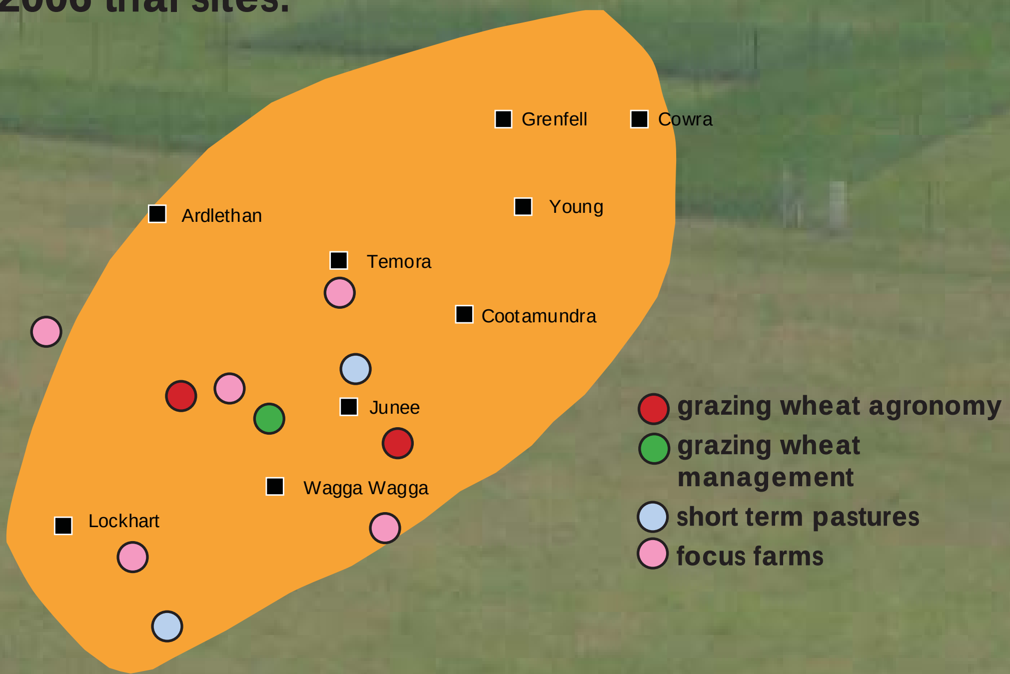
Research Priority:

rotations for mixed farming systems

through Grain & Graze:

- **grazing wheat agronomy**
- **grazing wheat management**
- **short term pasture species**
- **focus farms**

2006 trial sites:



In collaboration with:

FarmLink Research
Murrumbidgee Catchment Management Authority
NSW DEPARTMENT OF PRIMARY INDUSTRIES
CSIRO
CHARLES STURT UNIVERSITY

Funded by:

mla Meat & Livestock Australia
australian wool innovation limited
GRDC Grains Research & Development Corporation
Australian Government Land & Water Australia
Grain & Graze Profit through knowledge

filling the feed gap

The autumn/winter feed gap is a common problem in mixed farming systems. Although perennial pastures are an essential part of the farming system and have helped boost overall feed production, dry matter is generally limited after the autumn break when plants are recovering from a dry summer, through to winter when cold temperatures restrict growth. Supplementary feeding is often required to make up for this period of low production.

In recent years, the adoption of grazing wheats has increased rapidly as a profitable alternative to 'fill the feed gap', complementing perennial pastures which provide valuable feed throughout other parts of the year. Short term pastures (2-3 years) also provide another option for mixed farming systems to provide a short feed break in the middle of a cropping rotation, or sown in conjunction with perennial pastures to boost dry matter in the first few years.

The Murrumbidgee Grain & Graze project* is focusing on grazing wheats and short term pastures as profitable options for mixed farming systems. Results to date show the significant dry matter production and grazing potential of some grazing wheat varieties, and the impact this has on overall crop profitability. Results from the short term pasture trials show the potential for some annual legume species to provide high quality dry matter, lasting into the late spring/early summer period, although results have been limited by poor seasons.

**The Murrumbidgee Grain & Graze project is a collaborative project between FarmLink, Murrumbidgee Catchment Management Authority, NSW Department of Primary Industries, CSIRO and Charles Sturt University.*

1. Grazing wheats & canola - grazing and grain recovery

Project collaborators:
Guy McMullen[1], Jim Virgona[2], FarmLink
([1]NSW DPI, [2]CSU)

2006 was the third year of the Grain & Graze project, continuing trial work on the agronomic aspects of grazing wheats. The focus for 2006 was to be on the impact of grazing on crop water use, however this was not possible due

Table 1a - Site Details

Site Details	Eurongilly	Ganmain
Co-operator	James Brady	Ben Cruikshank
Sowing date	5th June (dry)*	31st May (dry)*
Previous crop	oats	canola
Deep N	135 kg N/ha	60 kg N/ha
Grazing details	23rd Aug to 5th/12th Sep (~40kg weaners)	30th Aug to 8th Sep (~50kg wethers)
Rainfall (Apr - Oct)	129mm	111mm

***emerged after rain on 10th June**

Figure 1a - Ganmain trial, August 2006

Photo: F. Gummer

Figure 1b - Marombi (l), Skipton (r), Ganmain Aug '06

Photos: F. Gummer

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to the drought. The focus of the trial then shifted to the potential for grazing canolas which were included to compare performance with the wheats. Although the drought prevented any grain harvest from the canola, dry matter production in a very tough year indicated their potential as a dual purpose crop. John Kirkegaard et al. (CSIRO) are investigating canola's dual purpose potential in a GRDC funded project (see page 11).

Aim: To determine grazing and grain recovery of wheat and canola varieties.

Method: Two sites were sown at Eurongilly and Ganmain (*Table 1a*) comparing a number of grazing wheat and canola varieties, both grazed and ungrazed:

- Marombi wheat (winter wheat)
- Wedgetail wheat (winter wheat)
- Ventura wheat (spring wheat)
- Maxol canola (winter canola)
- Skipton canola (spring canola)

Dry matter assessments (*Table 1b*) were undertaken by NSW DPI. Trials were harvested by AgriTech.

Results:

Grazing dry matter* & growth rates:

Compared with the previous 2 years' trials, dry matter produced prior to grazing was limited, less than 600kg/ha at Eurongilly (*Figure 1c*) and less than 800kg/ha at Ganmain (*Figure 1d*). Early dry matter tended to be higher in the canola than wheat, particularly at Ganmain, where growth rates up to the 30th August were 10-13 kg/ha/day for canola compared with 3-5 kg/ha/day for the wheats.

As the season progressed beyond the grazing period into September, wheat dry matter was similar to that of canola. The exception to this was the spring wheat Ventura which produced the greatest amount of dry matter at both sites.

*Note that dry matter results were statistically variable due to the season.

Table 1b - Feed Production & Quality, 2006

Variety	DM* (kg/ha)	Growth rate (kg/ha/d)	Digest-ibility %	Crude Protein %	Energy MJ/kg
Eurongilly	12th September				
Marombi	1476	85	86	24	13.1
Wedgetail	1415	79	87	21	13.3
Ventura	2595	157	82	25	12.5
Maxol	1578	102	92	28	14.2
Skipton	1792	153	89	27	13.6
Ganmain	8th September				
Marombi	1113	104	84	22	12.9
Wedgetail	1337	127	89	26	13.7
Ventura	2222	214	NA	NA	NA
Maxol	1048	31	91	32	14.0
Skipton	1269	74	87	33	13.3

***DM - ungrazed dry matter. Results were statistically variable due to drought conditions.**

Figure 1c - Dry Matter at Eurongilly, 2006

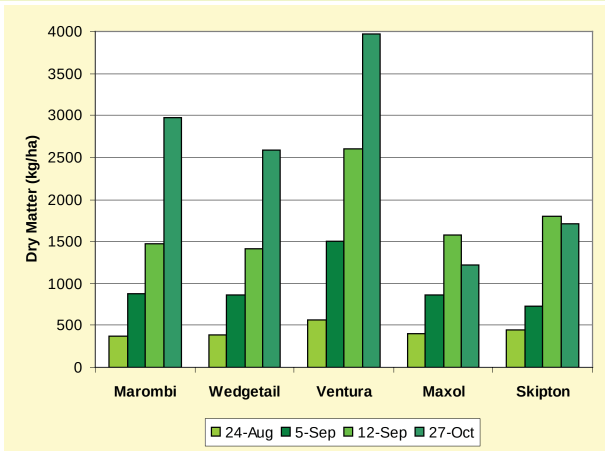
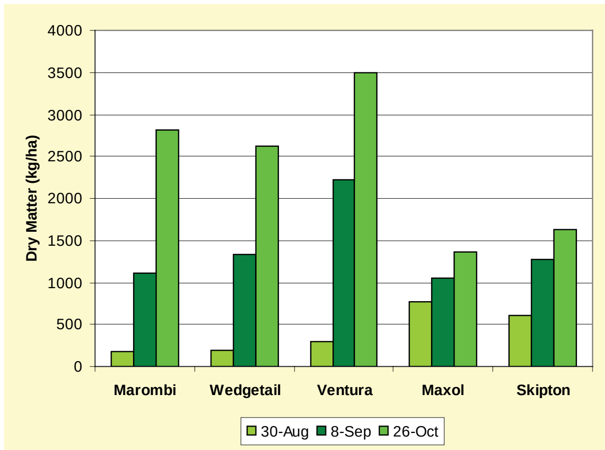


Figure 1d - Dry Matter at Ganmain, 2006



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Feed quality:
Feed quality of both the grazing wheats and canola was very good with levels suitable for high animal production (*Table 1b*).

Yield & grain quality:
Although the season meant canola plots were unable to be harvested, significant results were achieved from the wheat yields (*Table 1c*).

At both sites, ungrazed Marombi and Ventura outyielded Wedgetail. While grazing significantly reduced their yields at Ganmain, only the prolonged grazing reduced yields at Eurongilly. Wedgetail was unaffected by grazing.

Grain quality was very good despite the season, with relatively low screenings and high protein.

Acknowledgements: *Vince Van der Rijt (NSW DPI), Rod Fisher (NSW DPI), James Brady (co-operator, Eurongilly), Ben Cruikshank (co-operator, Ganmain), AgriTech.*

Table 1c - Wheat Yields 2006

Treatments	Ungrazed	Grazed 1	Grazed 2*
Eurongilly			
Marombi	0.61 [a]	0.49 [a]	0.47 [b]
Wedgetail	0.30 [c]	0.22 [c]	0.22 [c]
Ventura	0.61 [a]	0.53 [a]	0.30 [c]
Ganmain			
Marombi	0.82 [a]	0.59 [b]	NA
Wedgetail	0.39 [b]	0.50 [b]	NA
Ventura	1.02 [a]	0.22 [c]	NA

- ***Stock were left on some plots for a longer period at Eurongilly.**
- **Numbers followed by the same letter are not significantly different.**

Figure 1e - Wheat yields at Eurongilly, 2006

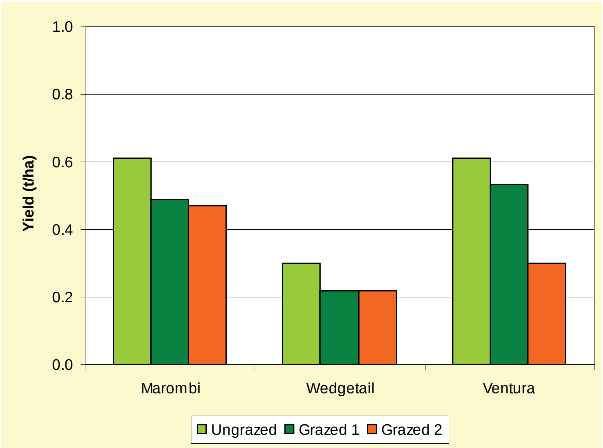
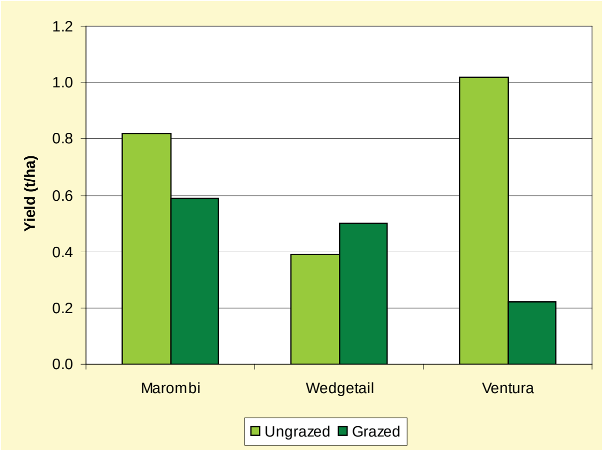


Figure 1f - Wheat yields at Ganmain, 2006



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Estimating wheat dry matter

(Felicity Gummer, FarmLink)

The ability to estimate dry matter in grazing wheat paddocks is an important component of fodder budgeting. While guidelines exist for estimating pasture dry matter, none are available for wheat forage. The Grain & Graze project has been developing rules of thumb for estimating wheat dry matter, which must also take into account different row spacings.

The following graphs were produced by measuring dry matter and pasture height of two wheat crops throughout the 2006 season. *Figures a and b* show a strong dry matter/height correlation whilst the crop is in the vegetative stage. These are taken from crops sown on 7" and 9" spacings, with plant densities of 163 and 100 plants/m^2 respectively. This will be further investigated in 2007 when row spacing is incorporated into the Grain & Graze wheat trial program.

Figure a - Dry matter/height relationship for wheat sown on 7" spacing with 163 plants/m^2

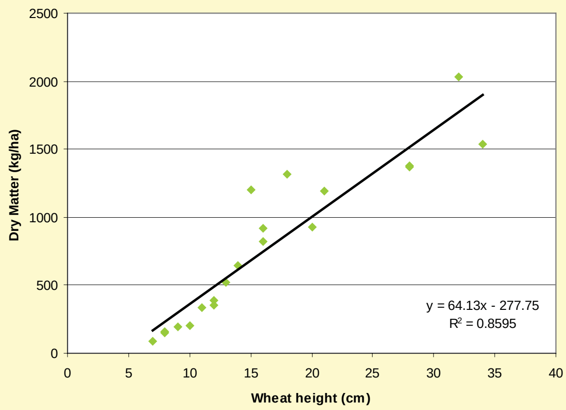
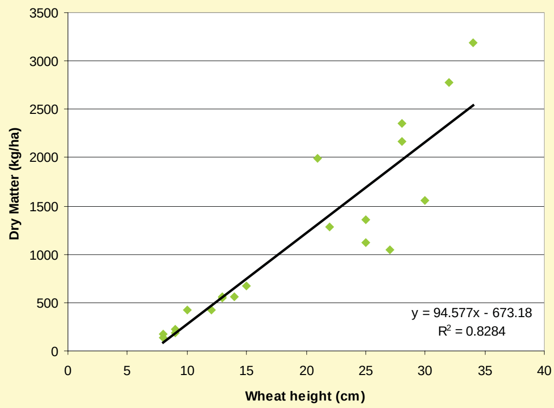


Figure b - Dry matter/height relationship for wheat sown on 9" spacing with 100 plants/m^2



Evaluating the potential for dual purpose canola

(summary of Risk & Opportunity Report compiled by John Kirkegaard, CSIRO for GRDC project CSP00085)

- Potential for all current canola growing areas, as well as new areas in the high rainfall zone.
- Winter & long-season spring canola varieties sown in mid-April can provide 2 to 4t/ha of forage for grazing by mid-August. Earlier sowing (before mid-April) suits winter types which require a cold period (vernalisation) to initiate flowering and prevent early bolting.
- Winter forage quality is very high - around 20% protein and 80% digestible, and is readily eaten by sheep. Merino lambs gained 210g/d. No animal health issues were observed, but guidelines for grazing brassicas should be followed.
- Canola can recover well from heavy grazing. Grazing before buds were visible delayed flowering by 0-4 days, compared to 28 days if the crop was already flowering when grazed. Significant delays in flowering caused yield reductions, particularly if spring conditions were unfavourable. (Yield penalties could be offset by the value of the grazing, hay or silage). No yield reductions occurred where cool, wet spring conditions allowed compensatory growth.
- The major risks identified are pests and diseases associated with early sowing (insects & viruses) or exacerbated by grazing (eg. blackleg).
- ***Choice of variety for specific sowing dates, regions and grazing management will be the key to maximising the dual purpose value of canola.***

2. Grazing wheats - grazing management

Project collaborators:
Guy McMullen[1], Jim Virgona[2], FarmLink
([1]NSW DPI, [2]CSU,)

Research as part of the Grain & Graze project has shown that grazing wheats can tolerate more intensive grazing than what has traditionally been recommended. The grazing management trial in 2005 revealed strong economic gains could be achieved by earlier commencement of grazing with higher stocking rates. Although this trial was repeated in 2006 at Marrar, drought conditions meant stocking duration was restricted and there was insufficient grain to harvest.

Aim: To determine the trade-off (if any) between grazing intensity and grain recovery in grazing wheats.

Method: The trial was established in a commercially sown paddock of Wedgetail, with 5 grazing treatments (*Table 2a*) imposing different levels of grazing intensity:

- ungrazed
- low stocking rate + 'early' lock-up
- high stocking rate + 'early' lock-up
- low stocking rate + 'late' lock-up
- high stocking rate + 'late' lock-up

Results:

Despite the lack of rain, 40kg lambs were stocked on the trial at a rate of 10/ha (low stocking rate) and 20/ha (high stocking rate) for either 3 weeks ('early' lock-up) or 4 weeks ('late' lock-up). However with very little spring rain, crop recovery was poor and grain harvest was abandoned, therefore no results are available.

One observation that was made, however, was the impact of the dry conditions on plant anchorage. By the end of the grazing period, approximately 15% of plants had been pulled out of the ground through grazing.

Acknowledgements: *Vince Van der Rijt (NSW DPI), Rod Fisher (NSW DPI), Graeme Heath (NSW DPI), John Pattison (co-operator, Marrar).*

Table 2a - Site Details

Site Details	Marrar
Co-operator	John Pattison
Variety	Wedgetail
Sowing details	Sown dry 15th May @ 90kg/ha with 90kg MAP; 24cm row spacing.
Stock type	Weaner lambs (~40kg)
Stocking rate	'low': 10 lambs/ha 'high': 20 lambs/ha
Grazing commenced	21st August (~750kg DM/ha)
Grazing lock-up	'early': 11th September 'late': 18th September
Rainfall (Apr - Oct)	119mm

Figure 2a - (l to r): low SR, high SR (Sept '06)

Figure 2b - (l to r): ungrazed, low SR, high SR (Sept '06)

3. Grazing wheats - liveweight gains

Project collaborators:
Hugh Dove[1], Guy McMullen[2], FarmLink
([1]CSIRO, [2]NSW DPI)

Very high liveweight gains can be achieved on grazing wheats, and can exceed those achieved on forage oats or pasture. However, trials have shown these weight gains to be highly variable, which do not appear to be related to cultivar preference, intake, digestibility or crude protein.

Research as part of the Grain & Graze project in 2005 and 2006 has shown significant liveweight responses in lambs to magnesium (Mg) and sodium (Na) supplements when grazing wheat, suggesting minerals may be the cause of liveweight variability seen previously. The sodium response may also at least partly be a magnesium response, with literature showing that sodium can increase magnesium uptake in the rumen which is otherwise restricted on low sodium and high potassium diets (as was the case in the trial). With magnesium deficiency being potentially widespread across south-east NSW due to low pH soils, it is suggested that a 1:1 supplement of MgO (eg. Causmag) and salt may be economically worthwhile for young sheep grazing dual purpose wheats, at a cost of around 1c/hd/day.

Aim: To determine the impact of magnesium and sodium supplements on overcoming limitations to liveweight gains recorded on grazing wheats.

Method: The trial was established in a commercially sown paddock of Wedgetail, with 3 treatments fed ad lib to 37kg XB lambs:

- nil supplement
- sodium supplement (salt @ 4g/hd/day)
- magnesium supplement* (MgO @ 17g/hd/day)

**poor quality hay was also fed with the magnesium supplement to increase palatability. The hay contained only a small quantity of magesium and did not influence overall magensium response.*

Table 3a - Mineral concentrations in wheat forage

Mineral (% DM)	Mg	Ca	K	Na
Requirement for growth in young sheep	0.12	0.15	0.50	0.05
Content in wheat forage:				
2005 trial	0.13	0.3	3.2	0.05
2006 trial	0.125	0.35	4.0	0.002
GRDC trial - unfertilised	0.10	0.20	3.50	0.005
fertilised (Mg)	0.17	0.23	3.27	0.008

red text indicates very high levels
blue text indicates low to marginal levels (for growing stock)

Figure 3a - Supplement feeders used for the trial

Figure 3b - 2005 lamb liveweight response

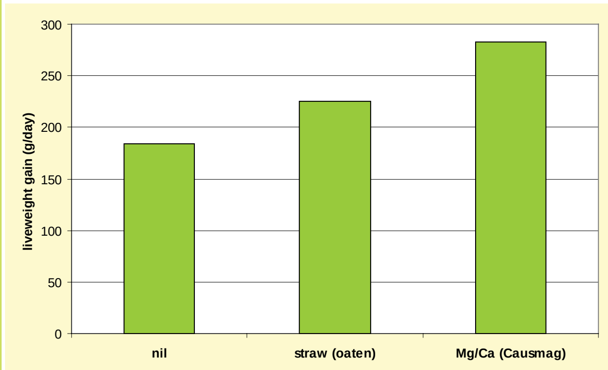
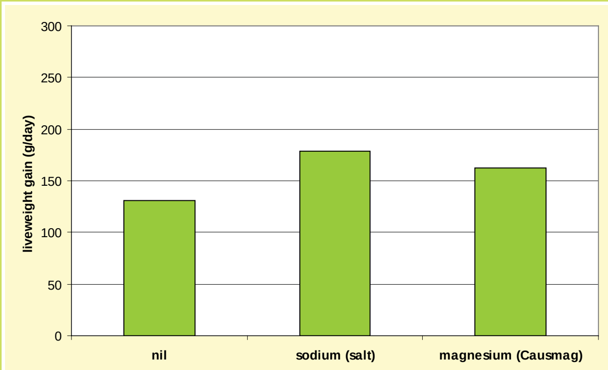


Figure 3c - 2006 lamb liveweight response



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The paddock was grazed between the 21st August and 18th September at 20 lambs/ha. In light of the poor season (134mm in-crop rainfall), the paddock was overgrazed in order to achieve animal responses. Subsequently no grain was harvested from the paddock.

Results:

Lambs fed the magnesium supplement in 2006 had 24% higher liveweight gains than those grazing on Wegetail wheat alone (*Figure 3c*). This compares with a 54% liveweight response in lambs fed a combined magnesium/calcium/sodium supplement in 2005 (*Figure 3b*). (Lower liveweight gains in 2006 compared with 2005 reflect drought conditions). The 2005 response was also attributed to magnesium as the wheat had sufficient calcium and sodium levels but was marginal for magnesium, as was the 2006 crop (*Table 3a*). *(Note that high potassium levels in the soil combined with low pH reduces magnesium uptake by plants, therefore lower magnesium levels are likely to be relatively common in surface soils across south-east NSW).*

Lambs fed a sodium supplement (salt) in 2006 also had significantly higher liveweight gains (37%) than those grazing wheat without a supplement (Fig. 3c). In contrast to the 2005 wheat crop, the 2006 crop was deficient in sodium, and was also high in potassium(Table 3a). Research has shown that diets low in sodium and high in potassium can reduce magnesium absorption from the rumen, therefore it is suggested that the response to sodium seen in the 2006 trial could at least in part be due to improved magnesium absorption. Although this requires further investigation in the field, the results suggest that providing a 1:1 supplement of Causmag and salt to young growing sheep grazing wheats would be economically worthwhile, given the supplement cost of approximately 1c/hd/day.

Acknowledgements: *Vince Van der Rijt (NSW DPI), Rod Fisher (NSW DPI), Graeme Heath (NSW DPI), John Pattison (co-operator, Marrar).*

Reference: *Dove, H., McMullen, G. and Kelman, W.M. (2007). Liveweight gain responses to magnesium or sodium supplements in young sheep grazing dual purpose wheats. J. Anim. Feed Sci. (special issue) (submitted).*

Figure 3d - Katrina Sait & Guy McMullen weighing lambs onto the Marrar trial, 2006

Photo: F. Gummer

Additional Supplement Trials

Hugh Dove, CSIRO, has also been investigating the use of supplements for lambs grazing dual purpose wheats as part of a separate GRDC funded project, conducted at Ginninderra (Canberra) in 2005 and 2006 as follows:

Magnesium fertiliser:

- Merino lambs at 3 stocking rates grazed Mackellar wheat, a portion of which had been fertilised with magnesium sulfate (425g/ha) 3 weeks before grazing.
- The fertiliser increased the magnesium content of the wheat from below (0.10% of DM) to above (0.17% of DM) that required by the sheep. It also resulted in 24% faster liveweight gain at a stocking rate of 18/ha. This response decreased at higher stocking rates as dry matter became limiting.

Salt supplement:

- Merino lambs grazing Mackellar wheat received either no supplement or had access to sodium (salt) fed ad lib in shallow troughs.
- Lambs with access to sodium grew 25% faster than those without supplement.

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4. Short term pastures - species selection

Project collaborators:
Felicity Gummer[1], Guy McMullen[2]
([1]FarmLink, [2]NSW DPI)

In addition to grazing wheats, short term (1 or 2 year) pastures were also trialled in the Grain & Graze project as options to fill the feed gap in mixed farming systems. Sown as a component of the whole farm feed production system, short term pastures have the ability to produce high quality feed in the late spring/ early summer period when other pastures are starting to decline. Depending on the species, they can also provide a break-crop alternative for cropping rotations.

Although Antas subclover performed particularly well in 2005, its production was limited by the drought conditions in 2006. This was typical of all the legumes except the highly winter active lucerne (Sardi 10), which perormed very well at Henty. Winfred forage brassica and the dual purpose crops (Wedgetail wheat and Skipton canola) also performed well given the season.

Aim: To evaluate short-term (1-2 years) pasture species for their value in filling the feed gap and their 'fit' in the cropping rotation.

Method: Six short term pasture species were sown at 2 sites, Henty and Illabo (*Table 4a*) in 2005 and compared with a grazing wheat (Wedgetail). The species, which were chosen for their potential late winter dry matter production, included:

- High density legumes (HDLs), consisting of Persian (Laser), berseem (Elite II) & arrowleaf (Zulu) clovers
- Balansa clover (Paradana)
- Subclover (Antas)
- Tetraploid ryegrass (Winterstar)
- Forage brassica (Winfred)
- Lucerne (Sardi 10 - highly winter active)

In 2006, the legumes were left to regenerate to measure persistence over a 2 year period, while the ryegrass, brassica and wheat were re-sown. Skipton canola was also sown on the buffer areas to compare its potential as an alternative dual purpose crop.

Table 4a - Site Details

Site Details	Illabo	Henty
Co-operator	Tony Lehmann	Graham Parker
Sowing date*	15th June '06	14th June '06
Crop '05	wheat	canola
Deep N '05	74kg N/ha	121kg N/ha
Soil pH_{CaCl2} '05	5.0 (0-10cm)	4.9 (0-10cm) 4.5 (10-20cm)
Al % '05	1.5	2.6 (0-10cm) 9.8 (10-20cm)
Phosphorus (Colwell) '05	48	60
Rainfall '06 (Apr - Oct)	132mm	180mm

***only ryegrass, brassica, wheat (& canola) were re-sown; other species relied on regeneration.**

Table 4b - Species performance 2006 (Yr 2)

Species	Plants /m²	DM (kg/ha)	Growth Rates (kg/ha/d)	Dig. %	CP %	Energy (MJ/kg)
Illabo	9th October					
HDLs	no regeneration					
Paradana balansa	NA	295	3	71	20	10.6
Antas subclover	NA	210	2	72	22	10.8
Winterstar ryegrass	122	383	3	83	21	12.6
Winfred brassica	68	1161	13	96	26	14.9
Sardi 10 lucerne	53	694	3	73	23	11.0
Wedgetail	112	2002	30	81	15	12.3
Skipton	79	1375	16	89	26	13.6
Henty	13th September					
HDLs	no regeneration					
Paradana balansa	no regeneration					
Antas subclover	220	487	5*	NA	NA	NA
Winterstar ryegrass	174	1331	15	84	18	12.9
Winfred brassica	58	1739	20	88	24	13.5
Sardi 10 lucerne	40	1840	20	71	20	10.5
Wedgetail	143	2323	25	78	22	11.7
Skipton	52	1810	20	87	27	13.3

Note: 'DM' = dry matter, 'Dig' = digestibility, 'CP' = crude protein. NA = not available.

***Antas subclover was the only species still actively growing at the end of October.**

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Results:

1. Dry matter & growth rates:

Dry matter production (*Figures 4a & 4b*) was significantly delayed by the late break and lack of follow-up rain. Apart from the lucerne at Henty, species generally only started to accumulate dry matter around August.

Regeneration of the legume species from 2005 was poor, particularly of HDLs (no regeneration) and Paradana balansa (small amount at Illabo). Antas subclover, the standout performer at both sites in 2005, also struggled to perform at Illabo. The best regeneration was achieved by Sardi 10 lucerne at Henty, growing around 30kg DM/ha/day during October. Heavy summer grazing limited lucerne re-growth at Illabo.

Winterstar ryegrass was the poorest performer of the non-legume species, particularly at Illabo where it struggled to establish with the late break. In contrast, Wedgetail wheat established relatively quickly, growing up to 30kg DM/ha/day in spring to produce the highest dry matter again at both sites (as in 2005). Given the season, the brassicas Skipton and Winfred also performed well, growing at 15-20kg DM/ha/day in spring. The potential for canola as a dual purpose crop was evaluated in the Grain & Graze agronomy trials at Eurongilly and Ganmain (pg. 8).

2. Feed quality:

Digestibility (ie. % of feed which is actually retained in the animal) was high during the spring sampling period, generally above the 70% level required for greater animal liveweight production (*Figures 4e & 4f*). The brassicas were particularly digestible with levels above 90% during October. Winfred brassica also tested highest for digestibility in 2005.

Energy levels, which are directly and positively related to digestibility, followed the same pattern (*Figures 4e & 4f*). Although crude protein is also positively related to digestibility, grasses are generally lower in protein than clovers. Consequently, both Winterstar ryegrass and Wedgetail had lower protein levels than the other species (*Table 4b*).

Acknowledgements: *Tony Lehmann (co-operator, Illabo), Graham Parker (co-operator, Henty).*

Figure 4a - Dry matter production at Illabo Yr 2 ('06)

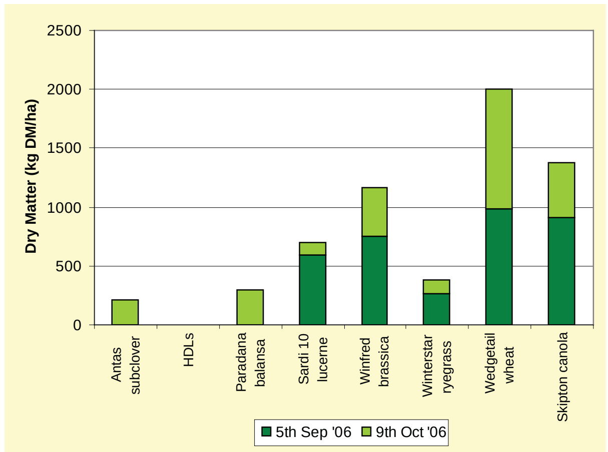

Figure 4b - Dry matter production at Henty Yr 2 ('06)

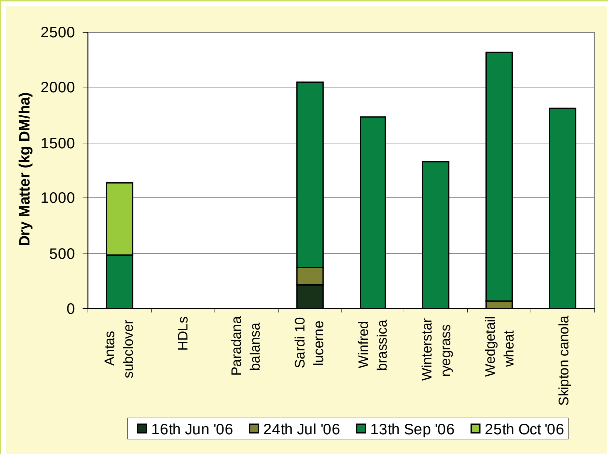

Figure 4c - 2005 vs 2006 total dry matter at Illabo

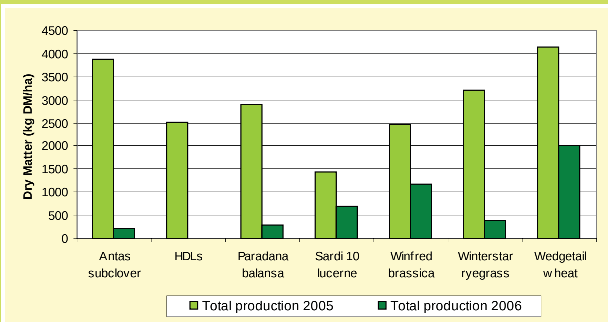

Figure 4d - 2005 vs 2006 total dry matter at Henty

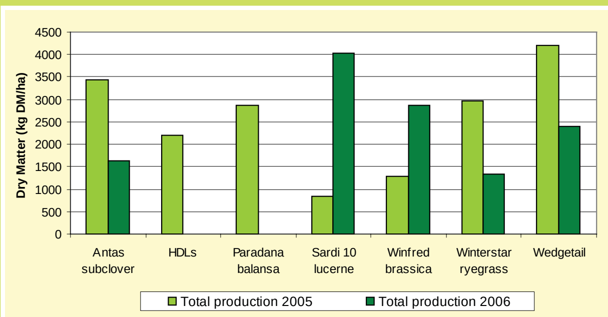

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Figure 4e - Feed quality at Illabo Yr 2 ('06)

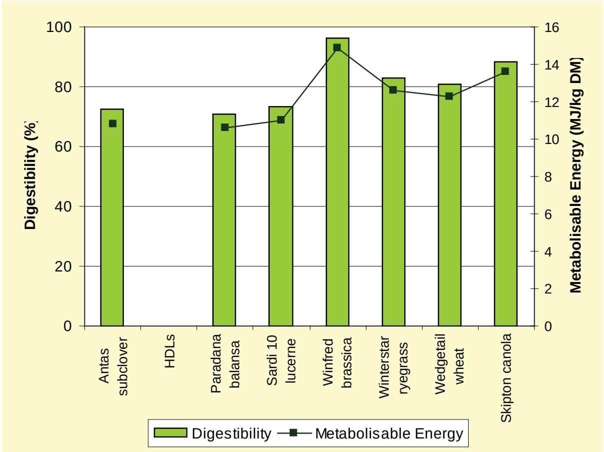

Figure 4f - Feed quality at Henty Yr 2 ('06)

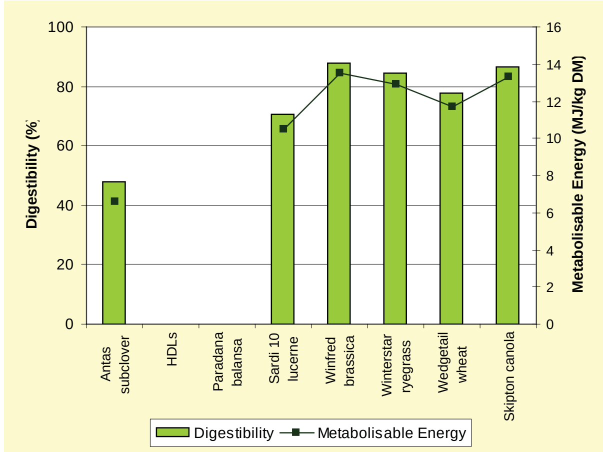

Figure 4g - Illabo trial 23rd August 2006

Figure 4h - Henty trial 13th September 2006