ATTRA Conserving Fuel on the Farm

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This publication draws heavily on the out-of-print book "Saving Energy on Montana Farms and Ranches," published by the Montana Department of Natural Resources and Conservation in January 1987. Material and diagrams from this publication are reprinted and adapted here with permission from the Montana Department of Environmental Quality.

Contents

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In today's climate of continually escalating fuel prices, farms must find ways to conserve fuel in order to reduce costs. This publication identifies a number of measures that will reduce fuel consumption on farms, and concludes with a list of resources for more information.

Introduction

Expenditures on U.S. farms increased by an average of 26 percent in 2005, and fuel costs contributed heavily to that increase. Specifically, U.S. farmers spent $5.84 billion on diesel fuel and $2.30 billion on gasoline in 2005.

While there is little you can do to change the price you pay for fuel, you can take steps that will reduce fuel consumption and save money.

This publication provides useful tips to help you start saving fuel on your farm today. Many are free or low-cost measures that can provide immediate savings. Others have an associated cost, but offer a cost-effective payback. This publication will focus on energy conservation in three areas:

- fuel storage
- vehicle operation and maintenance
- field practices

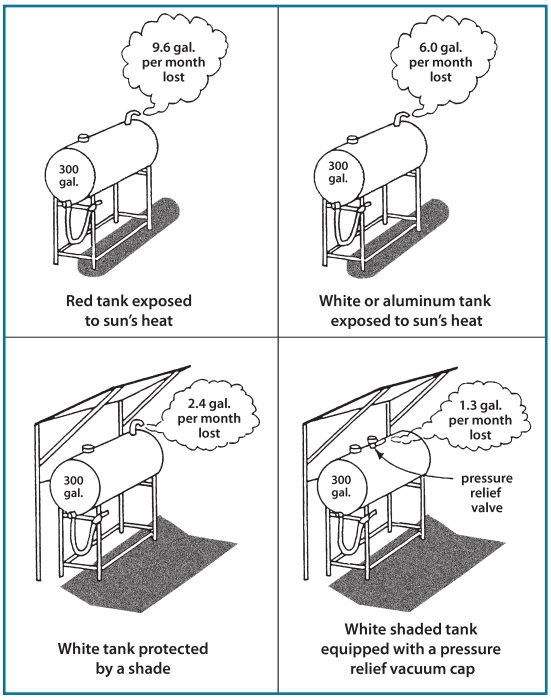
ATTRA offers several other publications that can help you conserve energy on your farm or ranch. See, for example, *Energy Saving Tips for Irrigators*, *Maintaining Irrigation Pumps, Motors, and Engines*, and *Efficient Agricultural Buildings: An Overview*. Also see ATTRA's *Farm Energy Calculators* page for information on calculators designed to help producers save electrical energy, fuel or fossil-fuel-based fertilizers.

Fuel Storage

Storage tanks can lose a considerable amount of fuel due to evaporation and leaks. A 300-gallon storage tank, for example, can lose about 120 gallons each year from evaporation. You can reduce that loss to about 15 gallons per year by following these steps:

Source: National Biodiesel Board

- Keep fuel tanks well-shaded.
- Paint tanks white or aluminum to reflect the sun's heat. Light colors reduce evaporation losses.
- Use pressure-relief vacuum caps rather than conventional gas caps.
- Lock unattended fuel tanks.
- Regularly inspect your tanks for leaks. During those inspections, tighten connections between the storage tank outlet and the pump, check valve packings, and check for seepage at the nozzle. Be especially vigilant about inspecting underground storage tanks, since leaks can cause groundwater contamination. *Note: Underground storage tanks have the least evaporation, but undetected leaks can contaminate groundwater.*



Source: Wyoming Energy Conservation Office

Fuel Storage Safety Considerations

- Label gasoline and diesel storage tanks to prevent mistakenly filling a diesel tractor with gasoline which can ruin the diesel injection pump and nozzles.
- Locate storage tanks at least 50 feet from any building, preferably downwind or downhill from the buildings.
- Keep a dry chemical fire extinguisher handy in case of fire.
- Don't smoke around fuel tanks.

Vehicles and Equipment

Before You Start an Engine

Use the recommended grade of fuel. Buying a better grade of diesel than you need can be a waste of money. Most owner's manuals specify a No. 2-D fuel for warm weather operation and No. 1-D for extreme cold weather work.

In cold climates, install an electric block heater and timer on equipment. It is less expensive to warm engines with electricity for a controlled period of time than it is to use liquid fuel. Three hours is generally sufficient to warm an engine. Many available units attach to the block using magnets. If a tractor engine is kept heated all winter for use as a standby generator, you can decrease electrical consumption by installing an air-sensing thermostat set at 20 degrees F, the point at which it will automatically turn on.

Getting the Most Out of an Engine

Make sure your thermostat works properly. A properly working thermostat saves energy. Most engines run most efficiently when water temperature is between 165 and 180 degrees F. Fuel consumption increases by approximately 25 percent when the engine is operating at 100 degrees F, instead of 180 degrees F. Check your owner's manual for more information.

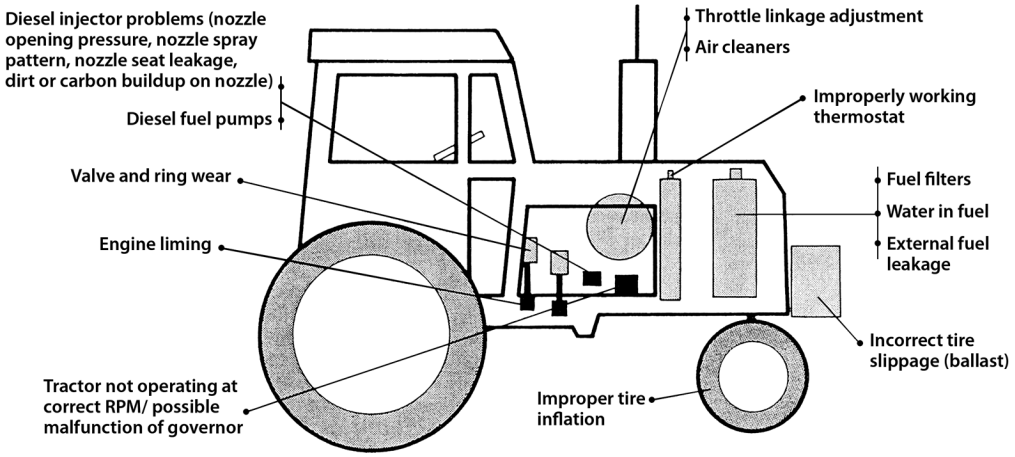
Related ATTRA Publications

Energy Saving Tips for Irrigators

Maintaining Irrigation Pumps, Motors, and Engines

Efficient Agricultural Buildings: An Overview

Factors Reducing Fuel Efficiency in a Diesel Tractor



Source: Wyoming Energy Conservation Office

Estimating Diesel Fuel Use

By using a "consumption factor" developed by the University of Nebraska and plugging in your figures, you can estimate your annual tractor diesel use:

Annual Consumption = Hours Use × Rated Horsepower × Consumption Factor

Diesel consumption factor: 0.054 gal/hp hr

EXAMPLE:

Approximate annual hours of use = 700

Tractor's maximum rated horsepower = 66

Annual diesel consumption = 700 × 66 × .054 = 2,495 gallons

Minimize idling, which can account for 15 to 20 percent of total fuel used. Letting an engine idle for 10 minutes during an average day, or 61 hours a year, will use about 31 gallons of fuel on a 75-horsepower diesel tractor.

Avoid quick starts—they waste fuel and are hard on equipment.

Perform maintenance. Keeping your farm vehicles and equipment in top operating condition will save fuel and money, help reduce repair costs, improve reliability, and minimize harmful exhaust emissions. Common maintenance measures include getting regular tune-ups; replacing air, oil and fuel filters routinely; changing oil as recommended by manufacturers; and using the proper grade of oil. Refer to your owner's manual for specific maintenance measures for your equipment.

One fouled spark plug or one stuck valve lifter can increase fuel use by 10 to 15 percent.

Blocked air filters can increase fuel consumption by as much as 20 percent.

Ensure that gas caps fit properly. Caps that are damaged, loose, or missing altogether will cause fuel to vaporize.

Reduce excess weight on vehicles. Lighter loads consume less fuel than heavier ones.

Keep your tires properly inflated. Having just one tire under-inflated by six pounds per square inch (psi) can increase fuel consumption by three percent, not to mention reducing the tire's life. Cold temperatures decrease the air pressure in tires, so check tire pressure regularly when tires are cold. Check your owner's manual for information on correct inflation pressure.

Have wheels aligned and balanced. Proper alignment and balance—like proper air pressure—help minimize resistance from your tires, which can reduce fuel economy.

Upgrade to more fuel-efficient models. When it's time to replace your equipment, compare fuel requirements of different makes and models. A higher purchase price can be partially offset by lower fuel costs. The Nebraska Tractor Test Laboratory conducts performance tests of tractors, including fuel performance. Test reports for many tractor makes and modes are available online at *http://tractortestlab.unl.edu.*

Field Practices

Depending on how you manage your fields, you could significantly reduce your fuel use by changing your field practices.

Conservation or Reduced Tillage

In conservation tillage, also known as minimum tillage or reduced tillage, crops are grown with minimum cultivation. Fuel savings vary, but could be as much as $10 per acre compared to traditional tillage methods. And, you can cut tractor use in half with no-till methods.

No-till planting. Source: USDA NRCS

The trade-off is a possible increase in the amount of chemical used for weed control and fertilizer. In conventional tillage, the operator normally will plow, disk, and harrow before and after planting. Reduced tillage minimizes these operations by either eliminating seedbed preparation or combining it with other field operations like planting. For example, strip or zone tilling methods till only a small area where seed is planted. Ridge- and mulch-till methods require fewer trips across the field. You can learn much more about reduced tillage options in ATTRA publications such as *Conservation Tillage* and *Pursuing Conservation Tillage Systems for Organic Crop Production*.

If you use equipment with too much or too little horsepower for the job, your fuel efficiency will decline dramatically.

Some practices that will reduce tillage are:

- Preparing the seedbed just ahead of planting to reduce the chances of rain between preparation and planting, and the possibility of having to reseed. Prepare a seedbed only in the row area, leaving the middle rough.
- Combining operations. For example, you may be able to combine the final seedbed preparation with planting, the fertilizer operation with a tillage operation, and so on.
- Using herbicides that don't require incorporation, in areas with minimal weed problems. You may also plant at optimum time to combat weeds by crop competition, reducing the need for herbicides.

The USDA Natural Resources Conservation Service has developed a useful tool called *Energy Estimator: Tillage*, which estimates diesel fuel use and costs in the production of key crops in your area and calculates potential energy savings available by changing from conventional tillage to alternative tillage systems. For more information, see the Energy Tools website at *http://energytools.sc.egov.usda.gov*.

Tractor Operation

Use the correct size equipment for the job. Choose the smallest, lightest tractor appropriate for the job to get the best fuel mileage. If you use equipment with too much or too little horsepower for the job, your fuel efficiency will decline dramatically.

Source: NREL

Avoid unnecessary driving. Technologies such as cell phones and radios can be used to solve problems from the field, rather than driving. Combine errands into a single trip, if possible.

Operate at the recommended speed. Power requirements increase with increased speed, resulting in greater fuel use. Consult your owner's manual for speed recommendations.

Use effective travel patterns. Lay out your fields to minimize turns and to keep the track on a level path (keeping erosion-control practices in mind). Coordinate livestock grazing location with tractor field work to minimize idling time when opening and closing gates. Installing cattle guards can eliminate stopping and idling time.

Tire Slippage

Tractor tire slippage should be from 10 to 15 percent. Insufficient ballast can create excessive tire slippage and increase fuel consumption, not to mention premature engine wear. Remove extra ballast for lighter loads. You'll get better fuel economy, reduce soil compaction, and your equipment will last longer.

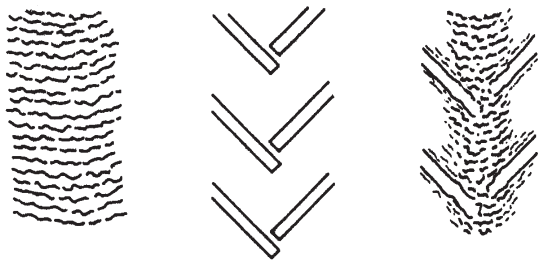
Ballasting a tractor (adding weight to the rear for increased traction and/or to the front for stability and good

steering) can correct slippage. The correct weight to match the job is important. Too much weight increases rolling resistance and strains the tires and drive train. Too little weight increases fuel consumption and tire wear.

Check advantages and disadvantages of single tires versus duals. In soft, loose soils, duals will increase the contact area between the tire and soil, which can be more effective for increasing drawbar power than adding ballast.

Checking Tractor Tire Slippage: Tread Marks

An approximate method for checking proper ballast is to observe the tire tread pattern produced when pulling under load, using the following guidelines:



Too little | Too much | Proper weight

Too little weight—the tread marks are wiped out entirely due to excessive slippage, which reduces forward progress.

Too much weight—the tire tracks will be sharp and distinct in the soil.

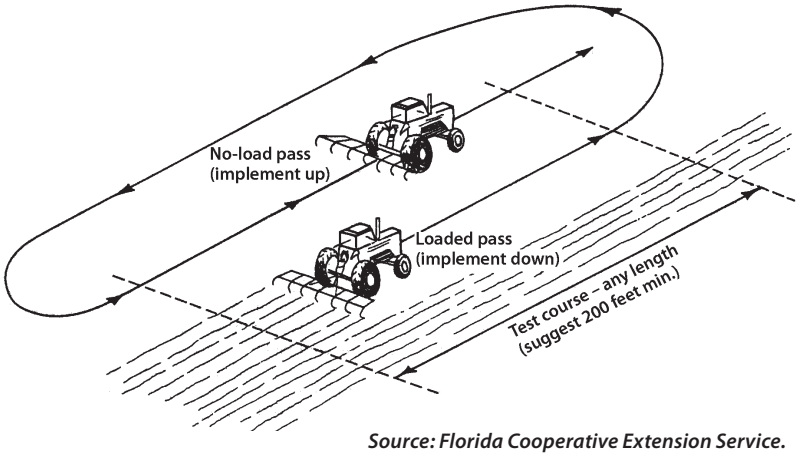
Proper weight—the soil between the cleats in the tire pattern is shifted, but the tread pattern is still visible

Source: Florida Cooperative Extension Service.

Checking Tractor Tire Slippage: Measuring

A more accurate way to determine slippage is to compare the number of rear wheel revolutions when the tractor is not under load with the number of revolutions under full load. When the tractor is under full load, the drive wheels should make about 10 revolutions compared with 8-1/2 when it's not under full load to advance the same distance.

You can easily determine the percent of tire slippage by following these six steps. You'll need another person to help, as well as paint, tape, or chalk; and two marker stakes.



Source: Florida Cooperative Extension Service.

1. With paint, tape, or chalk, make a reference mark on the sidewall of the rear tire.
2. While the tractor is performing a heavy draft operation at field speed, place the first stake to mark the spot where the tire meets the soil.
3. Walk beside the tractor counting ten revolutions of the wheel.
4. Use the second stake to mark the spot where the tire mark again meets the ground on the tenth revolution.
5. Take the implement out of the ground and again operate the tractor between the two stakes. Count the number of rear wheel revolutions for the tractor to cover the staked distance while pulling no load. Estimate the last wheel revolution as closely as possible.
6. Calculate the slip using this formula: **% Slip = [(10 – the no-load revolutions) × 100] / 10**
   EXAMPLE: If 8.5 revolutions occurred for the staked distance with no load, the percent of slip would be:
   % Slip: [(10-8.5) × 100] /10 = 15%
   Use the following information as a guide for adding or removing ballast:

% Slip	Result
0 to 5	Remove weight
10 to 15	Proper weight
20 or more	Add weight

Source: Fuels for Agriculture, Wyoming Energy Conservation Office.

Remember that a towed implement requires more ballast than a mounted implement. The mounted implement provides weight transfer to the rear tires that acts as additional ballast, which helps to control slippage.

Drawbar Work

Gear up and throttle down. Studies show that, on average, the drawbar load on a farm tractor is only 50 percent of its rated capacity. For partial drawbar loads, gearing up and throttling down to reduce engine speed (rpm) can reduce fuel consumption considerably. According to the Iowa State University Extension, fuel savings can range from 5 to 15 percent at 75 percent power, and 15 to 30 percent at 50 percent power.

For best fuel efficiency, select the gear that provides the desired ground speed at the reduced engine rpm, without overloading.

Because of the drop-off in fuel efficiency at higher loads, many diesel engines run more efficiently at 50 percent load and a reduced engine speed than at 100 percent load and full engine speed. Therefore, a large diesel tractor used for light drawbar loads can actually use less fuel if geared up and throttled back than a smaller tractor working at its full rated capacity.

For best fuel efficiency, select the gear that provides the desired ground speed at the reduced engine rpm, without overloading. (Overloading is indicated by black smoke or sluggish response to acceleration. Check your owner's manual for the "working rpm range" of your tractor.)

Hitching. Power and fuel are wasted if your tractor and implements "fight" each other as they move through the field. Align soil-engaging parts of tillage tools for minimum draft as illustrated below.

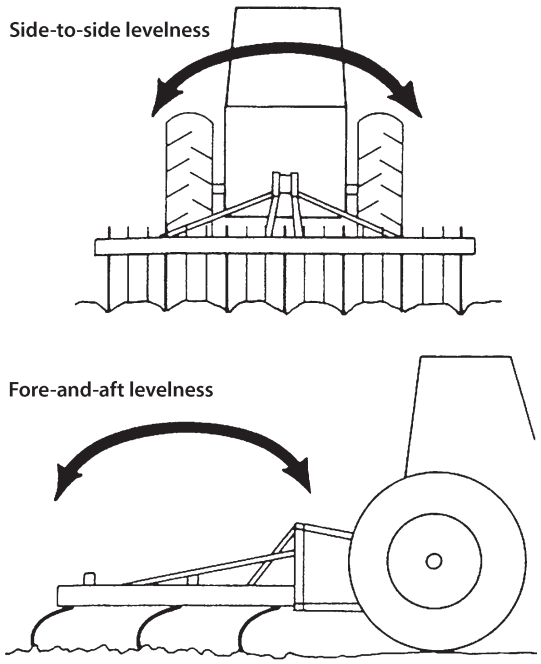
Matching Equipment to Task

Ask yourself if certain practices are slowly siphoning your energy dollars. Take a look around and see where better planning or a small investment might save energy and money in the long run. For example:

- Would a larger seed hopper decrease trips to refill planters?
- Is your disk so small that it takes an extra pass between rows, or is it so excessively wide that it requires too much horsepower?
- Are you using a full-sized vehicle for spraying, spreading, rock picking, and other tasks, instead of a small, lightweight vehicle, such as an ATV?

The table on the next page shows average fuel requirements for some common farming equipment.

As this publication illustrates, there are a lot of ways to reduce fuel consumption on your farm or ranch. Get started today on a fuel conservation plan and you could increase profits, prolong the life of your equipment, help protect the environment, and more.



Implement Hitching and Levelness.

Reprinted from Conservation, Storage & Handling of Fuel for Farm Machinery, Cooperative Extension Service, Purdue University.

Average Fuel Requirements for Farming Tasks

Operation	Gallons Per Acre	
	Gasoline	Diesel
Plow 8 inches deep	2.35	1.68
Heavy offset disk	1.33	0.95
Chisel plow	1.54	1.10
Tandem disk, stalks	0.63	0.45
Tandem disk, chiseled	0.77	0.55
Tandem disk, plowed	0.91	0.65
Field cultivate	0.84	0.60
Spring-tooth harrow	0.56	0.40
Spike-tooth harrow	0.42	0.30
Mulch treader	0.42	0.30
Rod weeder	0.42	0.30
Sweep plow	0.84	0.60
Cultivate row crops	0.63	0.45
Rolling cultivator	0.49	0.35
Anhydrous applicator	0.91	0.65
Planting row crops	0.70	0.50
No-till planter	0.49	0.35
Till plant (with sweep)	0.56	0.40
Grain drill	0.49	0.35
Combine, small grains	1.40	1.00
Combine, corn and grain sorghum	2.24	1.60
Mower (cutterbar)	0.49	0.35
Mower conditioner	0.84	0.60
Swather	0.77	0.55
Rake, single	0.35	0.25
Rake, tandem	0.21	0.15
Baler	0.63	0.45
Sprayer	0.14	0.10
Rotary mower	1.12	0.80
Haul small grains	0.84	0.60

Averages, based on values from agricultural engineers in several states.

Source: *Estimating Farm Fuel Requirements,* Colorado State University Cooperative Extension.

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