

## Nine Tips for Tractor Operators

A practical guide to getting the most from your tractor.

### *Managing Your Tractor*

Over the years PAMI and AFMRC have evaluated over 600 different pieces of farm equipment that all have one thing in common—they needed a tractor in order to use them. This work has given our project personnel experience with tractors of all sizes and brands, old and new.



If you exceed the maximum permissible working weight of your tractor, you can expect premature drivetrain failures and reliability problems. You may also exceed the authorized ROPS cab weight, jeopardizing safety.

Another general rule of thumb is that

you can improve productivity by going faster with a smaller implement, rather than by pulling a wider one at a slower speed.

But regardless of tractor size or brand, there are some basic, often overlooked operation guidelines that can help you get the best performance out of your tractor. Managing your tractor for the best possible performance can also help minimize your input costs. Here's a few tips to help.

### *Overall Weight*

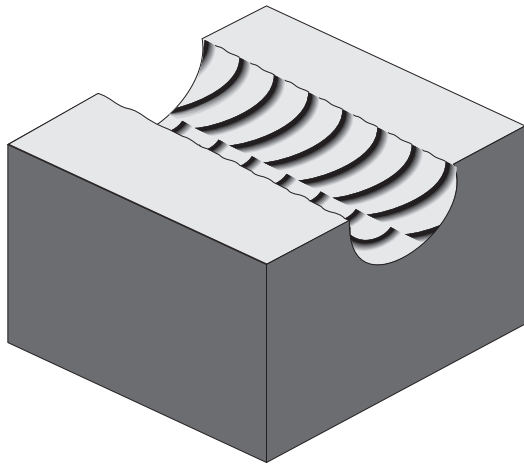
No matter how much power your tractor has when pulling equipment, you will almost always run out of traction before you run out of power—unless you over-ballast. But it's a misguided assumption to think that you will accomplish more work by putting more weight onto your tractor.

### *Ballasting, Ballast Distribution, and Wheel Slip*

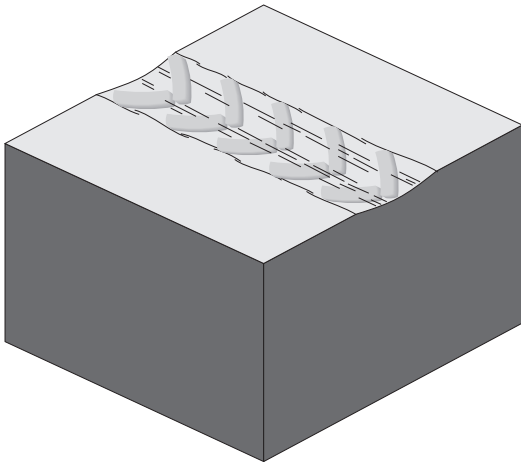
Most work is done where maximum tractor weight is not needed. Most farmers use more than 80 per cent of available power only 15 to 20 per cent of the time.

That's why weighting for typical conditions rather than maximum needs can reduce operating costs.

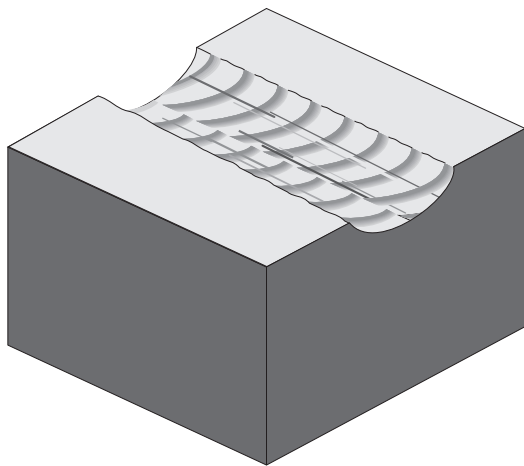
Ballast distribution between the front and back wheels should not be overlooked. Most operator's manuals or dealers can help you determine the total



***Too much weight***



***Too little weight***



***Right weight***

ballasted weight for your tractor.

To fine tune ballast distribution, it's important to consider three variables: horsepower, travel speed, and wheel slip (refer to Research Update 725, *Ballasting for Performance*). The total ballasted weight should be split about as follows:

	Front	Back
2WD	30%	70%
FWA	40%	60%
4WD	55%	45%

Wheel slip should be in the 10 to 15 per cent range for two wheel drive tractors and 8 to 12 per cent for four wheel drive tractors. The procedure for measuring wheel slip compares the number of wheel turns over a fixed distance with the tractor unloaded, to the number of wheel turns over the same distance under load. Some tractor operator's manuals include a section on how to measure wheel slip, or you can consult Research Update 725, *Ballasting for Performance*.

### ***Tires***

Radial or bias-ply, inflation pressure, load ratings, number of tires, and tire sizes all play a role in optimizing tractor performance. An improper combination of any of these variables can lead to tractor hop, increased soil compaction and rolling resistance, and premature tire wear or even failure.

A North Dakota State University study has shown that correctly inflated radials give about a six per cent improvement in traction compared to bias ply tires. An ASAE (American Society of Agricultural Engineers) study in 1986 says radial tires become economical after 667 hours of use. Radials generally offer a slightly larger footprint than bias-ply tires.

A survey in Oklahoma<sup>1</sup> showed that only 45% of tractor tires were within the recommended tire inflation values. The same is probably true elsewhere in North America.

Tires should be neither over nor under inflated. Over inflated tires will rut soft soils more easily,

decrease traction, wear unevenly, and strain the tire material itself. Under inflated tires reduce efficiency, increase wear, and increase the likelihood of side buckling and rim slip. Manufacturers publish load inflation tables to help you determine the optimum inflation for the number and size of tires you use. A general rule of thumb is to operate at the lowest allowable pressure.

Overloading tires will cause premature wear, excessive soil compaction, and increased fuel consumption due to increased rolling resistance.

Using duals is most easily justified where soil compaction is a real concern. But be aware that more tires will increase rolling resistance, especially in soft field conditions. In most conditions duals reduce wheel slip by about the same amount as an equal quantity of added weight.

AFMRC tests have shown that FWA (also known as MFWD) tractors with single tires is more efficient than the same tractor with duals. In similar tests on 4wd tractors, triples showed a 5-7% decrease in performance compared to duals.

## ***GUTD- Gear Up, Throttle Down***

Sometimes referred to as GUTD, this concept relates to the fact that an engine operated under maximum or near maximum load achieves the greatest amount of work per given volume of fuel.

But many field operations don't require maximum rated horsepower. You can save fuel in these operations by shifting to a higher gear and slowing engine rpm to maintain the desired field speed.

Some practical tips for working in GUTD mode:

- Use GUTD when the load pulled requires less than 70 per cent of the tractor's power.
- Engine speed can typically be dropped by 20 or 30 per cent below rated engine speed.
- Don't overload or lug the engine. Visible black smoke can be an indicator of an overloaded diesel engine.
- Make periodic checks for optimum GUTD settings. Work for a short time at your desired speed

## ***A few pressure pointers:***

- *Use an accurate tire gauge that is calibrated in one pound increments. Sources at the Nebraska Tractor Testing Lab suggest that a dial type is generally better than a bar type, but AFMRC evaluations of 10 different gauges suggest that bar type gauges are as or more accurate than dial types (Evaluation Report 707).*
- *AFMRC found fluid ballast damages tire gauges, normally causing them to read low, even on gauges designed for fluid. They suggest operators keep two gauges—one for regular use and one to use as a check gauge. Periodically test the regular use gauge against the check gauge by comparing pressure readings between the two on a dry inflated (car or truck) tire.*
- *Measure tire pressures cold—in the morning or several hours since the tractor's last use.*
- *Tires with fluid ballast will read different pressures, depending on whether you measure with the valve stem at the top or bottom of the tire. Measuring at the top of the tire is less messy, but also less accurate. As a rule of thumb, add about ½ pound of pressure for every foot of liquid depth in the tire. Whether you measure at the top or the bottom is not important as long as you always measure at the same spot for consistency.*
- *Measure pressure in all the tires at regular service intervals.*
- *Easy access means easy measuring. Position valve stems conveniently, especially if you're using duals.*

and throttle setting. Then quickly open the throttle. If the engine readily speeds up, the setting is suitable. If the engine does not respond, shift down a gear or increase engine speed. Perform the check again and readjust as necessary.

- Remember that GUTD also reduces PTO speed, and reaction time for tractor hydraulics is also reduced.

Tractor test data indicates that a large diesel

tractor working at reduced engine speed for a light drawbar load can use less fuel than a smaller tractor working at rated capacity. The following table illustrates this for two typical tractors<sup>2</sup>.

	Small Tractor	Large Tractor	Large Tractor
Throttle Setting	Full	Full	Reduced
Percent Load	100%	50%	50%
Drawbar Hp	55.79	56.67	56.72
Fuel Consumption (gal/hr)	4.49	5.23	4.20
Fuel Efficiency (hp•hr/gal)	12.54	10.91	13.55

A 1983 University of Saskatchewan study of 16 tractors under a range of loads showed overall fuel consumption reductions averaged 9 to 18 per cent in GUTD mode<sup>3</sup>. Even if GUTD is used only one-third of the time, savings can still be substantial.

## ***Soil Conditions***

Estimates indicate there are up to 1200 different soil types in North America<sup>4</sup>. On most farms, soil conditions can vary from field to field, and even within a field.

Soil damage reduces profits. Compacted soils inhibit water infiltration, leading to soil erosion and reduced yields due to runoff and poor drainage. Compaction can also reduce soil tilth and crop yields.

Compaction in the upper soil layers is determined by specific pressure at the surface, which depends on



*Managing soil compaction is about finding an acceptable compromise between compaction and tractor performance for your farm.*

tire inflation pressure and soil deformation. Compaction in the deeper soil layers is determined by the amount of load, and can become permanent and difficult to overcome<sup>5</sup>.

Methods for measuring soil compaction require a tool called a soil cone penetrometer. However, the results from this complex scientific device require interpretation, and the device is not readily available for on farm use. No simple tools or methods have yet been developed enabling the average farmer to measure soil compaction in a given field.

Reducing soil compaction and maximizing tractor efficiency may seem to be at odds with each other. Ideally, a tractor should have 12% slip at full power for optimum efficiency. It's important to find an acceptable compromise between soil compaction and tractor performance for your farm. In some cases it may be worth sacrificing some tractor performance in order to prevent long term compaction difficulties.

So we have to rely on general rules of thumb: Light, loose, tilled, or sandy soils may require more weight than firm, untilled, or heavy soils. But adding weight to driving axles in soft soils can increase rolling resistance to the point where gains in efficiency are offset. Instead, increasing surface contact with soil by increasing the number, size, or type of tires can produce increased traction efficiencies<sup>6</sup>.

Radial tires offer a bigger footprint than bias ply tires, and therefore less compaction. Don't look at your tractor in isolation. For operations that require less weight, lowering the tire pressure will lower compaction.

## ***Maintenance for Performance***

This topic could fill an entire report on it's own. Instead, we're going to look at a few maintenance issues that are frequently overlooked.

Clean air affects the performance and fuel consumption of tractors. (The Donaldson Company has comprehensive information available about proper techniques for servicing air filters—their contact information appears at the end of this report). A few rules of thumb can be applied when cleaning air filters:

### ***Did you know...***

If you feel you're getting more power when running your tractor at night time, you might be right. Running your tractor during the heat of the day also heats the fuel, and this can affect tractor performance. Generally speaking, cooler fuel in summer enhances performance. Some manufacturers are now putting fuel coolers on their tractors.

- Don't over service the air cleaner. Too much interaction with air filters introduces dirt into the system.

- Take the time to learn about proper air cleaner maintenance, especially if you're working in extremely dirty conditions and have to make frequent changes.

- Installing a dirt restriction gauge on your air cleaner is a good indicator for service intervals that eliminates the need for visual inspection. Service the element only when the restriction reading has reached the maximum allowed by the engine or equipment manufacturer. Make sure the gauge is working properly and then pay attention to it.

- Perform air cleaner maintenance with special attention to cleanliness.

Cooling systems are often the most overlooked part of the engine.

It's especially important to remember that anti-freeze for diesel and heavy equipment engines is different from automotive antifreeze because diesel engines use less aluminum and have higher flow rates.

A relatively inexpensive coolant test kit is available from most major manufacturers that allows operators to analyse and optimize engine coolants.

A recent study by Vern Hoffman, Extension Agricultural Engineer, (North Dakota State University) shows that indoor machinery storage is well worth the cost. The study revealed some interesting results<sup>7</sup>:

- Housed machinery had only 7.5% downtime while unhoused equipment was down 14.3% of the

time it should have been working

- Housing tractors indoors increases trade in value by 16% over tractors stored outside.

- Tractors, combines, and planters are the priorities for indoor storage. This equipment depreciates more rapidly when stored outside than other types of equipment.

### ***A Word About Fuel***

The space allowed here cannot do justice to the volumes written about fuel characteristics, but a few general tips are helpful.

Fuel density affects engine performance. Fuel suppliers normally change the fuel density according to the season. But running winter fuel in warmer spring time temperatures or summer fuel in cooler fall temperatures adversely affects engine performance. Plan your fuel inventory so winter stocks will be depleted by spring seeding time.

The density for most diesel fuels is normally in the range of 0.80 to 0.874 kg/L for optimum engine performance. Winter fuels were typically closer to the bottom end of that range, with summer fuels closer to the top end.

According to one fuel supplier, you can expect a diesel engine to get a 1% improvement in fuel economy by volume for every 0.01 kg/L increase in fuel density.

Fuel truck drivers should have fuel specification sheets on hand for every load of fuel they deliver. You can ask to see these sheets and confirm the fuel is at the appropriate density. Also, many fuel companies now have toll-free technical assistance numbers listed in your phonebook's yellow pages.

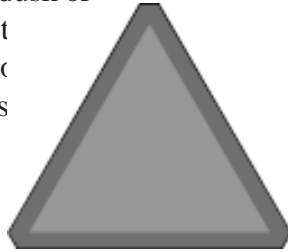
### ***Read Your Operator's Manual***

There's an old cliché that says "If all else fails, read the instructions." A far better rule to follow with farm equipment is "Before anything fails, read the instructions." Manufacturers go to great lengths to compile the most useful tool supplied with your tractor—the Operator's Manual. It's always a good idea to read it.

## Safety

Too many farmers and farm families are affected by accidents on farms every year. Don't become a statistic.

Don't disable safety guards and safety interlocks—they're there to protect you. Tractors are not intended for passengers, so don't take riders. Always make sure your SMV (slow moving vehicle) sign is in place when on roadways, and light or mark the extremities of towed equipment, especially when travelling at dusk or in the dark. Follow the safety instructions in your operator manual, and most of all, use common sense.



## More Information on Tractors

Evaluation Report 707, Comparison Tests on Tire Pressure Gauges, available from PAMI or AFMRC

Research Update 727- Standardized Tractor Performance Testing- What it is and what it isn't.

Research Update 725- Ballasting for Performance, available from PAMI

Tracks versus Wheels- Which is for You?, available from AFMRC see information box on last page of this report for contact information.

Tractor Performance- What's Best for You?, available from AFMRC

Northern Tractor Resource Centre, Montana State University, P.O. Box 7751, 2 Cowan Drive Havre, MT 59501 Phone: (406) 265-3700 FAX: (406) 265-3777

Air Cleaner Servicing, Coolant Test Kit information, available from Donaldson Company Inc., Box 1299, 1400 West 94th Street, Minneapolis, Minnesota 55440 Phone: (612) 887-3131

### Sources:

<sup>1</sup> Reichenberger, 1990

<sup>2</sup> Duane Hauck, Vernon L. Hofman, "Energy Ideas", North Dakota State University, January, 1979

<sup>3</sup> Bryan Lister, "Gear up and throttle down to save on fuel", Country Guide, June 1985

<sup>4</sup> Frank Buckingham, "Tractor weight versus tractor performance", Grainews, February, 1983

<sup>5</sup> Frank Buckingham, "A question of ballast", Power Farming Magazine, December, 1983, p. 9, 10

<sup>6</sup> Naifi G. Musonda, Radhey L. Kushawa, Ronald J. Ford, "Effect of Tire Combinations and Ballasting on 4WD and 2WD Tractive Efficiency", American Society of Agricultural Engineers 0883-8542/89/0504-0517, Vol. 5(4): December 1989, p. 517

<sup>7</sup> North Dakota State University Release, *Manitoba Cooperator*, March 7, 1996, page 57

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