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Energy management on Iowa farms

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Energy use on Iowa farms

Iowa agriculture spends about one billion dollars annually on the purchase of diesel fuel, electricity, propane, gasoline and natural gas. The actual amount fluctuates with the rise and fall of energy prices.

Grain prices have recently decreased and livestock prices continue to fluctuate. Controlling input costs is important to maintaining profitability. Although fuel and energy are not the most expensive inputs to crop or livestock production, they are typically the easiest to manage. Energy is required for all farm enterprises, but excessive consumption without a return in production lowers profitability.

Energy use is impacted by management style. Slight alterations in management can reduce energy costs often without changing production output. Tractor maintenance and operational techniques can reduce fuel used for field operations. When appropriate, eliminating a tillage pass or reducing aggressiveness (e.g. tillage depth) for field crops reduces fuel consumption.

ISU Farm Energy project

In collaboration with the Iowa Energy Center, ISU Extension and Outreach has developed a website (http://farmenergy.exnet.iastate.edu) with educational resources, including 24 fact sheets that describe energy management techniques for crop and livestock production. The fact sheets are grouped with subheadings such as farm equipment, field crops, and grain drying. Topics are focused on major Iowa commodities such as corn, soybeans, swine, poultry, and dairy. Additional fact sheets discuss lighting and heating in the farm shop, tracking the energy use on your farm, and other more general energy topics (e.g. electrical demand).

Additional resources available on the website include links to press articles about farm energy efficiency, archives of the annual ISU Farm Energy webinars, and upcoming field days and workshops announced via Twitter @ISU_Farm_Energy. A task force of statewide partners include members of Iowa's electrical service providers, Iowa Farm Bureau Federation, Iowa Economic Development Authority, and USDA Rural Development advise the project.

Measuring energy use on ISU research farms

The project has recently partnered with ISU Research and Demonstration Farms at several locations statewide, as well as the student-run Ag 450 Farm near Ames, Iowa to measure tractor fuel consumption, energy used during grain drying, and swine ventilation. Objectives are to measure baseline energy consumption during farm activities and also to demonstrate energy management techniques.

For example, lowering engine speed by shifting the throttle back and using a higher transmission gear for tractor drawbar loads can reduce fuel consumption while still performing the same amount of work in the field. During field cultivation prior to planting at the Nashua research farm, a field cultivator was pulled at 5 mi/h in either gear C1 at 2080 engine rpm or gear C2 at 1710 engine rpm. When using the higher gear and lower throttle setting, 18% less fuel per acre was used (figure 1).

One tractor has been selected at each participating research farm on which to mount a small on-board auxiliary fuel tank for in-field measurements. Future tests are planned to compare fuel consumption with tillage depth and different tire inflation pressures. A secondary task is to check items such as tire inflation and ballast present on the tractors with recommendations for optimal efficiency.

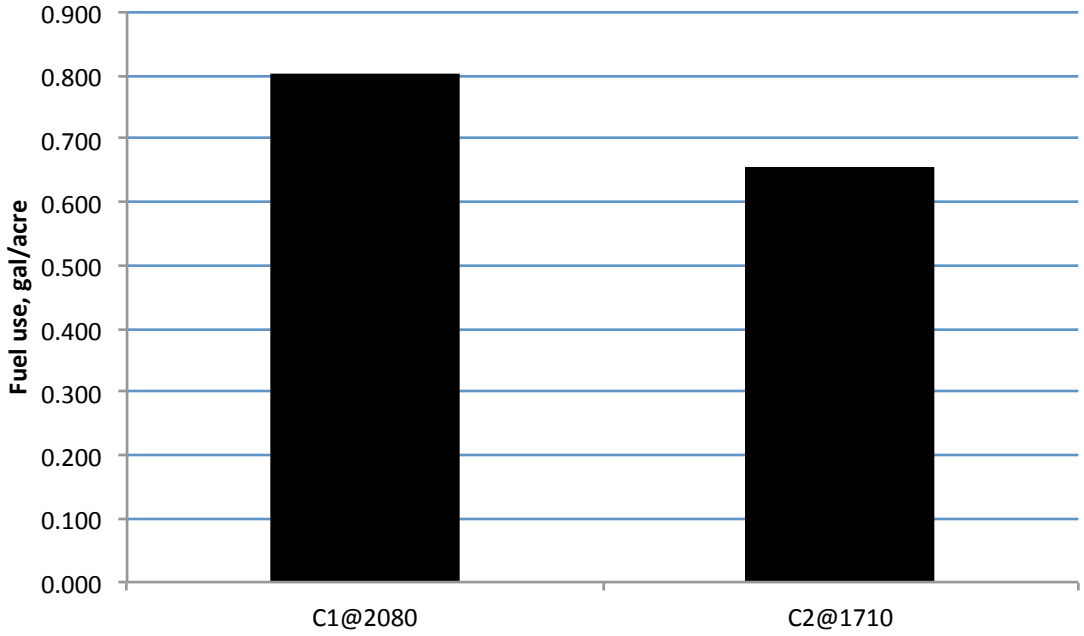

Figure 1. Field cultivation at 5 mi/hr using different transmission gear and engine throttle settings

Checking tire inflation and ballast

As an example, a John Deere 7730 tractor rated at approximately 170 hp is used by research farm staff for planting, side dressing fertilizer, and grain cart operation. It is also used on a smaller acreage with a 3-point mounted chisel plow. It has a significant amount of road transport for widely scattered field locations. Checking scale weights, the tractor currently carries 12,060 lb on the rear axle and 8200 lb on the front axle for a total tractor weight of 20,260 lb. Rear tires (480/80R42) were inflated to 13 psi and front tires (380/85R30) inflated to 22 psi.

For the current tractor weight, each of the four rear tires carries 3015 lb and the two front tires support 4100 lb each. For the rear tires, the tractor manual recommends 7 psi. Load and inflation tables from the tire manufacturer recommend 6 psi in the rear tires for this loading, but show increasing inflation pressure to 11 psi if an additional 4,000 lb is added to the rear axle. Suggested tire inflation for the front axle for existing axle loading is 20 psi (by both the tractor manual and tire manufacturer).

Correct tire inflation pressure as tested and determined by the manufacturer transfers the most horsepower from tires to soil (developing drawbar pull) with minimal increase in tire wear. Footnotes in tire load and inflation tables usually mention additional inflation if a mounted implement increases rear-axle weight in the raised position and for road speeds greater than about 25 mi/h.

Following this check, farm staff decided that both rear- and front-tire pressures were high and perhaps too conservative to take advantage of tractor horsepower. Front-tire air pressure was lowered to 20 psi. Rear-tire pressure was lowered to 10 psi as a compromise to gain additional tractive horsepower but still allow capacity to carry the mounted chisel plow at road speeds. Of additional note, during OECD tractor testing at the University of Nebraska-Lincoln, this model tractor with the same tire sizes also used 10- and 20-psi inflation pressure on rear and front tires, respectively. Tractor weight during the tests to maximize power and fuel efficiency was actually slightly higher on the rear-axle, corresponding to ballasting suggested in the ISU Farm Energy fact sheet PM 2089G,"Ballasting tractors for fuel efficiency." Based on this, the ISU research farm staff have also added additional rear-wheel weight.