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How to select a tractor

By W.T. Brown *

At the last count, 43 makes of tractors were available on the Australian markets. Each maker offers quite a few different models, so that when you come to choose your next tractor, you will be able to pick from rather more than 200 options. In fact, when considering individual needs, the range of options is much reduced. Most people would be lucky to have a choice of twenty, and a considered approach will reduce these to three or four.

Size

The first decision to make is how big a tractor you need, rather than how big a tractor you want. This is related to the scale of operations, and the time available for each job.

A mathematical method for calculating the size of tractor needed is set out on the next page. The basic calculations can be made with pencil and paper. Some rather sweeping assumptions have to be made about draft requirements or implements, about soil variability, about maintenance habits, and about managerial ability. To really work, the calculations require a good knowledge of seasonal variations and the effects of working over a longer or shorter time. You need to make some guesses about how your farm will develop, and what future work patterns will be. The game becomes so complex, that it is useful to have a computer to help with the calculations, to give not only machine sizes, but the possible profits or losses for each choice. Such programmes are available, and as the scale of operations increases, and the consequences of each decision have more effect on profit and loss, so more use will be made of computer programmes. But we will need more information than most of us have at present.

Machinery purchases are often decided by “past experience”, by some kind of scaling up based on past operations, by what neighbours do, and by what we read in the papers, see at field days, or hear from dealers. Those who manage to make the right decision make money; those who consistently make the wrong decision go broke. The first decision will be on the size of the tractor required. If the present tractor is coping then why buy a bigger tractor? You will need more power if you have increased or intend to increase the area worked. How much more will depend mainly on the extra area, but also on the amount of extra travelling that may be necessary to get to scattered blocks, and similar factors.

The other main justification for increasing the power of the tractor is because the amount of labour has been reduced. If you are not going to employ labour, and want to do it yourself, if casual labour is not available, or if you are no longer
prepared to work the long hours you
have in the past, then you will need
more power.
Power determines how quickly you
get through a particular job. You
need more power to get through
more work in the same time, or to
get through the same work in less
time.
There are other options to buying a
tractor to consider at this stage. Is
there a neighbour with excess
capacity of labour or power who
might contract or form a syndicate?
Can better labour management and
work organisation increase output?

Engine and fuel economy
Having decided the size of tractor
by calculating or scaling, there
remains a lot to settle. The main
feature of the engine is its power.
You should also look at other
features such as the torque back-up;
from rated speed to maximum
torque it should be 10 per cent or
more. While 20 per cent back-up is
better than 10 per cent, there is no
particular merit in having 30 per
cent rather than 20 per cent. Like
plant nutrients, it is sufficient to
have enough; other factors will then
limit performance.
Fuel economy is going to become
more important as fuel prices go up.
Remember that you can't get power
without burning fuel, so more
power means higher fuel
consumption (litres per hour). On
the other hand, fuel economy is a
measure of how efficiently the fuel
is converted to work and is
measured in litres per kilowatt-hour
or gram per kilowatt-hour.
Some tractors have poor fuel
economy at lighter loads, and this
should be checked where possible.
The difference could be as much as
25 per cent of the fuel consumption
over an average working day.
The air cleaning system will have an
influence on wear. Our Australian
conditions of dust are severe so look
for an intake ahead and high up.
These are brief generalisations,
there are other features which there
is not space to touch on. Some of
these are swept volume, speed,
turbo-charging and intercooling.

Gear Box
Having chosen the power, you need
to look at how this will be converted
to useful work. The gear box gives
the first transformation. A
mechanical gear box is more
efficient and cheaper than an
hydrostatic transmission, and so
should be preferred for broad area
work. The hydrostatic transmission
will come into its own where there is
a lot of forward and back
manoeuvring or variation in
loading.
The gear box should give you a
selection of six to eight speeds over
the working range. Fewer than this
will limit choice of implements and
working speeds; more than this
becomes duplication and more
expensive than necessary.
An on-the-go shift will help to keep
working rates up if you have the odd
heavy patch around your paddock,
and goes some way to giving the
flexibility of the hydrostatic
transmission. There will be some
power loss, but this is probably
out-weighed by the gain in working
rate.

Wheel equipment
The second stage of the
transformation of engine power to
useful work is through the wheel
equipment. This is an aspect of
tractor selection is more fully dealt
with in another paper.
For many farms, the option of
four-wheel-drive (4WD) should be
considered, not only for very big
tractors. The main advantage is a
better conversion of engine power to
drawbar power. How much better
depends on the soil conditions. The
worse the traction conditions, the
greater the advantage of 4WD. This
means that work can be done
quicker, using less fuel, and perhaps
with less tyre wear. The main
disadvantage is the increased cost.
Typically the 4WD will cost about
20 per cent more than the same size
2WD, but the work rate has been
shown to be 10 to 20 per cent
greater, and there are also fuel
savings. In terms of crop yield it can
mean the difference between getting
a crop in, or doing no seeding at all.
The value of 4WD then is very much
a matter for consideration for each
district, and for each farm.

Comfort
Of growing importance over the
past few year has been the comfort
of the operator. Seating has
improved, with sprung, damped
seats, adjustable for driver's weight
becoming almost universal.
A sound-treated cabin is highly
desirable to protect hearing, and to
reduce fatigue over the working
day. Noise levels below 85 dB.A. are
generally regarded as "safe". Only
a small percentage of the population
will suffer hearing damage at levels
less than this. Lower levels are less
tiring also.
In looking at different tractors,
check visibility from the driving seat
both to the rear and forward, and
particularly of the drawbar hitch
point. Check the position of lights if
you are going to work at night;
check the position of the controls
and how easy they are to operate.
These less important factors may
help to choose between models.
Don't underestimate the importance
of comfort. We look for more
comfort the older we get.

Service
Farmers rate service highly when
considering buying a tractor. You
need to place a value on the service
you can expect for spare parts
availability and for competent
repairs. Your confidence in your
ability to handle repairs will affect
the value you place on dealer
service. If you intend to try to
service the tractor yourself then
look at how accessible the engine,
transmission and other components
are, and what special tools or
facilities may be required.
There is much to be said for not
buying the early machine off the
production line; a better strategy
may be to wait for the later
production runs that have had early
faults corrected.
It is difficult to get reliable
information on the comparative
durability of different makes and
models. Local gossip may be a

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guide, but don't rely on the evidence of one example. In any event, it is good practice to read the instruction book soon after you buy the new tractor, and also to spend an hour or two making your own inspection and pre-delivery check.

**Price**

After size, price is the next most important. The most power for the least cost is a desirable objective. But while the initial capital cost is important, it must be balanced by both the rate of depreciation, and by operating costs. Some tractors lose their market value much faster than others, and this should be considered in assessing the cost.

Operating costs include the cost of fuel, spares, tyres, oil and filters. The direct cost of these is worth checking as the Prices Justification Tribunal enquiry showed that prices of similar parts from different firms varied widely. Some value should be placed on the hidden costs of breakdowns too. Delays in spare-parts supply can lead to losses in yield.

**Summary**

The selection of a farm tractor can be influenced by many factors, each of which merit consideration when purchasing a new unit. Nobody can make a broad generalisation that a particular tractor is best for broad-area cereal growing. Every farmer must consider his own options. Having made a selection, it is up to you to operate it to get the most of your money.

### Calculating tractor size

The following procedure will be helpful, but not highly accurate or infallible.

1. Decide how much area is to be covered in the operation.  
2. Decide how much time is available (number of days x hours/day).  
3. Calculate how much area will be covered per hour.  
4. Estimate your per cent field efficiency = time actually working x 100  
   time in field  
5. Calculate the necessary working rate (ha/h) =  
   \[ \text{ha/ha} = \frac{\text{hours}}{\text{time in field}} \times \text{per cent field efficiency} \]  
6. Decide your working speed.  
7. Calculate the required width of implement (metres) =  
   \[ \text{work rate (ha/h)} \times 10 \times \frac{\text{speed (km/h)}}{10} \]  
8. If the calculated width is acceptable proceed to 9 below; if the width is too great reconsider the decisions made above then recalculate.  
9. Estimate the draft to the implement (kiloNewtons/metre). See Table 4, page  
10. Calculate (in the case of tillage gear) drawbar pull required (kN) = draft (kN/m) x width (m).  
11. Calculate drawbar power (kW) =  
   \[ \text{pull (kN)} \times \text{speed (km/h)} \times 3.6 \]  
12. If the calculated drawbar power is reasonable, proceed to 13. If too big, reconsider some of the assumptions made above and recalculate.  
13. Assume that power-take-off power (kW) is about 1.6 times drawbar power (kW).  
14. Repeat calculations for each operation to discover the maximum power required.  
15. Find the capital cost of the tractor.  
16. Calculate:  
   Fixed costs: depreciation, interest, insurance, shelter, registration. Operating costs: fuel, repairs and maintenance, tyres, oil and filters etc.  
17. Calculate hourly cost of running ($/h).  
18. Calculate cost (dollars per hectare) of operation.  
19. Repeat these calculations for different assumptions of the time available to do the operation.  
20. Estimate the loss in yield for extra time taken to do an operation, or the loss of opportunity to do other income-earning jobs.  
21. Estimate the benefit per unit cost of each option size of machine.  
22. Choose the size giving the best return.