Native pasture cropping

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Take home messages

- *Native grass pastures can be successfully established to provide grazing potential for stock.*
- *A cereal crop can be sown into native pasture and harvested to provide an economic return.*
- *Native pasture cropping can be developed into a viable farming system in the Wimmera and southern Mallee.*

Background

The value to agriculture of native grass pastures has often been overlooked. Over 99% of Victoria's original native grasslands have been lost, and soil loss and degradation is continuing. Native grasses are mostly perennial, naturally adapted to local soil and rainfall conditions and drought resistant. Native grasslands also support a rich diversity of fauna, many of which are threatened in Victoria and which can play a significant role in controlling insect pests in nearby pastures and crops.

As pasture, native grasses have a range of production, environmental and economic benefits. Native pastures can improve soil health because they maintain 100% ground cover all year round, provide high levels of soil organic carbon and improve soil structure and nutrient availability. This greatly reduces soil loss due to wind erosion and leads to improved nitrogen use and water use efficiency. The Wimmera and Mallee regions have been identified as areas in which wind erosion of soil is moderate to severe and widespread. They are ranked as high priority areas for reducing soil erosion (Smith & Leys 2009).

Farming systems which incorporate native pastures have the potential to improve long-term soil health. Further gains can be reaped by incorporating cropping into native pasture farming. Pasture cropping is a zero till technique involving the sowing of winter cereal crops into summer-growing perennial native pastures. As a farming system, it can improve farm economic performance through reduced input costs for cropping, increased fodder after harvest for summer grazing and reduced annual weed problems. Crop stubble and the regenerating native pasture can be rotation grazed. Issues of soil salinity, fertility, organic carbon and moisture are addressed by native pastures maintaining living ground cover throughout the year (Seis 2008).

Re-establishing native grasses on farms in the Wimmera and Mallee as part of a native pasture and pasture cropping farming system will not only provide clear biodiversity benefits. It will improve farm profitability and sustainability and has the potential to increase the resilience of farming across the region. Native pastures and pasture cropping as a farming system have not been trialled on Wimmera/Mallee soils. This project investigated the viability of a pasture cropping system through native pasture establishment and pasture cropping trials.

Aim

The Project aims to develop a regionally viable farming system which incorporates the establishment of native perennial pastures, cropping into native pasture and rotational grazing of the pasture and stubble. The project demonstrates the potential for native pasture farming systems in the Wimmera/Mallee region to provide clear pastoral, cropping and environmental benefits. It addresses the multiple issues of improved soil health, biodiversity gains and increased resilience through an innovative mixed farming system trial. It focuses on the establishment of native grass pastures in Wimmera and Mallee soils, cropping and rotational grazing.

The objectives are:

- to establish native pasture in trial plots on soil types representative of Wimmera and southern Mallee farming regions
- to determine what impacts native pasture may have on soil moisture levels during the non-growing season
- to measure native pasture establishment and growth rates to determine summer grazing potential
- to sow a cereal crop into established native pasture and measure success parameters for the trial, including crop performance and yield
- to demonstrate the benefits of native pasture and pasture cropping as an alternative farming system to landholders and managers in the region.

Method

Two soil types were chosen for the establishment of native pasture trials: a sandy soil in the southern Mallee and a heavier clay loam soil in the Wimmera.

Site 1 is situated 12km east of Hopetoun, Vic., on a sandy soil type. Mean annual rainfall is 311mm, of which 192mm (62%) falls during the growing season. In 2009, the site was sown with wheat which was sprayed and slashed in preparation for trial plot establishment.

Location:	Hopetoun
Number of plots:	12
Pasture sowing date:	16 October 2009
Pasture species:	Red Grass *Bothriochloa macra*, Spider Grass *Chloris truncata*, Cotton Panic *Digitaria brownii*
Sowing rate:	9kg/ha, each species
Crop type:	Correl wheat
Crop sowing date:	12 May 2010
Seeding density:	130 plants/m^2
Seeder equipment:	Knife point, press wheel at 30cm row spacing
Fertiliser:	Urea 60kg/ha

Table 1. Plot types and cropping treatments implemented at Hopetoun trial site.

Plot type	Number of plots	Cropping treatment	Number of plots
Native pasture sown	8	Sown with Correl wheat	4
		No wheat sown	4
Fallow (not sown with pasture)	4	Sown with Correl wheat	2
		No wheat sown	2

Site 2 is at Kewell, 11km north of Longerenong, Vic., on a heavier, grey clay to red clay loam soil type. Mean annual rainfall is 414mm, of which 285mm (69%), falls during the growing season. The site was sown with field peas in 2009. Some stubble from the 2008 barley crop remained at the time of plot establishment.

Location:	Kewell
Number of plots:	12
Pasture sowing date:	15 October 2009
Pasture species:	Red Grass *Bothriochloa macra*, Tall Windmill Grass *Enterapogon acicularis*, Silky Blue Grass *Dichanthium sericeum*
Sowing rate:	9kg/ha, each species
Crop type:	Correl wheat
Crop sowing date:	13 May 2010
Seeding density:	130 plants/ m^2
Seeder equipment:	Knife point, press wheel at 30cm row spacing
Fertiliser:	Urea 60kg/ha

Table 2. Plot types and cropping treatments implemented at Kewell trial site.

Plot type	Number of plots	Cropping treatment	Number of plots
Native pasture sown	8	Sown with Correl wheat	5
		No wheat sown	3
Fallow (not sown with pasture)	4	Sown with Correl wheat	3
		No wheat sown	1

Each trial plot was 6 metres wide and 28 metres long. High pasture sowing rates were chosen to ensure adequate native pasture germination and establishment. At each site, soil samples were taken at 0 – 10, 10 – 40, 40 – 70 and 70 – 100 cm depths to measure moisture levels. Samples were taken before pasture establishment, after establishment of native pastures but before sowing of the cereal crop to measure crop starting moisture and any moisture penalties from pasture presence. Pasture dry matter cuts were taken to measure growth and stock forage potential. Cereal dry matter cuts were taken to measure crop growth performance. Grain yield and quality were measured at harvest.

Results

Native Pasture Establishment

Trial plots were sown with native pasture in mid-October 2009. Plots were worked once with harrows to scratch the soil surface because native grass seeds should be sown to a depth of 5–10 mm. Seeds of the three native grass species were mixed together and hand broadcast. Each site was then harrowed again to ensure that the maximum number of seeds reached sowing depth.

Germination followed summer rain, with most germination occurring along old stubble lines. All three pasture species germinated, though not evenly. At Hopetoun, Spider Grass dominated and very little Cotton Panic emerged. At Kewell, Silky Blue Grass was the dominant emergent.

Dry matter cuts were taken on 18 February 2010 at Hopetoun and 17 March 2010 at Kewell. Pasture had been growing for five months at Hopetoun and six months at Kewell. The results are shown in table 3.

Table 3. Native pasture dry matter results (kg/ ha) from the two trial sites.

Trial site	Mean weight (kg/ha)	Range (kg/ha)	Sample size (number of cuts)
Hopetoun	230.1	86.1 – 450.0	4
Kewell	750.1	244.4 – 1469.4	4

The two sites are not comparable because they occur on different soil types, in different rainfall zones and involve different native pasture species. However, the results do show the potential summer forage available from native pastures.

Soil test results

At Hopetoun, trial starting moisture was sampled on 20 August 2009. Post-summer pasture growth and cereal crop starting moisture were sampled on 18 March 2010. Due to the dryness of the soil in March, core samples could be taken only to 60cm depth. The post-summer pasture growth and cereal crop starting moisture soil test results are shown in table 4.

Table 4. Post-summer pasture growth and cereal crop starting plant available water (PAW) mm, levels by depth (cm) at Hopetoun.

Plot type	Plant available water (mm)			
	1 – 10 cm	10 – 40 cm	40 – 70 cm	70 –100 cm
Native Pasture (n=1)	3.0	12.1	9.0	-
No pasture (n=1)	6.7	19.2	15.5	-

The results show lower PAW levels in the pasture plot compared with the plot with no pasture, though only one sample was taken and statistical significance could not be tested.

At Kewell, the starting moisture was sampled on 1 October 2009. Post-summer pasture growth and crop starting moisture were sampled on 19 March 2010. The post-summer pasture growth and cereal crop starting moisture soil test results are shown in table 5.

Table 5. Post-summer pasture growth and cereal crop starting plant available water (PAW) levels by depth (cm) at Kewell.

Treatment	Plant available water (mm)			
	1 – 10 cm	10 – 40 cm	40 – 70 cm	70 – 100 cm
Native Pasture (n=3)	-6.0	-1.6	5.8	6.5
No pasture (n=3)	-7.5	27.3	24.6	15.3
P value	**0.593**	**0.067**	**0.423**	**0.474**
CV (%)	**41.6**	**75.2**	**152.1**	**112.6**
LSD (5%)	**NS**	**NS**	**NS**	**NS**

The results show that, although the PAW levels were lower at all depths in the native plots, the differences were not significant.

Cropping trial results

Correl wheat was sown into pasture and non-pasture plots at both trial sites in mid-May 2010. Dry matter cuts at GS32 were taken at Hopetoun on 26 August 2010 and at Kewell on 3 September 2010. The results are shown in table 7.

Table 7. Cereal dry matter cut results at the two trial sites.

Treatment	Mean dry matter weight (kg/ ha)	
	Hopetoun (n=2)	Kewell (n=6)
Native Pasture	1677	1680
No Pasture	1699	1964
P value	**-**	**0.325**
CV (%)	**-**	**25.8**
LSD (5%)	**-**	**NS**

The results in table 7 show no significant difference in the dry matter weights between plots sown with native pasture and plots with no native pasture at Kewell. The results for Hopetoun also show very little difference, though, due to a small sample size, significance could not be tested.

The Hopetoun trial site was harvested on 4 December 2010. The Kewell trial site was harvested on 28 December 2010. The results are shown in tables 8 and 9. Yield figures have been corrected to 11.5% moisture to standardise grain yield results.

Table 8. Cereal results for trial plots at Hopetoun. Sample size and mean yield, protein, moisture and screenings are shown.

Treatment	Yield (t/ha)	Protein (%)	Moisture (%)	Screenings (%)
Native Pasture (n=4)	2.4	8.3	10.5	8.8
No pasture (n=2)	3.2	9.8	10.5	6.9
P value	**0.035**	**0.042**	**0.50**	**0.423**
LSD (5%)	**0.594**	**1.27**	**0.64**	**18.85**
CV (%)	**1.8**	**1.1**	**0.5**	**18.1**

The results for Hopetoun show that wheat grown in the native pasture plots had significantly lower yield and protein compared with the plots with no pasture. Moisture levels and percentage screenings were not significantly different.

Table 9. Cereal results for trial plots at Kewell. Sample size and mean yield, protein, moisture and screening percentages are shown.

Treatment	Yield (t/ha)	Protein (%)	Moisture (%)	Screenings (%)
Native Pasture (n=5)	3.4	10.4	11.1	4.2
No Pasture (n=3)	3.0	9.9	11.1	4.3
P value	**0.123**	**0.162**	**0.423**	**0.973**
LSD (5%)	**2.26**	**3.43**	**0.287**	**6.42**
CV (%)	**19.8**	**9.5**	**0.7**	**43**

The results for Kewell show no significant differences between treatments in any of the crop performance measures.

Interpretation

The 2010 trial demonstrated that native pasture can be successfully established on Wimmera and southern Mallee soils under 2010 seasonal conditions and can provide summer forage within six months of sowing. The pasture dry matter results were quite varied and probably reflect the patchy nature of germination and establishment of the grasses in the first year. However, native grasses are largely perennial and will improve their pasture forage potential with continued growth over subsequent seasons.

Despite the short growth period, the pasture dry matter results compare favourably with results from a pasture cropping trial in the WA wheatbelt where perennial pasture yields ranged from 130 to 2520kg/ha (Nicholls 2010). The results for Hopetoun are lower than those from a BCG perennial pastures trial, also at Hopetoun, where five subtropical grass varieties produced mean dry weights of approximately 850 to 1400kg/ha after growing for 16 months (Craig 2010).

The only significant findings from the cereal phase of the trial were lower grain yield and protein levels in native pasture plots at the Hopetoun trial site. This is most likely due to lower levels of plant available water at sowing, as indicated by the soil test results. The lower protein results suggest less available nitrogen. It is possible that the urea levels applied at the start of the trial were insufficient for the crop growing in the sandy soil. By contrast, the cereal trial results for Kewell showed no significant differences in yield or quality, though the lower values for the pasture plots suggest a trend towards a pasture penalty.

The trial results showed that, under suitable seasonal conditions, it is possible to sow and harvest a cereal crop from native pasture. In Mallee sand soil types, such as at Hopetoun, native pastures were observed to reduce grain yield and quality. Crop performance may not be so affected in a Wimmera clay soil, such as at Kewell, with little or no penalty from cropping into native pasture. In a pasture cropping farming system, crop yield results should be viewed in the broader context of the summer grazing benefits available.

In the longer term, native grass pasture has the potential to provide on-going stock forage value. In seasons in which soil moisture levels are suitable, native pastures can also be successfully cropped, supporting a farming system that provides both a cropping and grazing return.

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References

Craig, S. 2010. Sub-tropical Pasture Options in the Mallee. BCG Final Report to Mallee Catchment Management Authority.

Nicholls, C. 2010. Pasture cropping provides perennial possibilities. *Focus*. March 2010. Future Farm Industries CRC.

Seis, C. 2008. Pasture cropping reaps financial and environmental benefits. *SALT Magazine* 17: 6—7. Future Farm Industries CRC.

Smith, J. & J. Leys 2009. Identification of areas within Australia for reducing soil loss by wind erosion. Australian Government Bureau of Rural Sciences Report.