filling the feed gap

The Focus Farms are a joint initiative between the Murrumbidgee Grain & Graze and Best Management Practices for Dryland Cropping projects. Monthly monitoring of the Focus Farms is providing an overview of the feed production cycle on a whole farm basis and how this impacts on environmental indicators such as water use, ground cover and biodiversity.

The Focus Farm initiative has been funded by the National Action Plan for Salinity and Water Quality through the Murrumbidgee Catchment Management Authority (MCMA).

Focus Farms

Aim: To monitor whole farm feed production on mixed farming systems and the impact these have on natural resource management.

Method: Five Focus Farms were selected across the Murrumbidgee Catchment that were typical of mixed farms in their region. Locations include:

- Coolamon
- Euroley Bridge (Leeton)
- Sebastopol (Temora)
- Tarcutta
- Tootool (Lockhart)

On each farm, 5 paddocks representing typical components of a mixed farming enterprise were selected for monthly monitoring (Table 1a). The paddocks include:

- annual pasture
- perennial pasture (lucerne)
- native pasture/remnant vegetation
- grazing cereal
- grain only cereal

Monitoring activities on the Focus Farms can be divided into a number of components, including production, biodiversity and soil moisture as follows:

Table 1a - Paddock descriptions (dominant species)

Pdk type	Coola-mon	Euroley Bridge	Sebas-topol	Tar-cutta	Tootool
annual pasture	sub-clover	sub-clover	sub-clover	sub-clover	sub-clover
perenn. pasture	lucerne /chicory	lucerne	lucerne	lucerne	lucerne
native pasture	k'roo grass, *stipa spp*	*dan-thonia*, *stipa* spp	*stipa* spp	red-grass	windmill grass, *stipa sp*, *juncus*
grain only cereal	wheat	wheat	wheat	barley	wheat
grazing cereal	wheat	oats	wheat	wheat	wheat

Figure 1a - lucerne paddock, Tarcutta (Feb '06)

Figure 1b - native paddock, Tootool (Mar '06)

filling the feed gap

1. Feed production and quality

Project collaborators:
Damien Doyle[1], Alison Bowman[1],
([1]NSW DPI)

To monitor feed production on a whole farm basis, Damien Doyle (Project Officer, NSW DPI) has been collecting the following data each month from the Focus Farms:

- dry matter
- pasture/crop growth rates
- feed quality
- ground cover
- soil moisture content
- soil characteristics to depth (once only)
- stocking rates & rainfall (provided by farmers)

Results: Monitoring results from the Focus Farms are produced by Damien monthly in 'Focus Farm Facts', which are available at www.farmlink.com.au/gg.htm

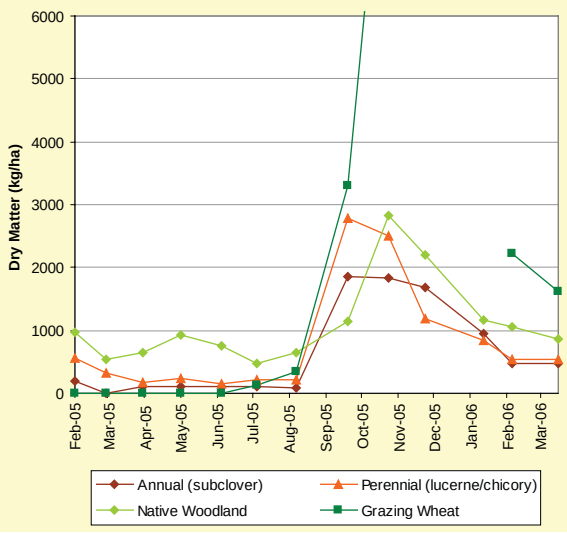
Dry matter production

With 12 months data now collected, whole farm feed curves have been created for each Focus Farm (Figures 1a - 1e) using the representative paddocks to identify surpluses and gaps in dry matter production. Whilst these are obviously driven by the 2005/2006 season, they do indicate typical periods of feed shortage experienced by mixed farming enterprises in this area. (Note that dry matter figures presented may reflect grazed dry matter.)

Across all farms, dry matter production was very low from February to August 2005. Although new growth was limited, residual dry matter in the native (or remnant vegetation) paddocks was highest during this period, which may reflect lighter grazing.

Following the breaking rains in the 2nd week of June, dry matter remained at a minimum due to a combination of slow growth rates (low leaf areas) and the need for grazing available feed. Feed supply didn't noticeably increase until September when growth rates exceeded stock demand in all paddocks to produce a

Figure 1c - Feed Curve, Coolamon



Note: lucerne cut for silage mid October.

Figure 1d - Feed Curve, Euroley Bridge

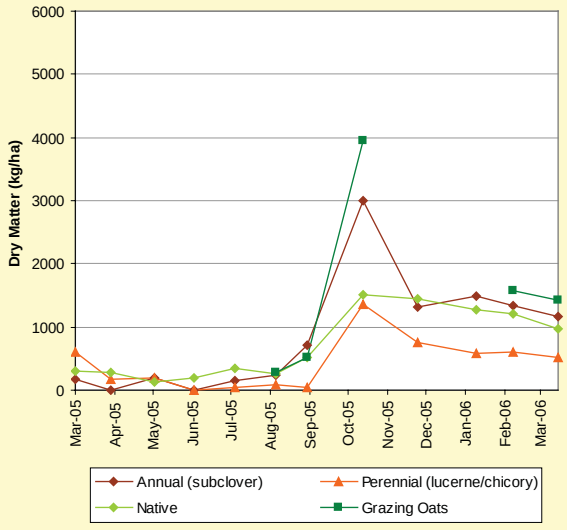
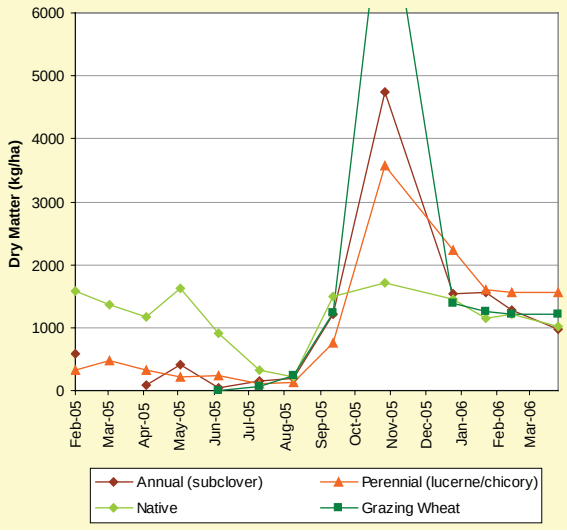


Figure 1e - Feed Curve, Sebastopol



filling the feed gap

late spring flush, peaking in November. Dry matter production was highest from the cereal crops, although this was obviously outside the grazing window.

Dry matter in the period from January to May 2006 was generally higher than the same period last year, with feed residue still being carried over from the abundant supply last spring. New growth has been minimal.

Pasture/crop growth

Pasture and crop growth rates increased rapidly from August, peaking in September/ October. Growth rate trends were similar between species and locations.

For example at Coolamon (Figure 1h), growth rates of the annual (subclover) and perennial (lucerne) paddocks peaked at 50-60kg DM/ ha/day respectively. Wheat growth rates increased to 150kg DM/ha/day in November.

Feed quality

Feed quality varied throughout the season. Using the Coolamon Focus Farm as an example, digestibility was above the desired 70% required for high production from August to October (Figure 1k over page), when actively growing green feed was available. As the plants senesced in late spring/early summer, digestibility dropped to levels that would be limiting production.

During its grazing period, grazing wheat peaked at 86% digestibility, declining to ~30% as a stubble. Lucerne generally had the highest digestibility throughout the year, maintaining a reasonable quanitity of green leaf. The digestibility of native pasture was generally lower throughout, peaking at 65% in spring.

As digestibility is directly related to metabolisable energy, the same trends have occurred. During summer, values ranged from just 3MJ in the wheat stubble to 7MJ in the lucerne, with 8MJ the suggested minimum requirement for dry sheep (Figure 1l over page).

Crude protein is also related to digestibility, but varies with species. Wheat again had very high protein levels (~33%) during the grazing period, but rapidly decreased during grain formation.

Figure 1f - Feed Curve, Tarcutta

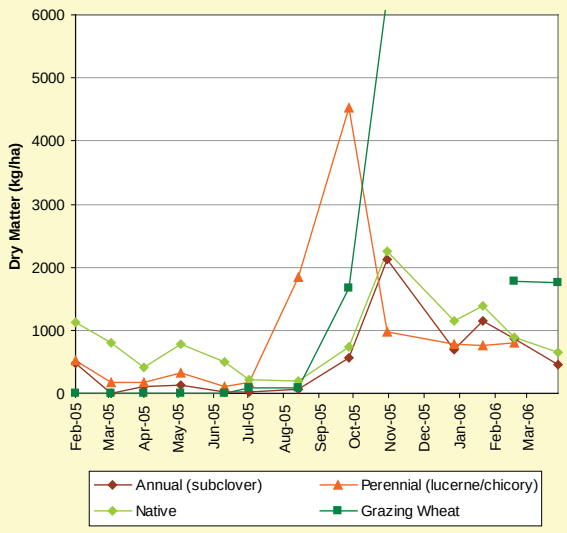


Figure 1g - Feed Curve, Tootool

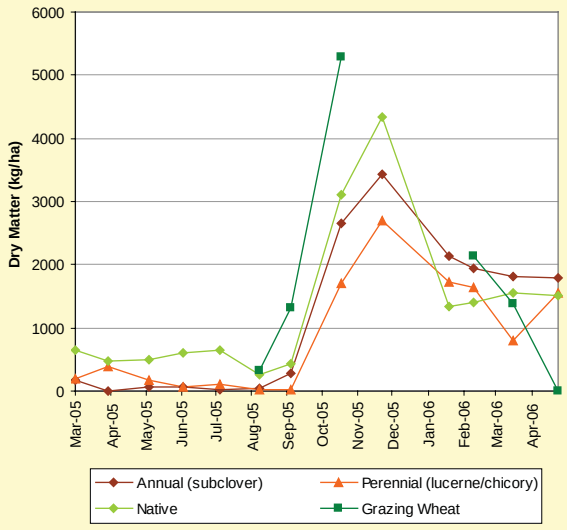
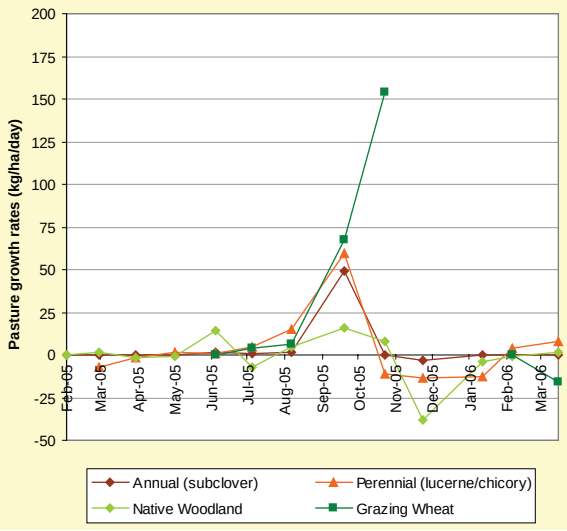


Figure 1h - Pasture/crop growth rates, Coolamon



filling the feed gap

Both lucerne, and to a lesser degree subclover, had generally higher protein levels throughout the year, typical of legume based pastures (Figure 1m over page).

Ground cover

'Increasing duration of groundcover levels above 70% (50% for sandy loams), by at least 1 month a year for land used for agricultural production' is a major target in the Murrumbidgee catchment.

Again using the Coolamon Focus Farm as an example, ground cover in the native woodland and annual pasture was generally very high throughout the year, with just 2 periods below the 70% ground cover target in the annual paddock (Figure 1i) reflecting heavier grazing. Once established (spring sown 2004), cover in the lucerne paddock also increased to high levels, but tended to fluctuate with grazing pressure. The grazing wheat paddock had up to full cover in spring, declining to ~60% stubble cover.

Acknowledgements: *all Focus Farm co-operators, Robert Scriven (MCMA), Sheila de Lange (MCMA), Guy McMullen (NSW DPI), Nigel Phillips (NSW DPI), Greg Condon (Grassroots Agronomy), Kirrily Condon (FarmLink)*

Figure 1i - Ground cover, Coolamon

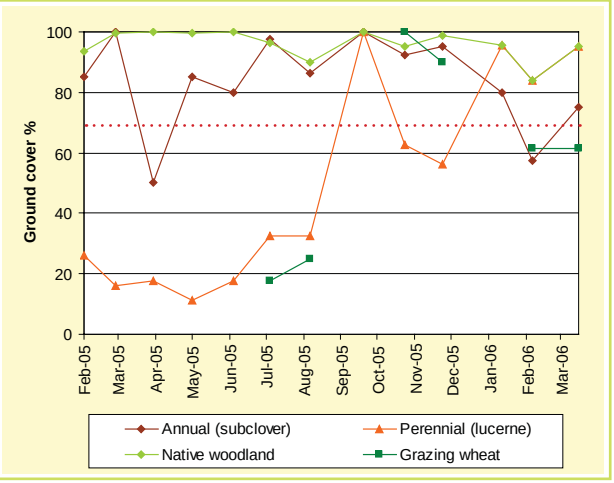


Figure 1j - Lucerne in Jan, Apr, May '06 (top to bottom)

filling the feed gap

Figure 1k - Digestibility, Coolamon

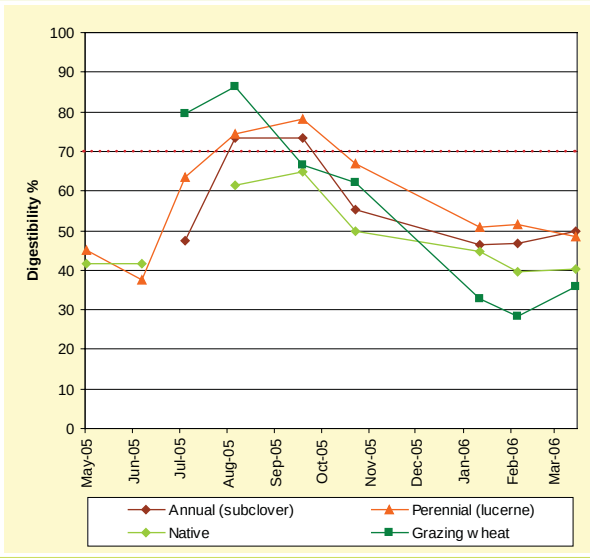


Figure 1l - Metabolisable Energy, Coolamon

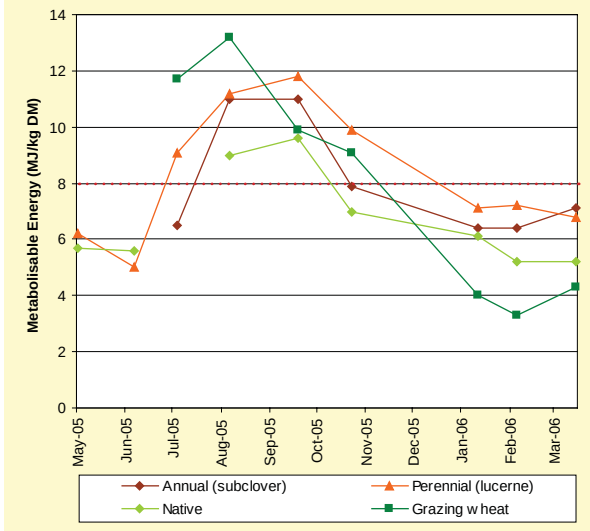


Figure 1m - Crude Protein, Coolamon

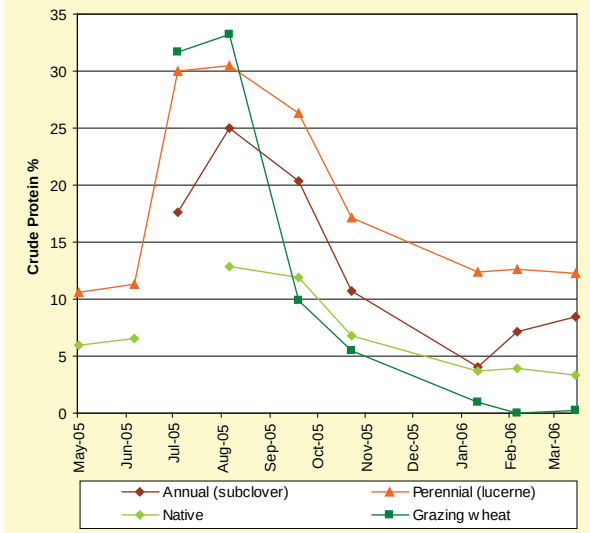


Figure 1n - lucerne/chicory, Coolamon (Jun '05)

Figure 1o - cutting lucerne silage, Coolamon (Oct '05)

Figure 1p - annual pasture, Coolamon (Nov '05)

filling the feed gap

2. Biodiversity

Project collaborators:
Sheila de Lange[1], Rob Scriven[1]
([1]MCMA)

Biodiversity is being monitored on each Focus Farm by Sheila de Lange (MCMA) as a component of the National Grain & Graze project. This component aims to determine the extent to which on-farm biodiversity is influenced by land use management, including cropping, grazing and non-productive or conservation areas, as well as by factors such as climate, soil type and topography. The data being collected includes:

- types of invertebrates (eg. spiders, ants & beetles) as indicators of environmental condition
- vegetation assessment (plant species and their abundance, ground cover, etc)
- soil microbial activity
- bird species
- soil characteristics (pH, phosphorus, nitrogen, etc)

Results: Biodiversity sampling commenced at the beginning of April 2006. Whilst all data collected is still being analysed in Tasmania through the National Grain & Graze project, some preliminary observations include:

- invertebrates - species found include ants (many types), wolf spiders, bees and beetles. There appeared to be fewer invertebrates in paddocks where stubble had been burnt.
- soil microbial activity - all farms showed some microbial activity, but tended to be less in drier locations. Initial observations also suggest there may be less activity in cropping paddocks than pasture or remnant vegetation paddocks, though this needs to be confirmed through analysis.
- bird species - preliminary results show that remnant areas of the farms had more bird species than other paddocks. Other remnant areas near the farm with similar vegetation also had more bird species than the on-farm remnant areas.

Figure 2a - MCMA Field Day, Tootool (March '06)

Figure 2b - Chocolate lillies in native woodland, Coolamon

Figure 2c - Goanna in remnant vegetation, Sebastopol

filling the feed gap

3. Water Use

Project collaborators:
Warren Bond, (CSIRO)

Warren Bond (CSIRO) has been monitoring soil water movement using electronic sensors in each paddock at the Coolamon Focus Farm to compare the effect of land use on soil moisture. Details of the paddocks are:

- annual pasture (Fig. 3a) - predominantly subclover for more than 5 years
- perennial pasture (Fig. 3b) - lucerne/chicory mix sown spring 2004
- native pasture (Fig. 3d) - ungrazed remnant woodland consisting of predominantly kangaroo grass and *Austrostipa* species (introduced annuals ~1% of the area)
- grazing cereal - wheat (Rosella)
- grain only cereal (Fig. 3e) - wheat (Rosella), ended up being lightly grazed

Soil water sensors* (Watermark® gypsum blocks) were placed at 20cm intervals to 1.6m at one point in each paddock to measure water movement within the profile. Data from the sensors was measured by loggers, which then 'radio-ed' results to a central base station receiver. The receiver then sent the data by cdma telephone link to a computer at CSIRO, from where the data was automatically uploaded to a website for viewing by about 3am the next day.

**note that the sensors measure soil water potential rather than soil water content, but still give a useful, low cost method of comparing water movement within the profile.*

Results: Regular reports were written by Warren Bond to accompany the data posted daily on the website, which can be viewed via a link on the FarmLink website at:

www.farmlink.com.au/gg3.htm

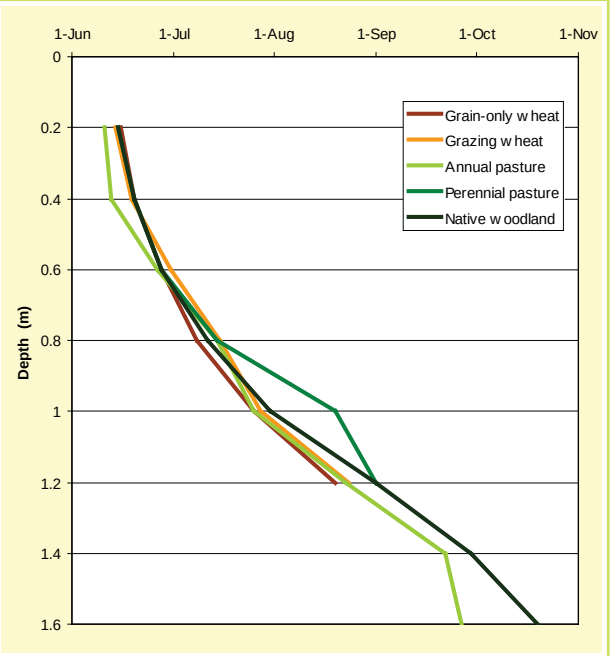
A summary of results was also prepared, with some of the key points as follows:

How wet did it get?:
Each paddock responded quickly to the breaking rains on the 10th June, with moisture rapidly reaching 0.4m depth. Moisture infiltration to lower depths continued at a

Figure 3a - Annual pasture (subclover) Aug '05

Figure 3b - Perennial pasture (lucerne) Aug '05

Figure 3c - Wetting Front Movement through Profile



filling the feed gap

slower rate, which was similar in all paddocks up until the end of August (Figure 3c).

However from the beginning of September, rapid growth in the wheat and perennial pasture (lucerne) paddocks (Figure 1h, page 28) resulted in greater water use that only allowed spring rainfall to penetrate to 1.2m. In contrast, minimal growth and consequent water use in the native woodland allowed deeper water infiltration to 1.6m, which may also have been aided by improved soil structure expected in undisturbed soils. A relatively wet profile in the annual pasture paddock coming into winter meant it had less capacity to store winter rainfall, so moisture penetrated to 1.6m sooner than in the native woodland.

How dry did it get?:

Up until the 1st December, some drying had occurred down to at least 1.2m in all paddocks except the annual pasture, with the perennial pasture (lucerne) drying to 1.4m (Figure 3f). The soil was driest down to 60-80cm under the wheat and lucerne paddocks. Below that, some soil water remained unused by the wheat crops.

Over summer and autumn, the perennial pasture (lucerne) and native woodland have gone on to extract water from deeper in the soil profile, down to at least 1.6m. Some re-wetting of the soil has occurred under the wheat and annual pasture paddocks in response to summer rainfall, although wheat has now dried down to ~0.8m, probably as a result of surface evaporation and some weed growth. The soil under the annual pasture remains very wet, with shallow rooting causing some drying to only 0.6m.

Summary:

Overall, annual pasture has been the least effective at using soil water, resulting in lower dry matter production and a greater risk of groundwater recharge.

Wheat was the most efficient user of soil water in winter and spring due to high growth rates. Less vigorous growth from the perennial pasture (lucerne) and native woodland meant they used less water during this period, but their

Figure 3d - Native woodland (Sept '05)

Figure 3e - Wheat (Sept '05)

Figure 3f - Soil Drying up to 1st December

Soil Depth	Grain wheat	Grazed wheat	Annual pasture	Lucerne	Native wood
0.2m	drier than 200 kPa*				
0.4m					
0.6m					
0.8m	signif. dry				
1.0m					
1.2m	some drying				
1.4m					
1.6m	no drying				

Note: *Watermark® sensors are only able to measure accurately to 200 kPa (wilting point is ~1500 kPa).

filling the feed gap

summer activity resulted in greater water use over summer and autumn.

Figures 3g - 3i:
(Note: the higher the soil water potential, the drier the soil)

pre-season 2005 (before June rainfall):

- native woodland was dry throughout profile, as expected due to perennials and trees
- both wheat paddocks (canola stubble) had some moisture thoughout the profile, increasing with depth - due to a combination of water unused by previous canola crops, as well as moisture retained from summer rainfall (124mm Nov-Feb) through good fallow management
- annual pasture was dry to 40cm as rainfall from summer storms triggered growth. Shallow rooting depth meant water accumulated below 60cm.
- perennial pasture was dry to 1.2m, with further root growth gradually drying soil out to 1.6m

mid-season 2005:

- most paddocks were at their wettest, meaning rainfall exceeded evaporation and water use
- all paddocks were very wet down to 80cm; overall the annual pasture had the wettest profile, followed by wheat paddocks, then perennial pasture and native woodland

end of season 2005 (before Dec rainfall):

- wheat and perennial pasture paddocks were driest, drying down to at least 80cm
- annual pasture and native woodland were wetter, with the native area not starting to dry the soil down until mid December when growth rates increased. Shallow roots and poorer growth of annual pasture meant the soil never really dried much below 40-60cm at any time of the year.

Acknowledgements: *Ian Jennings (co-operator, Coolamon).*

Figure 3g - Pre-season Soil Water (1st June 2005)

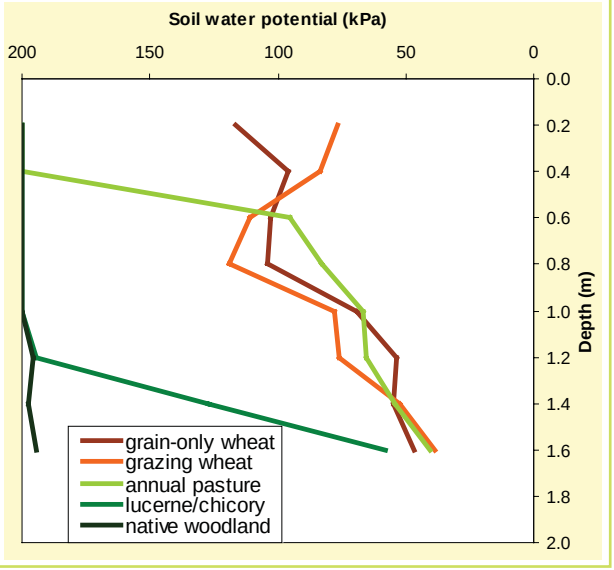


Figure 3h - Mid-season Soil Water (15th Sept 2005)

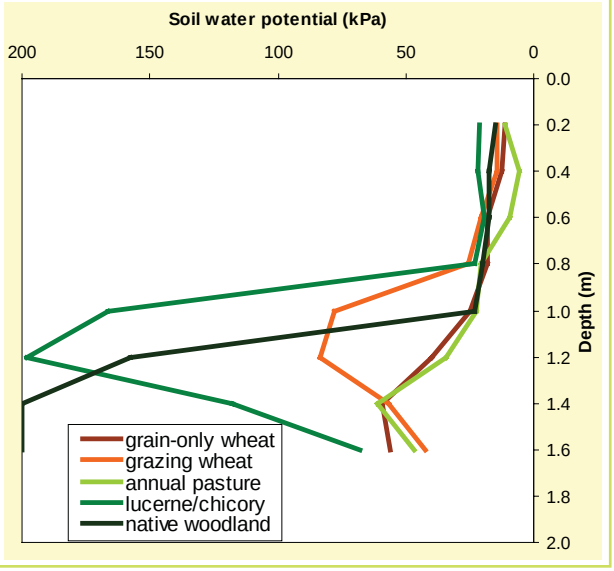


Figure 3i - End of Season Soil Water (1st Dec 2005)