chemical. A gallon of No. 2 diesel fuel is equal to 140,000 BTU. According to Green and McCulloch (1976)[2] 436,356 BTU are necessary to produce one pound of active ingredient of paraquat. This converts into 1.41 gallons of diesel fuel. Atrazine and cyanazine require .58 gallons of diesel fuel per pound of active ingredient.

The amount of diesel fuel consumed by tractors for tillage operations on an average gallons per acre or requirement is listed in *Table II*. These fuel requirements are from on-farm surveys in Nebraska (Shelton, 1979),[3] North Dakota, and other sources.

Table II. Diesel fuel required for various field operations.		
Operation		**Gal/a**
1.	Moldboard plowing	1.80
2.	Disc	.80
3.	Chisel plow	.95
4.	Field cultivator	.60
5.	Harrowing	.35
6.	Rodweed	.62
7.	Sweep plow	.92
8.	Drill	.40
9.	Sprayer	.10
Source: Nebraska and North Dakota On-Farm Fuel Use Surveys and calculations.		

Table III presents the operations performed for fallowing wheat, fuel consumed, and the cost per acre of energy at three price levels for six fallow systems. The prices of diesel fuel used in the calculations are $1, $1.30, and $2 per gallon. The chemical energy cost does not represent the cost per acre of the herbicide treatment when used in a chemical or ecofallow system.

If these systems produce yields which are not significantly different and if energy was the critical issue, growers would shift to a chemical fallow system assuming dependable weed control is obtained without herbicide carryover. By switching from conventional tillage to chemical fallow, 3 to 4 gallons per acre of diesel fuel could be saved. This represents $3 to $4 per acre when diesel fuel is priced at $1 per gallon. This is equivalent to 3.2 to 3.9 fewer gallons of diesel fuel being used during the fallow season. With diesel fuel at $1 per gallon, ecofallow offers savings of $2 to $2.50 per acre over conventional tillage. This translates into about two fewer gallons of diesel fuel used in ecofallow when compared to conventional systems.

Table III. Fuel requirements for tillage operations and chemical energy investment and their costs per acre at three price levels of diesel fuel for six selected fallow systems.

Job	Times	Gal/a time	Total Gal/a	Total energy cost/a Total Diesel cost/gallon		
				$1.00	**$1.30**	**$2.00**
Conventional System A						
Plow	1	1.80	1.80	$1.80	$2.34	$3.60
Field cultivator	3	.60	1.80	$1.80	$2.34	$3.60
Rodweed	2	.62	1.24	$1.24	$1.61	$2.48
Drill	1	.40	.40	$ .40	$ .52	$ .80
TOTAL			5.24	$5.24	$6.81	$10.48
Conventional System B						

Chisel plow	4	.95	3.80	$3.80	$4.94	$7.60
Field cultivator	2	.60	1.20	$1.20	$1.56	$2.40
Drill	1	.40	.40	$ .40	$ .52	$ .80
TOTAL			5.40	$5.40	$7.02	$10.80
Chemical System C						
Spray	1	.10	.10	$ .10	$ .13	$ .20
Herbicide (1.51 gal)[a]			1.51	$1.51	$1.96	$3.02
Drill	1	.40	.40	$ .40	$ .52	$ .80
TOTAL			2.01	$2.01	$2.61	$4.02
Chemical System D						
Spray	1	.10	.10	$ .10	$ .13	$ .20
Herbicide (93 gal)[a]			.93	$ .93	$1.21	$1.86
Drill	1	.40	.40	$ .40	$ .52	$ .80
TOTAL			1.43	$1.43	$1.86	$2.86
Ecofallow System E						
Spray	2	.10	.20	$ .20	$ .26	$ .40
Herbicide (1.8 gal)[a]			1.80	$1.80	$2.34	$3.60
Sweep - subsurface	1	.92	.92	$ .92	$1.20	$1.84
Drill	1	.40	.40	$ .40	$ .52	$ .80
TOTAL			3.32	$3.32	$4.32	$6.64
Ecofallow System F						
Spray	1	.10	.10	$ .10	$ .13	$ .20
Herbicide (.58 gal)[a]			.58	$ .58	$ .75	$1.16
Sweep - subsurface	2	.92	1.84	$1.84	$2.40	$3.68
Drill	1	.40	.40	$ .40	$ .52	$ .80
TOTAL			2.92	$2.92	$3.80	$5.84

[a]Energy requirements are based on active ingredient (lb/acre).

Other Considerations

In deciding which system to use, energy costs will certainly play a key role. Different investments in machinery and cash costs are present in the six selected tillage systems. The producer must weight such factors as the value of machinery at the end of the depreciation period, investment credit, income tax savings from depreciation, and cash operating costs. Economic present value analysis of these factors for a ten-year period gives the lowest net present value to system D (chemical fallow) and the highest net present value to conventional tillage. Ecofallow's net present value is less than the conventional tillage net present value. Consequently, the economic incentive for farmers to adopt a chemical fallow system, or at least a combination of herbicide-tillage, is present. The herbicide-tillage combination is attractive to producers even though the net present value costs per acre are higher than chemical systems.

Mechanical tillage reduces the risk of poor weed control if chemicals were the only weed control measure. Mechanical tillage also reduces the concern of difficult to impossible drilling into heavy residues and hard soil surfaces which could exist under a chemical fallow system.

Summary

Energy used in agriculture is a small part of the total U.S. energy budget. However, individual farmers have a vested interest in conserving energy. The adoption of chemical fallow could save $3 to $4 per acre at a diesel fuel price of $1 per gallon over conventional tillage. Ecofallow offers energy savings of $2 to $2.50 per acre over conventional tillage. As energy prices increase, the dollar savings become even greater.

[1]Booz, Allen, and Hamilton, Inc., 1976. *Energy Use in the Food System*. Office of Industrial programs, Federal Energy Administration FEA/76/083-D. U.S. Government Printing Office, Washington D.C.
[2]Green, M. B., and A. McCulloch, 1976. "Energy considerations in the use of herbicides." *Journal of the Science of Food and Agriculture*. 27(2):95-100
[3]Shelton, D. P. and others. 1979. *Nebraska On-Farm Fuel Use Survey, CC 79-204*. (OUT OF PRINT) Department of Agricultural Engineering, University of Nebraska, Institute of Agriculture & Natural Resources, Lincoln.

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