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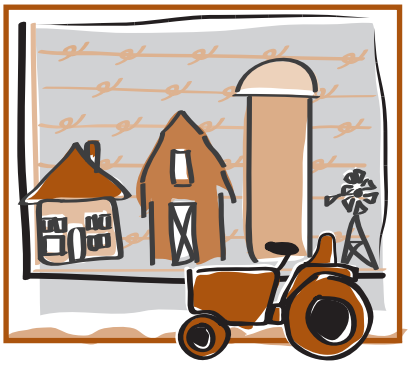

Estimating Farm Fuel Requirements

Fact Sheet No. **5.006** Farm and Ranch Series | **Equipment**

by H.W. Downs and R.W. Hansen*

With increasing concern for fuel conservation and energy management, farmers may wish to estimate the amount of fuel required to perform specific farming operations. By knowing the amount of fuel used, farmers can select the best conservation practices to manage farm equipment.

Type of Fuel

There are three common types of fuels used in farm tractors: diesel fuel, gasoline and LP gas. Their respective physical characteristics are:

Diesel fuel	7.0 lb/gal	138,000 Btu/gal
Gasoline	6.2 lb/gal	124,300 Btu/gal
LP gas	4.25 lb/gal	92,300 Btu/gal

The present trend is toward larger tractors and diesel engines. The diesel engine is more efficient and powers nearly all new tractors over 100 horsepower (hp).

Estimating Fuel Requirements

Tractors – even the larger, high-horsepower units – use an average of only 55 to 60 percent of their maximum horsepower on a year-round basis.

Table 1: Average rates of fuel consumption for year-round operation of three fuel-type tractors.

Engine fuel type	Average fuel consumption per rated PTO-hp
Diesel fuel	0.048 gal/hr
Gasoline	0.068 gal/hr
LP gas	0.080 gal/hr

The average horsepower use is less than the maximum power rating mainly because a tractor is selected to do high-power requirement operations, such as heavy tillage, in a timely manner, and usually has excess power for seedbed finishing, seeding and cultivating. Only a few crop production operations require maximum power. Fuel consumption is shown in Table 1.

Fuel Requirements for Crop Production

To disk a field, the gallons of fuel per acre for that field are nearly constant regardless of the size disk and tractor used. For the same operation, differences due to equipment are quite small. Therefore, the fuel used per acre for any specific operation can be assumed to be constant except for small variations due to soil types, moisture content and depth of operation.

Energy-use rates for farming operations frequently are measured in horsepower hours (hp-hrs). A tractor-disk combination with an average 100 hp at the drawbar for five hours delivers 500 hp-hrs of energy for the disking operation. Since it is not practical for farmers to measure drawbar horsepower, energy requirements normally are based on rated maximum power takeoff horsepower (PTO-hp). Diesel tractors deliver an average of 13.0 PTO-hp-hrs/gal; gasoline, 9.0 hp-hrs/gal; and LP gas, 7.5 hp-hrs/gal.

Example: A diesel tractor rated at 100 maximum PTO-hp operating at full load uses 7.69 gal/hr: 100 hp / 13.0 hp-hrs/gal = 7.69 gal/hr. On the same basis, a 100 hp gasoline tractor uses 100 / 9.0 or 11.1 gal/hr, and an LP gas tractor, 100 / 7.5 or 13.3 gal/hr.

Agricultural engineers from several states have compiled average values for power requirements and fuel used per acre for specific farming tasks as shown in Table 2. These figures assume typical conditions and average working depths and may be used to make fuel estimates for the indicated

Quick Facts

- Estimating the amount of fuel used in farming operations will help select the best conservation practices for farm equipment.
- Tractors use an average of only 55 to 60 percent of their maximum horsepower on a year-round basis.
- Energy-use rates for farming operations frequently are measured in horsepower hours.
- Select the most fuel-conserving method by comparing different tillage methods and cropping systems.

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Table 2: Average energy-use rates and fuel requirements for farming tasks.

Operation	Energy-use rate, PTO hp-hrs/acre	Gallons per acre		
		Gasoline	Diesel	LP gas
Shred stalks	10.5	1.00	0.72	1.20
Plow 8 inches deep	24.4	2.35	1.68	2.82
Heavy offset disk	13.8	1.33	0.95	1.60
Chisel plow	16.0	1.54	1.10	1.85
Tandem disk, stalks	6.0	0.63	0.45	0.76
Tandem disk, chiseled	7.2	0.77	0.55	0.92
Tandem disk, plowed	9.4	0.91	0.65	1.09
Field cultivate	8.0	0.84	0.60	1.01
Spring-tooth harrow	5.2	0.56	0.40	0.67
Spike-tooth harrow	3.4	0.42	0.30	0.50
Mulch treader	4.0	0.42	0.30	0.50
Rod weeder	4.0	0.42	0.30	0.50
Sweep plow	8.7	0.84	0.60	1.01
Cultivate row crops	6.0	0.63	0.45	0.76
Rolling cultivator	3.9	0.49	0.35	0.59
Rotary hoe	2.8	0.35	0.25	0.42
Anhydrous applicator	9.4	0.91	0.65	1.09
Planting row crops	6.7	0.70	0.50	0.84
No-till planter	3.9	0.49	0.35	0.59
Till plant (with sweep)	4.5	0.56	0.40	0.67
Grain drill	4.7	0.49	0.35	0.59
Combine, small grains	11.0	1.40	1.00	1.68
Combine, beans	12.0	1.54	1.10	1.85
Combine, corn and grain sorghum	17.6	2.24	1.60	2.69
Corn picker	12.6	1.61	1.15	1.93
Mower (cutterbar)	3.5	0.49	0.35	0.59
Mower conditioner	7.2	0.84	0.60	1.01
Swather	6.6	0.77	0.55	0.92
Rake, single	2.5	0.35	0.25	0.42
Rake, tandem	1.5	0.21	0.15	0.25
Baler	5.0	0.63	0.45	0.76
Stack wagon	6.0	0.70	0.50	0.84
Sprayer	1.0	0.14	0.10	0.17
Rotary mower	9.6	1.12	0.80	1.34
Haul small grains	6.0	0.84	0.60	1.01
Grain drying	84.0	8.40	6.0	10.08
Forage harvester, green forage	12.4	1.33	0.95	1.60
Forage harvester, haylage	16.3	1.75	1.25	2.10
Forage harvester, corn silage	46.7	5.04	3.60	6.05
Forage blower, green forage	4.6	0.49	0.35	0.59
Forage blower, haylage	8.3	0.35	0.25	0.42
Forage blower, corn silage	18.2	1.96	1.40	2.35
Forage blower, high-moisture ear corn	5.9	0.63	0.45	0.76

operations. If a higher-than-average fuel requirement is indicated because of some local condition, such as heavy soil, increase the table values by 25 percent. Reductions of as much as 25 percent may be made for light energy requirement situations. There are exceptions to the plus-or-minus 25-percent correction, such as the application of chemicals where the variation is nearer plus or minus 10 percent.

The best way to adapt these figures to your own situation is to run periodic checks. Carefully measure the amount of fuel used for specific operations over a short time, such as two or three days. By using the field acreage and amount of fuel consumed, you can check your average against the figures in the table.

Table 3: Fuel requirement comparison of moldboard plow vs. stubble mulch system for wheat production.

Operation	Diesel fuel, gal/acre*	
	Moldboard plow	Stubble mulch
Disk	0.45	0.45
Plow	1.68	—
Sweep	—	0.60
Mulch treader	—	0.30
Sweep (twice)	—	1.20
Disk (twice)	1.30	—
Field cultivation	0.60	0.60
Drill	0.35	0.35
Combine	1.00	1.00

*To convert to metrics, use the following conversions: 1 gallon = 3.8 liters, 1 acre = .4 hectare.

Compare Different Tillage Methods

The table also can be used to compare fuel requirements for different tillage methods or for different cropping systems. Such comparisons become more and more important with increasing emphasis on fuel conservation. For example, suppose you want to compare diesel fuel requirements for two different tillage systems for wheat production. Assume average conditions and compare a moldboard plow system with a stubble mulch system as shown in Table 3. The comparison reveals that the stubble mulch system saves 0.88 gallons of diesel fuel per acre over the moldboard system.

The figures in this fact sheet are averages based on available research data. A farmer could make a reasonable estimate by using these figures, but should maintain personal records and make spot checks to refine the accuracy of the figures to individual farming systems and conditions.

References

Agricultural Engineering Yearbook. American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph, Mich.

Estimating Farming Fuel Requirements. Wendell Bowers and Myron Paine, Oklahoma State University, Stillwater, Okla.

Nebraska Tractor Test Reports, Department of Agricultural Engineering, University of Nebraska, Lincoln, Neb.