Yield and soil water use for annual crops sown over subtropical perennial pastures

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Purpose:	- To evaluate the performance of annual crops when pasture cropped over different perennial species
	- To quantify the soil water balance under permanent perennial pastures, pasture-cropped and annual based farming systems in the NAR
Location:	West Moora (Barberton West Road)
Soil Type:	Deep sandy soil
Soil Results:	Table 1
Rotation:	2008: perennial sown (September); 2009 Barley; 2010 Lupins
2011 GSR:	341mm
2009 GSR:	370mm

Table 1: *Trial site soil test results- average across all plots*

Depth	Ammonium Nitrogen	Nitrate Nitrogen	Phosphorus Colwell	Potassium Colwell	Sulphur	Organic Carbon	Cond-uctivity	pH
cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	%	dS/m	($CaCl_2$)
0 to 10	7.4	8.8	12.0	28.8	7.9	1.1	0.06	5.3

BACKGROUND

Sub-tropical perennial grasses (e.g. Gatton panic and Rhodes grass) are being adopted in the Northern Agricultural Region (NAR) on deep sandy soils in an effort to stabilise fragile soils, reduce groundwater recharge and provide out of season fodder for grazing enterprises. Because sub-tropical perennials become dormant during winter, there might also be scope to grow a grain crop whilst maintaining 'live' ground cover.

In 2008, the EverCrop project established a 3 ha focus site south-west of Moora on a deep sandy soil to evaluate the profitability and NRM benefits of pasture cropping. Rhodes grass and siratro plots were sown on 36 cm row spacing and Gatton panic on 36 and 72 cm row spacing. There are 4 permanent pasture, 2 'crop only' and 8 pasture cropped treatments (Table 1). Annual crops have been sown (on 180 cm row spacing) across pasture cropped and 'crop only' treatments for the past three seasons. The Lupin crop was not assessed in 2010 due to crop failure. Results for Buloke barley (2009 and 2011) are reported below.

TRIAL DESIGN

Plot size: 6 x 30 m

Machinery: Disc seeder with trailing press wheels

Repetitions: 3

Crop details: Buloke Barley (2009, 2011) @ 70 kg/ha sown on 3 Jun 2009 and 31 May 2011

Fertiliser:

Product	kg/ha	Treatments*	Timing	Application Date	
				2009	2011
Agstar Extra	80	All	At seeding	3 June	31 May
Sulfate of ammonia + Potash + Urea	50 50 30	All	3 leaf stage	9 July	8 July
Urea	30 100	NL & pasture NH	6 leaf stage	-	5 August

**See Table 2 for treatment code descriptions*

Herbicide:

2009 **Pre:** Sprayseed @ 2L/ha

Post: Barracuda @ 800mL/ha (16 July)

2011 **Pre:** Roundup @ 1L/ha

Post: Jaguar @ 750 mL/ha (29 June); 2,4-D amine @ 1.4L/ha, Associate @ 5g (17 August)

TRIAL LAYOUT

***Table 2**. List of treatments at the Moora pasture cropping site.*

Treatment Code	*Treatment description*
CNH*	Crop only, with 80 kg N/ha
CNL	Crop only, with 50 kg N/ha
G36*	Gatton panic only, 36 cm row spacing
G36NH*	Gatton panic 36 cm, pasture cropped with 80 kg N/ha
G36NL	Gatton panic 36 cm, pasture cropped with 50 kg N/ha
G72	Gatton panic only, 72 cm row spacing
G72NH	Gatton panic 72 cm, pasture cropped with 80 kg N/ha
G72NL	Gatton panic 72 cm, pasture cropped with 50 kg N/ha
R36	Rhodes grass only, 36 cm row spacing
R36NH	Rhodes grass 36 cm, pasture cropped with 80 kg N/ha
R36NL	Rhodes grass 36 cm, pasture cropped with 50 kg N/ha
S36*	Siratro only, 36 cm row spacing
S36NH*	Siratro 36 cm, pasture cropped with 80 kg N/ha
S36NL	Siratro 36 cm, pasture cropped with 50 kg N/ha

** indicates treatments where Neutron Moisture Meter access tubes were installed.*

RESULTS

***Table 3:** Buloke barley yield when sown across different perennial pastures*

	2009 (t/ha)		2011 (t/ha)	
Pasture base	**50 N**	**80 N**	**50 N**	**80 N**
Control – no perennial base	2.8	3.3	2.7	3.4
Siratro -36 cm row spacing	2.9	2.8	3.4	3.0
Gatton panic – 72 cm row spacing	2.8	2.6	3.3	3.1
Gatton panic – 36 cm row spacing	2.6	2.4	3.3	3.3
Rhodes grass – 36 cm row spacing (initially)	2.5	2.7	3.5	3.7

l.s.d (5%)	0.3	0.6

In 2011, grain yields for the control (crop only) treatments were similar to those achieved in 2009. Pasture cropped treatments yielded more than 2.4 t/ha in 2009 and 3.0 t/ha in 2011. In both years, there was no significant yield penalty for barley sown across perennial pastures when supplied 50 N (in line with district practice). However, grain yield was slightly depressed in 2009 (relative to the control) for the 80 N treatments, possibly due to increased competition from the pasture in spring. The good yields across *all* pasture cropping treatments in 2011 were possibly due to better nitrogen and water cycling in the 'pasture cropped' plots offsetting the impact of competition for water.

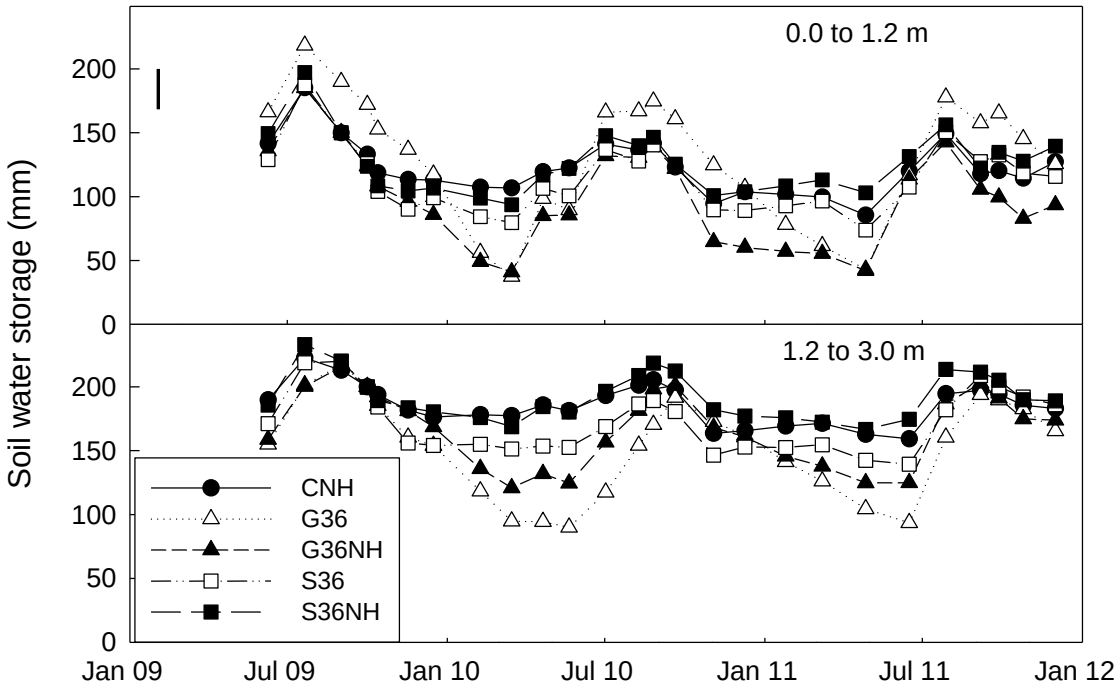

Figure 1. *Soil water storage under crop only, pasture only, and pasture cropped treatments for the top 1.2 m soil (top panel) and 1.2-3.0 m soil (bottom panel). See Table 2 for treatment code descriptions.*

Soil water contents under the perennials were about 100 mm lower than under the 'crop only' plot for the summer and autumn periods (Figure 1). Perennial 'pasture only' treatments were more effective in scavenging subsoil moisture than their pasture-cropped counterparts in both summer periods (2009/10 and 2010/11), indicating that the presence of the crop does impact on root growth and water uptake by the pasture plants. Siratro was less effective than Gatton panic, largely due to the very low density (about 2 plants m^{-2}).

Deep drainage beyond 3.0 m was highest in 2009 (average 109 mm) and substantially lower in 2010 (0.6 mm) and 2011 (7.9 mm). Averaged over all three years, drainage was significantly lower relative to the crop treatment for the Gatton panic 'pasture only' treatment, but not for any of the other treatments.

CONCLUSIONS

- Pasture cropping systems can provide grain (and out of season fodder) on deep sandy soils and reduce the likelihood of groundwater recharge.
- Potential yield penalties associated with pasture cropping across perennials on deep sandy soils in the west midlands appear to be less than 20%.

- Pastures started competing with the crop for soil water during grain filling, but impacts on soil water and grain yield were generally small given average rainfall in spring.
- During the crop growing season, there was little difference in soil water under annual crop, perennial pasture, and pasture-cropped plots.
- Soil water contents were much lower under pasture and pasture-cropped plots during summer and autumn.

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