Tractor tyre selection

Tractor tyre specification is a key element in achieving fuel efficiency. Factors that need to be considered include tread, diameter, width, rim size, load indexes, single/double/triple arrangements and typical operating speeds. Unsuitable tyres may make it difficult or impossible to implement other fuel-efficiency measures. Larger tyres spread the weight and enable operation at lower and at a wider range of pressures.

Introduction

Tyres are the key traction point on a vehicle. They are responsible for transmitting power from your tractor to the field. If your tractor’s tyres are not optimised properly, you will use more fuel than you need. Experts suggest that the tendency in Australia has been to overinflate tyres (Francis, 2013) and studies have shown that adjusting tyre pressures alone can deliver fuel savings in the range of five to 15 percent (Intelligent Energy Europe, 2010).

Inflation pressures are not the end-all of tyres, however. Following the guidelines provided in this paper will ensure that you are using the right set-up for the equipment you have and the type of work you’re performing.

Radial versus bias ply construction

There are two distinct types of tyre construction: bias ply and radial ply. Radial ply tyres are the more recent type: introduced in the 1940s, they have become the standard tyre type for most applications, thanks to the advantages they offer.

Figure 1: Bias and radial ply tyre constructions. Adapted from (Brodbeck, 2004).

The crisscrossing of plies in bias tyres means that the sidewalls of these tyres are relatively stiff. This is advantageous in situations in which strong sidewalls are pivotal, such as in forestry, where foliage and other obstructions may abrade, puncture or tear the sidewalls of a tyre. However, the stiff sidewalls of bias tyres also result in greater internal friction than the softer walls of radial tyres and have therefore been replaced in many applications.

‘Depending on conditions, radial tires show an advantage of 6% to 14% in traction, fuel efficiency, and reduced wheel slippage over bias tyres.’ (Brodbeck, 2004)

Quick tips

- **Consult with a professional.** Selecting a tyre involves several factors. A tractor tyre expert can save you considerable time and help you make the correct decision.
- **Bigger tyres for lower pressures.** If possible, get the largest tyres your tractor and operations permit. This will allow you to employ a wider range of pressures to maximise traction and efficiency.
- **Radial tyres are go.** Modern radial tyres allow for efficient operation, sometimes at lower pressures than you’d expect.

The selection of ply construction also has implications on the type of ballasting methods you can use. In short: due to their weaker sidewalls, radial ply tyres are not suited to holding liquid inside them and therefore this ballasting method should be avoided to prevent damaging the tyres. Refer to supplementary paper, *Tractor ballasting*.

For most farming applications in NSW, radial tyres are preferred as their construction improves stiffness along the tread and results in greater traction.

Tread types

In addition to ply construction, there are five main types of tyre tread designs; these are: R1, R1W, R2, R3 and R4.

Figure 2: Different tread types (Brodbeck, 2004).

R3 and R4 are typically known as ‘turf’ and ‘industrial’ tyres, respectively. R3 tyres have a very non-aggressive pattern (and are thus a good choice for work on golf courses, lawns, etc.); typically, they are selected for use in situations where a lawn must be protected or soil disturbed as little as possible. R4 tyres are usually chosen for use in industrial and construction applications. Sometimes, however, a tractor can be sold with R3 or R4 tyres fitted so that it can be transported by road.
R1, R1W and R2 tyres are known as ‘agricultural’ tyres and provide the best traction for farm field conditions.

R2 tyres are used for field work in wet conditions and for high-value vegetable crops (such as rice and sugarcane), while R1 tyres are typically the best option for the type of soils found in Australia.

R1W tyres have deeper skids that provide increased traction in wet, sticky soil conditions. Some literature also suggests that they have a greater lifespan than R1s when used periodically on roads.

What is the right-sized tyre?
Refer to your vehicle’s supplier or manufacturer for the appropriate size of tyre (width, height, etc.) for your tractor, based on the type of work you’ll be performing. In general, you should attempt to obtain the largest tyres that your tractor allows, as this improves traction performance by permitting operation at lower tyre pressures for any given weight. This relation can be observed via the mobility number $B_N$:

However, farmers should also weigh the benefits of having larger tyres against the disadvantages of carrying heavy, large tyres when additional traction is not required (e.g. on light loads). Also important is to ensure that your tyre width and spacing set-up can match the crop row spacing you require.

Considerations for FWA tractors
Front wheel assist (FWA) tractors differ from 2WD tractors in that all wheels are driven and hence provide traction. This results in better fuel efficiency but introduces some logistical issues when it comes to selecting tyres.

FWA tractors typically have front tyres that are two-thirds the size of their rear tyres. For this reason, the front axle turns at a rate 1.5 times faster than the rear axle, so that both axles cover the same distance. This multiplier (1.5) is called the axle ratio and must be obtained for the machine from its documentation or by contacting its supplier/manufacturer.

A further consideration is that for FWA tractors, it is desirable for there to be a subtle ‘front axle lead’ so that the front axle covers a distance one to five percent greater than the rear axle. This will improve driveability and steering.

Selecting the right-sized tyre for the front axle of a FWA tractor involves using the axle ratio and lead percent, as shown below:

$$\frac{\text{Required front tyre diameter (m)}}{\text{rear tyre diameter (m)}} = \left(1 + \frac{\text{front tyre lead (percentage)}}{100}\right)$$

For example, in a case where we have a FWA tractor with an axle ratio of 1.5, a desired front axle lead of 2.5 percent, and a rear tyre diameter of 1.2 metres, our required front tyre diameter is given by:

$$\frac{\text{Required front tyre diameter (m)}}{1.2 \text{ m}} = \left(1 + \frac{2.5}{100}\right)$$

$$\text{Required front tyre diameter (m)} = 0.8 \times 1.025 = 0.82 \text{ m}$$

Wheel types
When considering a new tractor for your property, it is good practice to take carefully considered ‘professional’ advice from the industry regarding tyre options and packages. This advice must be balanced against the manufacturer’s options and availability if you’re to ensure a long, productive service life for the tyre equipment.

With regard to tractor wheels, three main styles exist. These include the following:

Cast (non-adjustable) wheels
Often used for high-powered tractors and well suited to heavy drawbar field work in Australian conditions, these wheels can change the overall mass of the tractor significantly. They’re better suited to heavy field cultivation than the wheel styles detailed below.

Welded (non-adjustable)
The lighter ‘welded’ wheel provides weight-saving features for tractors engaged in heavy linkage operations. The weight-saving feature provides an overall increase in rear axle carrying capacity through a reduction in wheel mass. Very often ‘drilled’ at the factory for the field fitment of cast weights, this wheel type can be ballasted, ‘if required’, for trailed draught equipment. In addition to its lighter weight, the welded wheel is often manufactured to extremely tight tolerances for alignment. This high level of tolerance can provide improved ride quality for high-speed transport applications.
Tractor tyre selection

The styles of wheel outlined above are considered to be non-adjustable. If you choose a non-adjustable wheel type and adjustment for various row-crop requirements is important, you’ll require a bar-type rear axle for your tractor. This bar axle will allow the wheels to be slid to the required track settings on the tractor’s axle bar.

The following wheel style is appropriate for small/medium tractors engaged in various row-crop applications:

‘Lugged adjustable’ wheel

The traditional style of wheel is often referred to as a ‘lugged adjustable’ wheel. This type of wheel has been superseded ‘to a greater or lesser degree’ by waffle or ring rims; however, all of these wheel styles allow simple and relatively easy track setting changes to be made on-farm.

Remember that ‘in-field’ set-up and maintenance will greatly impact overall performance and ‘lifetime’ service efficiency of the wheel/tyre package you choose.

Singles? Doubles? Triples?

Logistically, it is easier to check and maintain tyre pressures with fewer tyres. In addition, fewer wheels mean a lower gross tractor weight, which contributes to fuel efficiency.

However, heavier machines require increased pressure on tyres to meet the inflation rating for that load. It is important to check the inflation rating on your tyres and attempt to be close to the lower range of what is acceptable for them.

At some point, if your machine is particularly heavy, the required tyre inflation will be too high for your tyres, or may result in high soil compaction or increased wheel slip. At this point you should consider adding additional wheels so that you can operate each tyre at lower pressure, thereby increasing traction and reducing soil compaction.

Used tyres

Second-hand tyres are rarely a good idea as it may be difficult to observe wear or damage to tractor tyres, making tyre failure and the tyres’ remaining lifespan hard to predict.

In addition, a worn tyre is less capable of sustaining heavy loads than is an equivalent new tyre. Used tyres may therefore perform in sub-par ways.

Taking care of your tyres

Proper storage techniques and care are vital to maximising the lifespan of your tyres and to maintaining their performance.

Tyre storage

Figure 4: Adapted from (Balkrishna Industries Limited (BKT), 2010). Tyres should be stored in cool and dry conditions, indoors. Tubeless tyres should be stored in an upright position and should not be stacked.

The following factors will contribute to the deterioration of tyres (Balkrishna Industries Limited (BKT), 2010):

- heat,
- air currents,
- oils, fuels and solvents,
- sunlight,
- ozone (from electrical generators and arc welders),
- water,
- dust and dirt.

Attempt to avoid exposure to these when storing your tyres.

Further information

Instructional video for tyre selection

An Instructional video on how to properly select tyres and how to measure important parameters such as the axle ratio (in cases where this information is not available from your tractor’s supplier or documentation) is available: https://www.youtube.com/watch?v=cX08Qjohdzt8

Tyre care, maintenance and safety

www.bkt-tires.com/bkt_care_safety.html

Acknowledgements

NSW Farmers thanks Mark Francis, Business Manager at New Holland Agriculture, for advice in the preparation of this paper.
Tractor tyre selection

References

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