Tyre pressure and fuel efficiency

Managing tyre pressure is an essential means of achieving fuel efficiency in tractors and other heavy farm machinery. Fuel savings of five to 15 per cent can be made by correctly adjusting tyre pressure to match operating conditions. The general rule is lower pressure in the paddock and higher pressure on the road. Adjusting tyre pressure for paddock work helps to optimise traction and minimise soil compaction. Tools to facilitate tyre pressure management include wireless monitors and central tyre inflation systems.

The importance of tyre pressure
Monitoring and adjusting tyre pressure are essential tools for achieving fuel efficiency in heavy farm vehicles.

Farm machines operate under a wide range of load, speed and ground-surface conditions. Adjusting tyre pressure to account for these differences can result in fuel savings in the range of five to 15 percent (Intelligent Energy Europe, 2012).

In Australia, however, many farmers keep their tyre pressures on one setting — for example ‘30 psi all round’ — thus missing the fuel savings that can be made by implementing good practices around tyre-pressure management.

General principles
‘Low in the paddock, high on the road’
Reducing tyre pressure in the paddock reduces fuel consumption, enables better traction on soft soil, reduces soil compaction and extends tyre life.

Lowering tyre pressure also lowers track height, which may improve the efficiency of connection to implements (the most efficient towing link, for example, is one that is on the same level). By contrast, higher tyre pressures on the road reduce rolling resistance. The basic rule is:

- use lower tyre pressure in the field to reduce tractive power demand, track depth and soil compaction, and
- use higher tyre pressure on the road to reduce rolling resistance.

In a field trial it was shown that deflating tyres from road to field pressure used 14 percent less fuel. If you’re using 30, 40 or 50 litres per hour you can knock off four to five litres of fuel (Dallimore, 2013).

Provided your ballast is in the right ball park, fuel savings in the range of 5 to 15 percent can be achieved by adjusting pressure in response to observed traction outcomes (Intelligent Energy Europe, 2012).

Tread softly for traction efficiency
The key factors in fuel-efficient tractor set-up are wheel configuration, ballast, tyre selection and tyre pressure.

Quick tips
- Know your recommended pressures. Research and record recommended operating pressures for your machine and its tyres (in paddock and on the road).
- Check tyre pressures regularly. Make a tyre pressure plan that details when and where to make tyre-pressure changes.
- Provide training and motivate staff. Don’t assume your staff know how to measure and adjust tyre pressure on heavy vehicles. Ensure supervisors/operators are aware that staff are required conduct routine checks.
- Put tyre-inflation charts and instructions in the cab. Make it easy for operators to know what to do.
- ‘Low in the paddock, high on the road’. Take the time to change pressures when moving between road and paddock.
- Install labour-saving technology. Consider installing a wireless tyre-pressure monitor or central tyre-inflation system.
- Get the right wheel and tyre set-up. Ensure you have a wheel and tyre configuration that allows for tyre pressure that is sufficiently low.
- Use tyre pressure, not ballast, to manage traction. Once ballast is in the right ball park, adjusting tyre pressure is the most effective means of optimising wheel slip.

If you’ve dealt with the other factors, adjusting tyre pressure is a powerful tool for achieving tractive and fuel efficiency in the paddock. A softer, less inflated tyre will spread the weight, connecting more gently with the soil; too flat a tyre, however, will ‘grab’ too much, putting strain on the engine. When fine-tuning tyre pressure, it is important that you observe the results by using a traction monitor or by inspecting tyre prints. Refer to supplementary paper, Tractor ballasting.

Wheel and tyre configuration
Double and triple wheel configurations help spread the load and enable lower tyre pressure for given gross machinery weights, but limits on track width may rule out such wheel configurations on your farm. Seek configurations of wheels and tyres that give you the most scope to operate at low tyre pressures and that maximise wheel-to-ground contact in the paddock. It is essential that the tyres you run can operate safely and efficiently at the lower range of their rated tyre inflation pressures.

Refer to supplementary paper, Tractor tyre selection.
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Implementing a tyre-pressure plan

Identify target tyre pressures
The first step is to identify optimal target tyre pressures – for your machinery and your main operating conditions. This will help to ensure your pressures are the right ball park.

Load and inflation tables are available from tyre manufacturers and online, as are tyre pressure calculators that you can download onto your computer, smartphone or other mobile device (see Further information, below).

Combine this research with your knowledge of what works for your particular operations to develop a table that documents target pressures for the main duties of each machine or trailer.

Planning and implementation
Setting the tyre pressure for given field conditions correctly comes with experience and careful observation. It also involves commitment by those operating the machinery.

Developing a practical implementation plan may entail discussion with your operators, agreeing on how often to measure and adjust tyre pressures, and printing out agreed pressures for given situations and for events that routinely trigger pressure changes (posting them as notes in the cab).

We recommend that you monitor results to see if you are getting the expected fuel savings and performance benefits.

The physical task of deflating and inflating tyres in the field can be time-consuming, so your tyre-pressure plan should be practical to implement. The ‘when’ and ‘how’ of adjustment is therefore an important consideration. Fortunately, new technologies that make tyre-pressure optimisation simpler to achieve are becoming available (see Central tyre inflation systems, below).

Adjusting tyre pressure for the paddock
As a starting point, inflate tyres to the lowest recommended pressure for the weight carried per tyre.

- If the axle load changes, adjust the tyre inflation pressures accordingly.
- To determine load per tyre, divide the total axle weight by the number of tyres per axle, taking into account extra weight on the rear axle due to mounted equipment.
- For optimum performance, set all tyres on a given axle to the same pressure.
- Observe traction outcomes and readjust accordingly.

Check the inflation pressure often, preferably when the tyres are cold, such as in the morning. Gauge readings can be one to three psi higher when the tyres are warm.

Measuring pressure
Make sure your staff members understand how to measure tyre pressure and keep a tyre gauge in each cab. Several options are available to enable operators to monitor tyre pressure easily.

- Manual tyre gauges are a cheap and adequate solution for many machines. Use a high-quality gauge that is easy to read, accurate, consistent and graduated in at least one psi increments. Gauges designed for use on off-road tyres are recommended.
- Wireless tyre pressure monitors provide remote measurement of tyre pressure to the operator and are relatively inexpensive. They allow the operator to see an in-cab display of all tyre pressures at one time. They may also include alarms that can be pre-set at desired tyre pressures. For example: a four-tyre monitor from Tyredogs will cost between $300 and $500, with DIY installation (Tyredog, 2013).
- Central tyre inflation (CTI) systems provide pressure monitors and allow tyres to be inflated and deflated from the cab using an on-board air compressor.
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Central tyre inflation systems
Central tyre inflation (CTI) systems are common in military and on-road transport systems but rare on Australian farms. This is despite the benefits reported by farmers who’ve installed such systems. For example, a Victorian farmer using a CTI system has reported an increased ability to adjust tyre pressure on his machinery, with significant benefits for soil compaction.

“I am constantly changing the tyre pressure in the Fendt for various applications. We might run nine psi in the rear tyres and 14 psi in the front for ripping and then pump them up to 15 or 16 psi for use on the road … I can recall spraying a paddock earlier this year with a trailed boom spray and, a week later, you couldn’t see the wheel marks at all … And I was also using a two-tonne linkage spreader to broadcast urea and, in three days, the crop was standing again where the wheels had been.” (Saunders, 2009)

CTI system types
There are a variety of CTI systems and most vary according to machinery type, individual-use scenarios and the money spent on the system. There is no ‘standard system’ per se. This is how one CTI system, installed on an agricultural tractor, works:

“When you decide to inflate, the smaller valve opens the line and the larger valve is used to quickly fill the tyre. When the proper pressure in the tyre is achieved, the valves are closed and the pressure is released in both lines. No air line is under pressure while the machinery is working. The compressor is mounted on a platform at the rear of the tractor, near the hydraulic outlets, and the system requires a high-capacity, hydraulically powered air compressor (40 ft³/min).” (Eckelkamp, 2013)

CTI systems are not cheap to retrofit with prices ranging from $7,000 to $20,000 installed and few products currently available on the market in Australia.

When considering CTI systems, farmers should look for systems that allow tyre pressures to be monitored and changed from the driver’s seat. This will allow for quick and easy tyre inflation and deflation for all driving and load variations.

Given the importance of tyre pressure adjustment to fuel efficiency, it is hoped that farm machinery manufacturers will start including CTI as integrated equipment at point of sale.

Further information
Soil compaction
Soil compaction can have an impact over a range of soils and climatic zones and can affect different industries, such as cropping, grazing and forestry. This site gives an overview of contributing factors and of the effects of soil compaction:

Improving tractor performance and fuel efficiency
www.msue.msu.edu/objects/content_revision/download.cfm?revision_id.490364/workspace_id.65638

Michelin
Michelin’s website outlines four main criteria for calculating the right agricultural tyre pressure and includes an agricultural tyre-pressure calculation tool.
www.michelin-agricultural-tyres.co.uk/Learn-share/The-right-pressure-for-your-tractor-tyres

Goodyear
This major tyre manufacturer’s website includes a mobile-friendly tyre-pressure calculator.
www.tirepressurecalculator.com

AIR CTI Australia
Information from an Australian supplier of central tyre-inflation systems.
www.aircti.com/10_contact_us_australia.html

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References


