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CC279 Gear Up -- Throttle Down

David P. Shelton
University of Nebraska-Lincoln, dshelton2@unl.edu

Kenneth Von Bargen
University of Nebraska-Lincoln

Farm Energy Tips

USE ENERGY WISELY

CC 279

Gear Up—Throttle Down

David P. Shelton, Research Associate
Ag Engineering
Kenneth Von Bargen, Professor, Systems Engineering

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 rated tractor horsepower. This is especially true when older 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 lighter 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 is confirmed by the Nebraska Tractor Tests. Information on fuel savings is given in three of the Drawbar Performance tests.

Test One: (Maximum Available Power). In a gear selected by the manufacturer, the pull and travel speed are measured and used to determine maximum available power. This test is performed at full throttle.

Test Two: (50% of Pull at Maximum Power). In the same gear and at full throttle, the tractor is tested at half of the pull of Test One.

Test Three: (50% of Pull at Reduced Engine Speed). The tractor is tested in a higher gear with a reduced throttle setting. Drawbar horsepower, speed, and pull are about the same as for Test Two.

During Test Three, most tractors use between 15 and 30 percent less fuel than during Test Two. Throttle setting and gear selection are the only factors changed between the two tests.

Twelve diesel tractors in the 90-120 drawbar horsepower range were selected as an example. These tractors are commonly purchased by Nebraska farmers. For Tests Two and Three, fuel consumption (gallons per hour) and fuel efficiency (horsepower—hours per gallon) were compared. A higher fuel efficiency means that the tractor produced more work per gallon of fuel used. This measure is not influenced by engine size and can, therefore, be used to compare efficiencies of tractors with different horsepowers.

Table 1. Average performance of twelve diesel tractors in the 90-120 drawbar horsepower range.

	Average	*Range*
Test Two: (50% of Pull at Maximum Power)		
Drawbar horsepower	60.56	
Gallons per hour	5.67	4.49 to 6.67
Horsepower hours per gallon	10.75	9.80 to 11.95
Test Three: (50% of Pull at Reduced Engine Speed)		
Drawbar horsepower	60.56	
Gallons per hour	4.54	4.00 to 5.24
Horsepower hours per gallon	13.39	12.16 to 14.64

When the tractor was "geared up and throttled down," fuel consumption was reduced an average of 25 percent, and fuel use efficiency was 20 percent better. Remember, both travel speed and drawbar horsepower were the same for the two tests. Only a change in throttle and gear occurred.

Normally, this practice can be used when loads require less than about 65 percent of a tractor's power. It is generally safe to reduce engine RPM by 20 to 30 percent of the rated RPM. You should 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 indication of an overloaded

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diesel engine. An easy way to 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, you should shift down a gear or increase the engine speed. Again, check for engine overload at the new settings.

There is no justification for operating either turbocharged or naturally aspirated engines at full throttle when full drawbar horsepower is not required.

Five major tractor manufacturers who responded to an inquiry concerning the "gear up-throttle down" practice indicated that the practice was suitable for their tractors and capable of saving fuel. Further, it was stated that this practice could decrease maintenance, down time, and expenses generally incurred from over-speeding mechanical equipment.

However, there are two major drawbacks with this practice. When engine speed is reduced, power take off (PTO) speed is correspondingly reduced and reaction time of the tractor hydraulics is slower.

Suppose you need to perform an operation which requires 55 drawbar horsepower. You have a choice between two tractors. The first is rated at 56 drawbar horsepower and the second at 110 drawbar horsepower. Should you use the small tractor at full throttle and full load, the large tractor at full throttle and 50 percent load, or the large tractor at 50 percent load but geared up and throttled back?

Data in Table 2 show that the large tractor when geared up and throttled back has the highest fuel efficiency (13.55 horsepower-hours per gallon). The savings is about 1 gallon per hour over full throttle operation of the large tractor. In addition, 0.29 gallons per hour are saved over the fuel used by the small tractor. This shows that a large tractor properly matched to a light load can 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 time period.

Remember, fuel consumption and engine efficiency can vary widely for specific tractors. Consult the individual Tractor Test Reports for your tractors when making an efficiency selection. Keep accurate records of the fuel usage of all your tractors under a variety of operating conditions. (See publication CC 271 in this series of Farm Energy Tips entitled Fuel Use.) By doing this, you will be able to confirm that you have selected the most economical tractor for a certain operation.

Table 2. 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 $\left(\frac{\text{Gallons}}{\text{Hour}}\right)$	4.49	5.23	4.20
Fuel efficiency $\left(\frac{\text{Horsepower-Hours}}{\text{Gallon}}\right)$	12.54	10.91	13.55

(Values are for two typical tractors).

In summary, the fuel saving practice of "gear up-throttle down" involves reducing engine speed to 70 to 80 percent of rated engine speed, and shifting to a higher gear to maintain the desired field speed. This practice is suitable for light drawbar loads (less than 65 percent of full power) when reduced PTO speed is not a problem. Remember NOT to overload the engine.

To check, operate for a short time at the desired throttle setting in the selected gear. Quickly open the throttle. The engine should speed up readily.

By using the practice of "gear up-throttle down" whenever possible, you will be on your way toward "Using Energy Wisely" and getting the most for your fuel dollars.

Table 3. Appropriate metric conversions.

Multiply	*by*	*to obtain*
Gallons/hour	3.785	Liters/hour
Horsepower	0.746	Kilowatts
$\frac{\text{Horsepower-hours}}{\text{Gallon}}$	0.197	$\frac{\text{Kilowatt-hours}}{\text{liter}}$

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