Oregon State University

Crop Science Report
RESEARCH/EXTENSION

Energy Use in Alfalfa Production

David B. Hannaway, Agronomist
Oregon State University

INTRODUCTION

Modern agriculture has been developed through the use of cheap sources of energy for power on our farms and in our processing plants, and for the production of abundant supplies of nitrogen and other fertilizers, agricultural chemicals and other needed supplies. By substituting capital, mechanization, and the liberal use of energy for labor, the farmers and related agricultural industries in the United States have been able to produce, process, and market an abundance of food at prices far below those paid by consumers in most other countries. We are now aware that more attention must be given to the cost of long-term availability of petroleum and natural gas in the development of future agricultural systems.

In the immediate future, we will depend on petroleum products to fuel our tractors, combines and other field machinery. In some cases, machinery size can be reduced. Nevertheless, the saving of energy in field machines will probably be modest at best and, in some cases, energy use will increase in order to reduce labor costs. However, in the case of fertilizer and pesticides, significant savings can be realized through timely applications and more careful control of rates of application. Greater use of animal manures and legumes in our farming practices can significantly reduce the amount of synthetic nitrogen fertilizer used. Pesticide usage can also be reduced through more careful monitoring of pest populations and through greater use of other control practices.

ALFALFA HAY

The establishment, production and harvesting of alfalfa for hay results in the use of considerable quantities of energy. However, the production of tomatoes, cotton, melons, and rice in California all use considerably more energy (Table 1).

EXT/ACS 33 10/80

Table 1. Energy requirements for selected crops in California

Crop	Gallons Diesel Equiv/Acre
tomatoes	676
cotton	146
melons	143
rice	100
alfalfa	54

When the energy requirements for producing alfalfa hay are listed by operation, irrigation is by far the most energy intensive step (Table 2).

Table 2. Energy requirements for alfalfa production in California

Operation	Gallons Diesel Equiv/Acre
establishment	3.9
cultural practices	0.8
harvesting	6.3
	11.0
transportation	3.4
fertilization	4.6
irrigation	29.6
farm vehicles	5.2
	53.8

Irrigation

Although irrigation costs are site and area specific, irrigation is a major energy consumption area. For this reason it becomes important to obtain the greatest benefit from this energy usage. Irrigation energy costs are directly related to: 1) the amount of water pumped and 2) the hydrolic head against which this water is pumped. The total amount of water used can be reduced by providing only the water needed by the crop. This can be done by irrigation scheduling. Jim Vomicil of the Soils Department can provide irrigation scheduling information to those of you needing assistance in this area.

Improving the performance of irrigation pumping plants is the second major mechanism to reduce irrigation energy requirements. Although the amount of energy used for pumping irrigation water may not be as great as you think (only 2.8% of the total electrical energy used in Oregon) it is important that this energy not be wasted.

Marvin Shearer of the Agricultural Engineering Department is conducting a study of the efficiency of irrigation pumping plants in Oregon. Many of the sites examined need maintenance. However, the most dramatic improvements that can be made are in the fittings used around the pumps. Many of these improvements can be made with minor expenditures that will reduce the total dynamic head. The deficiencies found included sharp 90 degree turns near pumps with water flowing at velocities of 20-30 feet per second, abrupt expanders rather than tapered increasers, insufficient straight pipe on the suction side of horizontal centrifugal pumps, check valves located in the suction line within four pipe diameters of the pump, and an excessive number of turns with undersized pipe at the pump discharge. They also noticed water leaks due to deteriorating gaskets and poor fittings.

Many of the turns could have been eliminated by simply changing the orientation of the pump to the mainline. Many of the high energy loss fittings could be replaced and paid for in less than one year's time by power cost savings.

Although correcting these deficiencies in existing systems will not reduce energy consumption, it will result in better performance for the energy consumed. Reductions in energy requirements are possible, however, in the design of new systems. Pump, pipe and nozzle selection will all affect future energy usage. System design should include a comparison of initial investment with the combined operating and investment costs over the life of the system.

Land selection, where applicable, provides another opportunity to save energy. High lifts have high energy requirements. The Willamette Valley has great potential for irrigation development - 500,000 acres requiring low lifts. However, variable energy costs in the state must also be considered, as energy is three times as expensive in the Willamette Valley as it is in other areas of the state.

More detailed information on irrigation systems is available in the workshops presented in various counties. Your attendance would be well worth the time.

Harvesting

Energy costs associated with harvesting of alfalfa depend greatly upon the size of the operation and the input of labor vs. energy intensive machinery. For a typical operation of swathing and conditioning, raking, baling and stacking, this totals 6.15 diesel equivalent/acre (Table 3).

Table 3. Energy requirements for harvesting alfalfa

Operation	Diesel Equivalents, Gal/A	
mower, conditioner	0.60	
rake (2)	0.50	
baler	0.45	
stack wagon	0.50	
	2.05	X 3 cuttings
	6.15	

Reduction in energy use will be provided by fitting the size of the tractor to the size of the operation, adjusting to elevation and load requirements and proper maintenance.

Establishment

Practices vary depending upon soil conditions, fertility, pH, etc., but a common series of operations involved in alfalfa establishment requires 5.28 gallons of diesel equivalent/acre (Table 4).

Table 4. Energy requirements for alfalfa establishment

Operation	Diesel Equivalents, Gal/A
plow - 8 inches	1.68
disk (2)	1.30
lime	.20
fertilize	.20
preplant herbicide	.10
disk	.65
land plane (2)	.50
drill	.35
cultipack	.35
	5.28

In addition to fitting the equipment to the job, fertilizer and lime should be applied as needed according to soil test data and current recommendations. Herbicides should be applied at the recommended rate to control specific weed problems. Selection of varieties should be made for the particular area and management practices followed to assure a long-lived stand. This will assure that establishment energy costs will not need to be repeated within a short time.

PEST MANAGEMENT

Integrated pest management principles will result in more effective control and reduced use of chemicals. However, these management practices may actually increase energy consumption in some cases.

Herbicides

Reducing the use of herbicides by fallowing and disking germinated seedlings increases the use of diesel fuel on the farm for disking. This consumption of energy (and resultant costs) are of prime interest to the producer. However, total energy costs, which include the production of the chemical need to be considered in developing a total energy balance sheet.

Insecticides

Although insects are not often a major problem with alfalfa produced in Oregon, outbreaks of large populations of alfalfa weevils, grasshoppers, or aphids make spraying financially rewarding in some cases. The use of sampling procedures to determine the best time for insecticide application will increase efficacy and reduce the number of applications with an addition spin off of energy savings.

Rodenticides

Rodent control has been identified as the number one alfalfa production problem in several areas in Oregon. Damage from rodents includes reduced production and damage to hay harvesting equipment. Effective use of rodenticides and trapping equipment should be considered an essential management practice to maintain stand life, thereby reducing the associated energy costs.