

ENERGY IDEAS

COOPERATIVE
EXTENSION
SERVICE



north dakota energy management
and conservation

NORTH DAKOTA
STATE UNIVERSITY
MAR 14 1979
SERIALS DEPT.
LIBRARY

North Dakota State University Fargo, North Dakota 58105

CIRCULAR AE-651



JANUARY 1979

Gear Up... Throttle Down!

DUANE HAUCK
Extension Associate
Agricultural Engineer

VERNON L. HOFMAN
Extension
Agricultural Engineer

The amount of tractor fuel required to perform a specific amount of work depends partially upon how the tractor is operated. The load, engine speed, gear used, amount of turning and amount of engine idle can cause fuel consumption to vary considerably.

For most efficient operation, a tractor's engine should be operated near its rated capacity. However, there are many field operations which do not require full rated tractor horsepower. This is especially true when implements which were sized for a smaller tractor are used with high horsepower tractors. Further, many operations must be performed at a fixed field speed. For these light or part load operations, a substantial amount of fuel can be saved by shifting to a higher gear and slowing the engine speed to maintain the desired field speed.

This fact is proved conclusively by Nebraska Tractor Tests. A tractor is tested in the following manner:

1. The tractor is tested for maximum drawbar horsepower in a gear selected by the tractor manufacturer.
2. In the same gear, the tractor is tested pulling 50 percent of the maximum power run load.
3. The tractor is tested in a higher gear and at a reduced engine speed to maintain the same pull and travel speed as in run 2.

RESULTS: During run 3, most tractors tested use between 15 and 30 percent less fuel than during run 2, even though the same amount of work was performed during both runs. Throttle setting and gear selection are the only factors changed.

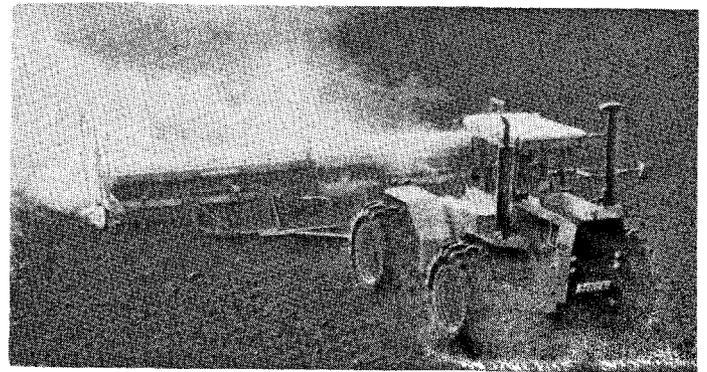


FIGURE 1. For light drawbar loads, fuel efficiency can be improved by shifting to a higher gear and reducing the engine speed.

Normally, this practice can be used when loads require less than 65 percent of the tractor's power. It is generally safe to reduce engine RPM by 20 to 30 percent of the rated RPM. Check the operator's manual for specific recommendations for your tractor.

When using the practice of "gear up - throttle down", the most important thing to remember is NOT to overload or lug the engine. Visible black smoke may be one indicator of an overloaded diesel engine. An easy check to be sure that the engine is not overloaded is to work for a short time at the desired speed and throttle setting. Then, rapidly open the throttle. If the engine readily picks up speed, it is not overloaded, and the original throttle setting is suitable. If the engine does not respond normally, shift down a gear or increase the engine speed. Again, check for engine overload at the new settings.

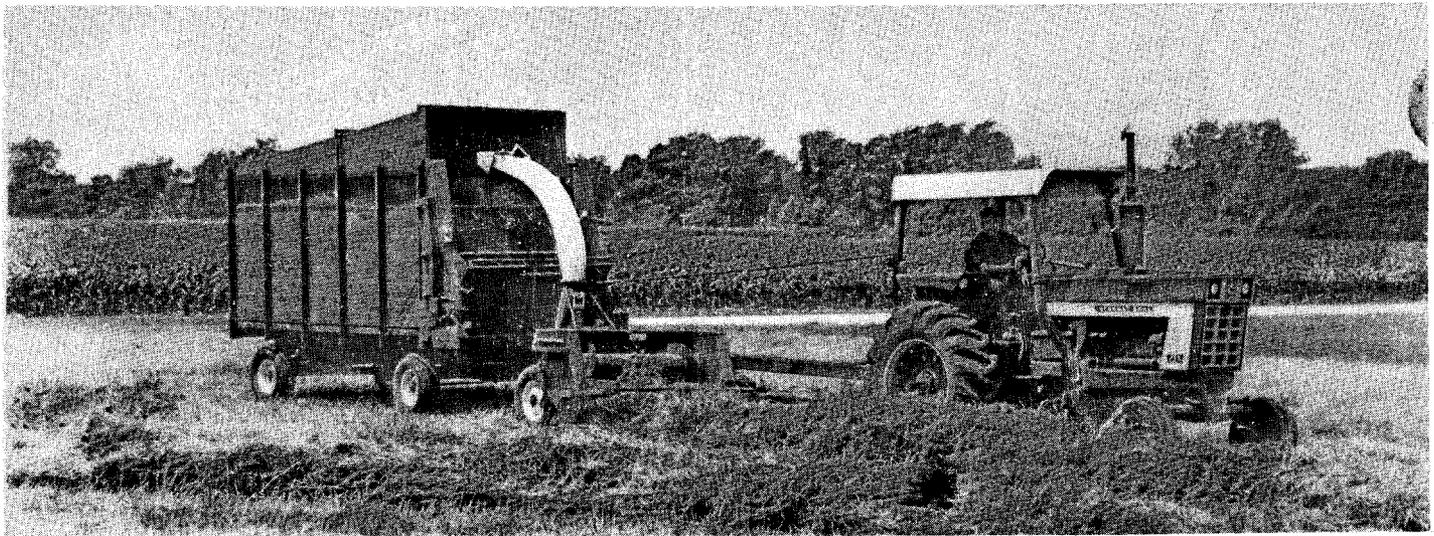


FIGURE 2. It is important to match the tractor to the load when doing PTO work because this equipment usually must be operated at rated RPM.

However, there are two drawbacks with the practice of “gear up - throttle down”. When engine speed is reduced, power take off (PTO) speed is correspondingly reduced and reaction time of the tractor hydraulics is slower.

Nebraska Tractor Tests indicate that a large diesel tractor operated at reduced engine speed for light drawbar loads may actually use less fuel than would a smaller tractor working at its rated capacity.

For example – suppose you have a choice between two tractors to perform an operation which requires 55 drawbar horsepower. The first is rated at 56 drawbar horsepower and the second at 110 drawbar horsepower. Which tractor should be used?

Data in Table 1 show that the large tractor geared up and throttled down has the highest fuel efficiency (13.55 horsepower-hour per gallon). The saving is about 1 gallon per hour over full throttle operation of the large tractor and .29 gallons per hour saved over the fuel used by the small tractor. This shows that a large tractor properly matched to a light load may save energy compared to a tractor half the size operating at full load. An added gain is increased annual usage of the large tractor. This helps spread the costs of owning a large tractor over an extended period of time.

Remember, Nebraska Tractor Tests are conducted on a concrete surface. Tractors operated in the field will have more rolling resistance, especially on soft or freshly tilled soil, so results may vary slightly from test data.

TABLE 1

Tractor and Operation Comparison

| | Small Tractor | Large Tractor | Large Tractor |
|--|------------------|------------------|------------------|
| Throttle Setting | Full | Full | Reduced |
| Percent Load | 100% | 50% | 50% |
| Drawbar Horsepower | 55.79 | 56.67 | 56.72 |
| Fuel Consumption (Gallons / Hour) | 4.49 | 5.23 | 4.20 |
| Fuel Efficiency (Horsepower-Hours / Gallon) | 12.54 | 10.91 | 13.55 |

(Values are for two typical tractors)

Many tractor operators feel that because a tractor is turbocharged it needs to be operated at full RPM. There is no justification for this if full drawbar horsepower is not required.

Fuel consumption and fuel efficiency can vary widely for specific tractors. Fuel efficiency (horsepower-hours per gallon) is the amount of work the tractor produces per gallon of fuel used. This measure is not influenced by engine size and can be used to compare efficiencies of tractors with different horsepowers. Consult the individual tractor test reports for your tractor when making an efficiency selection. Also, by keeping accurate records of the fuel usage of your tractors under a variety of operating conditions, you will be able to confirm that you have selected the most economical tractor for a certain operation.