MALLEE CATCHMENT
TECHNICAL BULLETIN

Technical Bulletin #28

Do fodder crops improve the sustainable management of Mallee soils?

Above: Overview of the 2011 forage trial site. Photo: Mallee Sustainable Farming.

Above: Forage trial site 2011. Photo: Mallee Sustainable Farming.

This technical bulletin summarises the findings of field research conducted to compare and investigate the production, feed quality, soil health benefits and erosion risks of potential forage crops suited to the low-rainfall Mallee environment.

Background

Continuous cropping has been widely adopted in the Mallee, displacing fallow and volunteer pastures. However, diversification of cropping options is required in order to sustain these systems. Fodder crops may have a place in Mallee farming systems as they provide alternative in-crop management options and have a lower production risk than crops grown for grain, particularly on low production land. The adoption of fodder crops may increase the sustainability of continuous cropping systems, reducing the need for fallowing and minimising overgrazing of volunteer pastures; thereby reducing wind erosion and improving soil health. Fodder crops may also assist to increase feed availability and quality for livestock enterprises.

Methods

In 2011, a trial was established with the following treatments: oats wheat; barley; vetch; peas; open pollinated (OP) canola; hybrid canola; medic pasture; oats plus

At a glance

- Field pea and canola demonstrated the potential to increase winter feed supply for livestock;
- Legume fodder crops provided a high quality feed throughout the growing season while cereal and canola rapidly lost quality after winter;
- Non-cereal crops yielded well in a year with low growing season rainfall but high sub-soil moisture;
- Nitrogen and soil water was increased following legumes which is likely to benefit subsequent cereal crops;
- Groundcover was high (>50%) and therefore erosion risk was low following all fodder crops.

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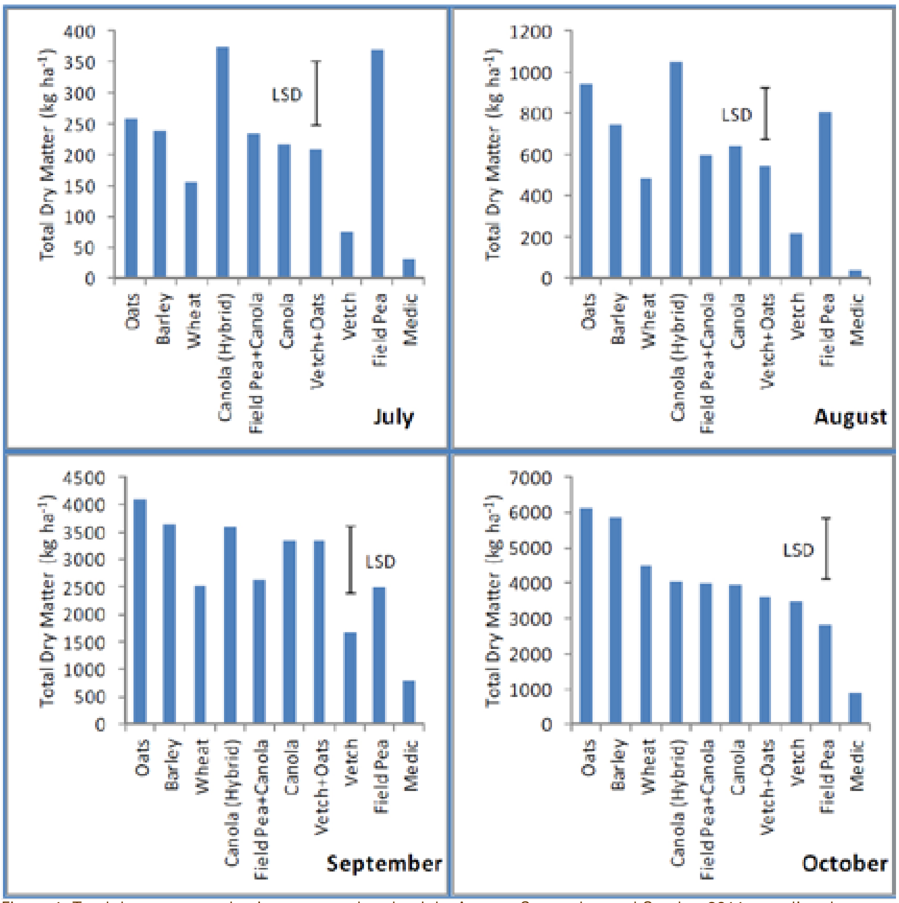

Figure 1. Total dry matter production measured at the July, August, September and October 2011 sampling dates. Dry matter production is accrued and no grazing was completed for any treatments.

vetch mix; and OP canola plus peas mix. Biomass production of each treatment was measured on four occasions:

- July 12, 2011 (July);
- August 5, 2011 (August);
- September 12, 2011 (September); and
- October 14, 2011 (October).

Samples from monoculture treatments were analysed for the feed quality parameters of:

- crude protein (percent);
- neutral detergent fibre (percent);
- dry matter digestibility (percent) and;
- metabolisable energy (Mj/kg) dry matter.

On July 25, 2011, subplots of each treatment were grazed; except for medic and vetch which were grazed on August 25, 2011. Grain yield was determined for grazed and un-grazed plots.

The 'grain' sub-plot for each treatment was used for post harvest measurements of soil water; soil nitrogen; soil disease; ground cover and dry aggregates. These sub-plots were also used for assessments of erosion susceptibility; utilising ground cover; determined using a levy point sample at ten locations and dry aggregation, and measured at three locations to obtain an average with each plot.

Results

Dry matter production

Total dry matter remained low for all treatments for the July and August sampling, with all biomass measurements remaining approximately 1 t ha^{-1} or less (Figure 1). Dry matter for all treatments increased significantly after this date, with the greatest growth rates occurring between August and September (Figure 1). In July, hybrid canola and field pea had significantly higher biomass than all other treatments but there was no difference between the two. In August, hybrid canola again had the highest dry matter production, significantly higher than all treatments other than field pea and oats. Fewer significant differences in biomass accumulation between the treatments were measured in September. Oats had the highest September biomass which was significantly higher than the dry matter of the wheat, field pea, vetch, medic and field pea plus canola mix treatments. Both oats and barley had accumulated more dry matter than all other treatments by October.

Biomass production of the medic treatment was consistently low over the growing season. Medic production was visibly suppressed after the application of select herbicide, the impact of this on dry matter production is unknown but thought to be high.

Forage quality

At the July sampling, all treatments had high protein levels of at least 25%. However, at the August, September and October sampling times, protein level began to separate between treatments. This was largely based on whether the treatment was a legume or non-legume plant species (Figure 2). In August, oats and barley had significantly lower protein than all legume treatments. Protein levels of medic and vetch were significantly greater than non-legume species, with the exception of canola not having a significantly different protein level to medic. All legume plant types had significantly greater levels of protein than non-legume species at the last two sampling dates.

Dry Matter Digestibility (DMD) in July and August was high with all values approximately 70% or higher. By September, the DMD of both canola treatments had declined considerably with significantly lower DMD than all treatments other than medic. By October, the DMD of both canola treatments was a very low (approximately) 30% and this was significantly lower than all other treatments. Vetch had the highest DMD in October and was significantly higher than wheat, field pea and medic. All feed sources had greater than 27% Neutral Detergent Fibre (NDF) and most treatments greater than 30% across all sampling dates.

Legumes generally had the lowest Metabolisable Energy (ME) at the August sampling, with field pea significantly lower than all treatments other than medic. Both

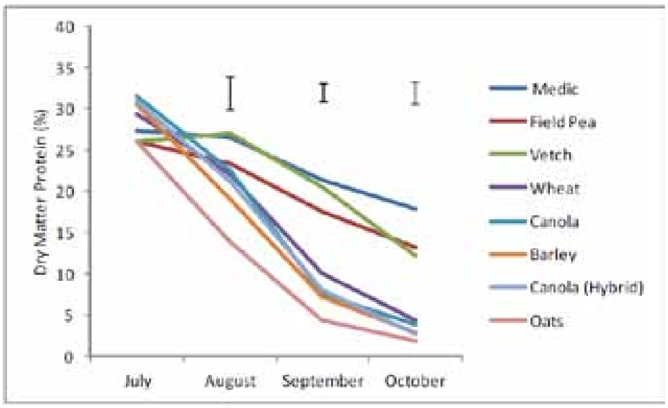

Figure 2. Protein percentage (%) of the dry matter at each sampling date. Error bars indicate Least Significant Difference (LSD) at each sampling time. Replicates from the July 2011 sampling were combined therefore there is no LSD for the July sampling date.

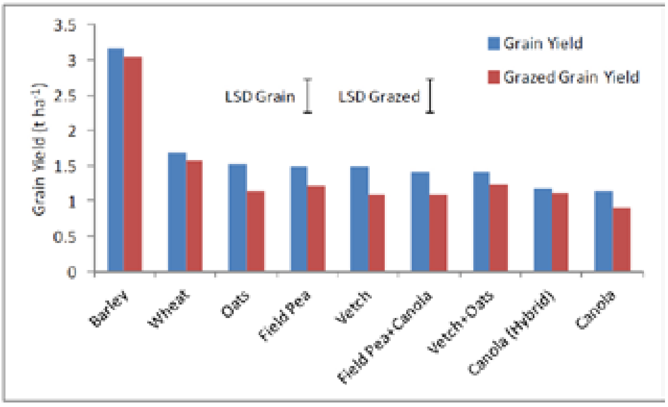

Figure 3. Grain yield of each treatment. Yields are of sub-plots that were left to go to grain or grazed once and left to go to grain.

canola treatments had the highest energy contents in August and were significantly higher than all legume treatments and wheat. However, by September, both canola treatments had significantly lower ME than all other treatments. In October, the ME content of both canola treatments was extremely low (ME approximately 4). Vetch dry matter had the highest ME (10) and was significantly higher than wheat, field pea and medic.

Grain yield

As shown in Figure 3, both the grazed and the un-grazed yield of barley was significantly greater than all other treatments. Break crop treatments yielded comparably to wheat in 2011 with the only other significant differences being the wheat yield greater than both canola treatments in the un-grazed plots and the wheat yield being greater than the open pollinated canola in the grazed plots. Figure 3 shows that the average grain yield after grazing was approximately 3-25% lower than if the crops were left un-grazed. However, these differences were not significant.

Crop sequence effects

The most noticeable crop sequence effect was the influence of crop type on the mineral nitrogen levels remaining in the soil after harvest (Figure 4). After categorising treatments into cereal, oilseeds, legumes or mixed treatments, it was found that soil mineral nitrogen levels were significantly greater in the 0-60 cm soil layer after legumes than after the other treatment categories. Mineral nitrogen levels were also significantly greater, following mixed treatments than cereal treatments at this depth. At the 60-120 cm depth, inorganic nitrogen was significantly higher following legumes than cereals. Differences between treatments in soil water content were also measured at the 60-120 cm depth layer. This soil layer was significantly drier under wheat than under field pea, vetch or the vetch plus oat mix.

Soil borne diseases were also assessed under each treatment post harvest. Significant differences were found between treatments for Take-all, Pythium, Pratylenchus and Black spot, but not for Rhizoctonia, root rot or cereal cyst nematode. Other Predicta B soil borne diseases had no detectable disease level. An interesting finding was that Take-All levels were highest under all legume monoculture treatments (with the exception of field pea not significantly different to oats). However, the Take-All levels measured were unlikely to cause yield loss to subsequent crops. Wheat treatments resulted in significantly higher levels of Pratylenchus neglectus nematodes in the soil. Pratylenchus was present at levels that could reduce yields by up to ten percent. Pythium levels in the soil were significantly higher following field pea than all treatments, except for vetch and medic. Field pea and the field pea plus canola mix also resulted in significantly higher Black spot levels than all other treatments.

Erosion susceptibility

There was no significant difference between treatments for dry aggregates, with a site mean of 39.8% aggregation. However, there were significant differences between treatments for

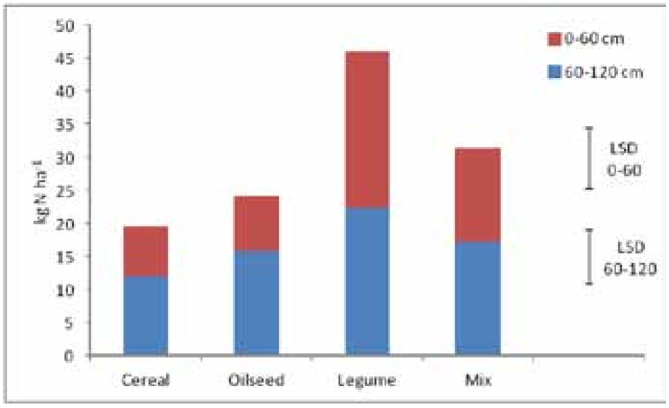

Figure 4. Mineral nitrogen levels for categorised treatments (cereal, oilseed, legume and legume and non-legume mix) in the 0-60 cm and 60-120 cm soil layers.

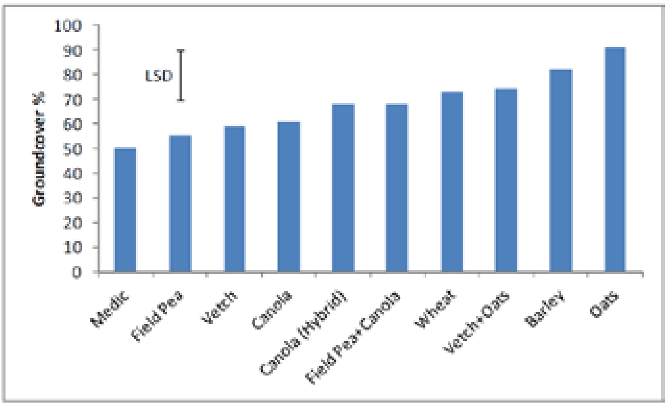

Figure 5. Groundcover measured post harvest for each treatment.

groundcover (Figure 5). All treatments containing cereals had significantly higher groundcover levels than legume monocultures. The medic treatment had the lowest groundcover, which was significantly different from all cereals, hybrid canola and both mix treatments. However, the average groundcover of the medic treatment was 50% which is high enough to minimise potential soil erosion.

Implications of the findings

The results demonstrated the potential to increase biomass production over the growing season by using a mix of crop types and by incorporating non-cereal crops. Total biomass at the end of the growing season was maximised through cereals; however, canola and field pea produced greater biomass in July and August, thus indicating that these crops could potentially be used to increase early feed supply. In terms of livestock enterprises, the winter period is generally considered a feed gap, therefore increasing dry matter production in these months will be more beneficial than having higher biomass in spring. There was no productive advantage of growing fodder crops in mixtures, compared to growing individual crop types in monocultures.

Feed quality is also important to improve livestock production and fast growing lambs require a feed source with 14-17% crude protein, 11-12 ME, high digestibility and a fibre content of at least 30%. Canola produced high quality feed in winter but as the season progressed, the forage quality became poor with low protein, high fibre and low digestibility. The protein levels of cereal forages also declined rapidly in late winter-early spring and would not meet the protein requirements of fast growing livestock after this period. Conversely, legume forages provided a high quality feed source throughout the growing season.

The potential to include non-cereal crops in Mallee rotations was demonstrated. Apart from barley, grain yields at the site were similar for cereals, oil seeds and legume crops. There was also no significant effect of grazing these crops on grain yield, which may be due to the high stored water at the site prior to seeding in 2011. The full soil water profile buffered the low in-crop rainfall received and therefore reduced the risks of growing non-cereal crops.

Growing legumes crops and pastures also resulted in higher post harvest mineral nitrogen and sub-soil moisture levels, which are likely to be of benefit to subsequent non-legume crops. However, legume crops, especially field pea, tended to increase the risk of some soil borne diseases; yet, the reasons for this and potential rotational impacts are not clear. Furthermore, fodder crops did not increase the risk of soil erosion at the site, with all groundcover levels greater than 50%. However, grazing management of the different stubble types may influence erosion risk in commercial practice.

The key points from this project are:

- Fodder crops could be successfully used by Mallee farmers to diversify and increase feed supply and quality to livestock enterprises;
- Non-cereal crops can be successful in low rainfall years when subsoil moisture levels are high prior to seeding. More research is required to establish the risk of non-cereal crops across a range of seasons and sub-soil moisture levels;
- Grazing had negligible impact on final grain yield. Further work is required to establish if this was a result of high sub-soil moisture levels prior to seeding;
- The rotational benefits are highest from legume crops and pastures as soil nitrogen levels were higher and sub-soil moisture was spared for following non-legume crops;
- Erosion potential post harvest was low; however, the grazing practices of different stubble types may impact on groundcover.

Acknowledgements

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Further information

The information for this bulletin has been taken from: *Do Fodder Crops Improve the Sustainable Management of Mallee Soils? 2011* – A report for the Mallee CMA by MSF.

A copy of the report can be downloaded from the Mallee CMA website: **www.malleecma.vic.gov.au**

Above: Emerged foraged crop 2011. Photo: Mallee Sustainable Farming.

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