

Tractor Setup

Improving Energy Efficiency on Irrigated Australian Cotton Farms

The Improving Energy Efficiency on Irrigated Australian Cotton Farms project aims to deliver an industry-wide awareness campaign that provides tailored energy efficiency information and tools to irrigators and their advisors. This activity received funding from the Department of Industry as part of the Energy Efficiency Information Grants Program.

Reducing tractor fuel use

Tractors typically consume around a quarter of all direct energy use on a cotton farm. Tractor fuel saving methods can play a significant part in improving farm profitability. In fact, energy cost is around 40% of the total cost of a tractor, so it pays to reduce energy use.

While farmers do work efficiently there are often some gains to be made in tractor set-up and operation that can substantially reduce tractor fuel consumption.

Farming Systems

The number of operations is crucial to reducing fuel use. Avoiding or combining operations is the fastest way to make significant fuel savings. This is particularly true for heavy tillage, such as bed forming.



Round bale harvesting is one change to our farming system

Farming systems have the largest effect on tractor fuel use. Reduce, eliminate or combine operations, where possible, to make the biggest savings.

Optimal working depth

Every centimetre of working depth moves around 150 tonnes of soil per hectare. Every centimetre increase in working depth requires around an additional litre of diesel per hectare.



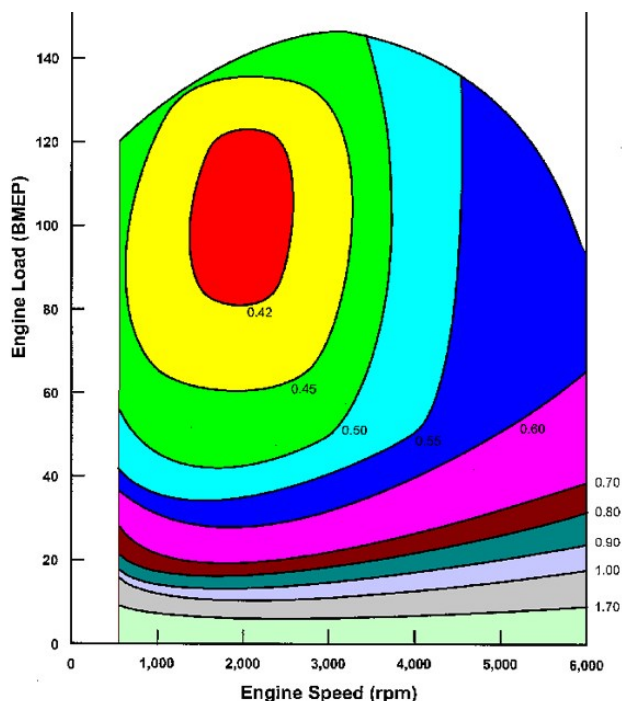
Costs increase quickly as working depth increases

Pupae busting, for example, should be a full soil surface disturbance to a depth of ten centimetres. It pays to check working depth at least once per field because working beyond this depth is simply wasting fuel. Soil moisture is important in achieving an efficient cultivation. Wet soils make light work for the cultivator however, this damages the soil and does not achieve an effective cultivation. Do not cultivate in very wet soil.

Tractor Setup

From fuel to the flywheel

The conversion of stored chemical energy in diesel to energy applied to the soil via the implement is actually very low. Your tractor's engine is the first step in the process. Older diesel engines will only convert around 35% to 40% of the chemical energy in the diesel to mechanical energy at the flywheel. More modern engines still only convert around 45% of the energy in diesel into mechanical energy, yet this is still a big improvement over older engines. All engines have a "sweet" point where they use the least amount of fuel per unit of power output (the red area in the chart below). This is a measure called the *specific fuel consumption*, which is usually measured in grams of diesel per kilowatt hour of energy produced. Different engines have different performance characteristics. Two engines may have the same rated power but the engine with a low specific fuel consumption over a larger operating range will have a lower fuel use.



Tyres and ballasting

Added to engine performance is the *tractive efficiency*, which is the performance at the soil/tyre interface. The largest force at this interface is *rolling resistance*, which is the amount of power required for the tractor to simply move itself across the field. Avoiding wet soils and controlled traffic reduces this force.

At the tyre/soil interface there is a trade-off with wheel-slip. We can add more ballast to reduce slip, but this increases rolling resistance (and compaction). We can reduce ballast and rolling resistance but lose out on more wheel slip. 14% wheel-slip is optimum. Always use recommended tyre inflation pressures.

Only around 20% of the energy contained in diesel is successfully converted into tractive effort. More sophisticated tractors have engine management, traction management, variable speed transmissions and other systems. These systems assist the operator to continually optimise these complex interactions between engine and traction management.

Measurement is the key

If you can't measure it, you can't fix it. Measuring fuel use is the key to identifying savings. Recording fuel use in a log book is a practical way to monitor performance. In-cab fuel use displays are very useful to the operator but sometimes underestimate total fuel use by not recording fuel used during turning or moving between fields.

For further information on Tractor Setup or the Improving Energy Efficiency on Irrigated Australian Cotton Farms project please contact the Cotton Research and Development Corporation on 02 6792 4088 or the CottonInfo Team member in your area.



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