Break crops for the Mallee

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Take home messages

- **wheat consistently yields more following a broadleaf break-crop than following wheat or a long-fallow.**
- **wheat yields more when grown after legumes (peas and vetch) than after brassicas (mustard, canola). Wheat yields are consistently higher following vetch than all other break crops.**
- **canola, pea hay or vetch hay followed by two wheat crops were more profitable than continuous wheat or fallow followed by two wheat crops.**

Background

In the BCG region, the area sown to broad leaf break-crops declined dramatically in response to the Millennium Drought. This was a rational response by farm managers, given the high risk and poor profitability of many break crops in drought years. However, following a wet 2010/2011 summer, many farmers took the opportunity to include a break crop in their rotation by sowing canola. Plantings of canola significantly increased this year, with some growers sowing canola for the first time in many years. The 2011 growing season also highlighted the importance of break crops in our farming systems: the yield of many cereal paddocks was limited by low soil nitrogen, root diseases and grass weeds. Break crop selection and management in 2012 will be a very important factor affecting farm profitability in the coming years.

This study is funded by the five year GRDC national initiative to increase water-use efficiency (WUE) by 10%, and has just completed its third year. Previous results related to the break crops trial can be found on page 35 in the *2010 BCG Season Research Results*.

Aim

To identify low risk, profitable break crops and end-uses for the Mallee region and quantify their benefits to subsequent wheat crops.

Method

This experiment was established 13km south-east of Hopetoun on Warrakirri's *Bullarto Downs* property and was repeated on two different soil types typical to the region, 2km apart. The sand site lay on top of an east-west dune with sandy topsoil and clay subsoil. The clay site was located on a low-lying flat with clay loam topsoil and moderate subsoil constraints.

Plots (2.1 x 28m) were pegged out in three separate areas in December 2008 using a split block randomised design with four replicates. The first area (block A) was planted to break crops in 2009, followed by wheat in 2010 and 2011. It will again be sown to wheat in 2012. The second area (block B) was sown to wheat in 2009, to break crops in 2010 and wheat in 2011. The third area (block C) was sown to wheat in 2009 and 2010, to break crops in 2011 and will be sown to wheat in 2012.

Location:	Hopetoun
Replicates:	4
Sowing date:	various (refer Table 1)

Seeding density:	various (refer Table 1)
Crop type/s:	Correll wheat, Hurricane canola, Twilight peas, Morava vetch and chemical fallow
Inputs/Fertiliser:	55kg/ha MAP
Seeding equipment:	knife points, 30cm row spacing, press wheels
Soil Fertility:	Sand site: 21 mg/kg Colwell P, 35 PBI
	Clay site: 33 mg/kg Colwell P, 147 PBI

Table 1. 2011 Break Crop and sowing details

Crop Type	Variety	Sowing date	Sowing rate kg/ha	Plants/m^2	N Fertiliser	End Use	
						Sand	Clay
Canola	Hurricane	28 April*	2.6	70	1 July 21kgN/ha Clay - 2 Aug 41kgN/ha	Hay (7 Sept) & grain	Hay (6 Oct) & grain
Peas	Twilight	1 June	80	40	-	Hay (6 Oct) & grain	
Wheat	Correll	28 April	73	130	Sand – 1 July 21kgN/ha Clay – 1 July 46kgN/ha	Hay (23 Sept), Grain	
Vetch	Morava	28 April**	40	60	-	Hay (6 Oct) & Brown manure (6 Oct)	
Fallow	Chemical		-	-	-	Long (22 July) & short (31 Sept)	

**Due to mouse damage, canola was re-sown at the clay site on 10 June.*

***Due to hare damage, vetch at the clay site was re-sown on the 1 June.*

End use: date in brackets indicates date hay was cut or treatment was implemented.

Two soil cores per plot (segmented into layers to a depth of 1.3 m) were taken on 15 December 2010, 29 March 2011 and 7 December 2011. Plant available water and mineral nitrogen were determined on the samples. The soil water content measured on cores sampled in December 2011 were used to calculate plant available water (PAW).

Two cores were taken per plot to a depth of 130cm pre-sowing on 31 March and were tested for DNA levels of soil-borne disease inoculum (Pre-dicta B testing).

Correll wheat (67kg/ha) was sown over the area occupied by the 2009 and 2010 break crops on 28 April 2010. Dry matter production was measured at flowering and at maturity in all crops. Half of each of the 2011 break crop plots was cut for hay at an appropriate time for each crop (biomass cut at approximately 10 cm above ground level and removed from plots) and for vetch half of each plot was brown manured. The other half of all the plots was machine harvested for grain yield and the grain analysed for quality (protein, oil, moisture, and screenings).

Total amounts of N fixed were derived from shoot data (N15 analysis) by assuming plant N was partitioned 67% above-ground, 33% below-ground in nodulated roots.

Gross margins were calculated for each crop and end-use in 2009 and for wheat in 2010 and 2011. 2009 hay prices were assumed to be $200/t for vetch, peas, canola and mustard, $150/t for wheaten hay. Grain prices used were $214/t for H2 wheat, $184 for APW and $144/t for AGP. The variable costs used to calculate the gross margins include cutting $40/ha, bailing $30/t, urea $650/t and MAP $780/t.

Results

What is the effect of break crops on subsequent wheat production?

At the sand site, peas, juncea canola, vetch and canola grown in 2010 left more mineral nitrogen in March 2011 than the fallow, which probably leached during the wet growing season and summer of 2010 (Table 2). There was no significant effect of crop type on the amount of mineral nitrogen in the soil prior to sowing at the clay site in 2011.

Table 2. Soil mineral N kg/ha in March 2011 under the various break crops that where grown in 2010.

2010 Crop	Soil mineral N kg/ha Mar 2011	
	Sand	Clay
Peas	80	226
Juncea Canola	88	209
Wheat	79	203
Vetch	89	245
Fallow	68	238
Sig. diff. **LSD (P=<0.05)** **CV%**	**P=0.040** **14** **17%**	**NS**

At the sand site, wheat grown in 2011 yielded more where broadleaf break crops had been grown in 2010 (Table 3). At the clay site, wheat following vetch and peas yielded more than wheat following wheat, fallow and juncea canola. There was no significant effect of break crop end-use (hay, grain, brown manure) at either site.

Table 3. Mean 2011 Wheat yield when grown following various crops or fallow in 2010.

2010 Crop	Sand		Clay	
	Yield (t/ha)	Protein (%)	Yield (t/ha)	Protein (%)
Juncea Canola	3.0	12.0	3.3	12.8
Peas	3.0	11.6	4.0	12.7
Vetch	3.4	11.6	4.0	12.7
Wheat	2.5	11.5	3.6	12.4
Fallow	2.5	11.6	3.1	13.2
Sig. diff. **LSD (P=<0.05)** **CV%**	**P=<0.001** **0.4** **14%**	**NS**	**P=<0.001** **0.4** **10%**	**P=0.003** **0.4** **3%**

In the second year after a break crop at the sand site, wheat grown two years after vetch or peas yielded more than wheat grown two years after canola, juncea canola, wheat or fallow. Wheat grown two years after vetch yielded 0.5 t/ha more than wheat grown two years after peas, reflecting the greater amount of nitrogen produced by vetch in 2009 (58kg/ha N and 30kg/ha N at the sand site by vetch and peas respectively). At the clay site, there were no significant differences between treatments (yield and protein), perhaps reflecting the higher N fertility of that site (Table 4).

Table 4. Mean 2011 wheat yield, when grown following wheat in 2010 and various break crops in 2009

2009 Crop	2011 Wheat yield	
	Sand	Clay
Canola	2.4	2.9
Peas	2.5	2.7
Juncea Canola	2.3	2.9
Wheat	2.3	2.8
Vetch	3.0	3.0
Fallow	2.3	2.6
Sig. diff. **LSD (P=<0.05)** **CV%**	**P=<0.001** **0.2** **8%**	**NS**

At the clay site pea, hay in 2009 followed by wheat in 2010 and 2011 had the highest mean gross margin (Figure 1). Pea hay and grain and canola grain followed by wheat were more profitable than continuous wheat or fallow followed by wheat.

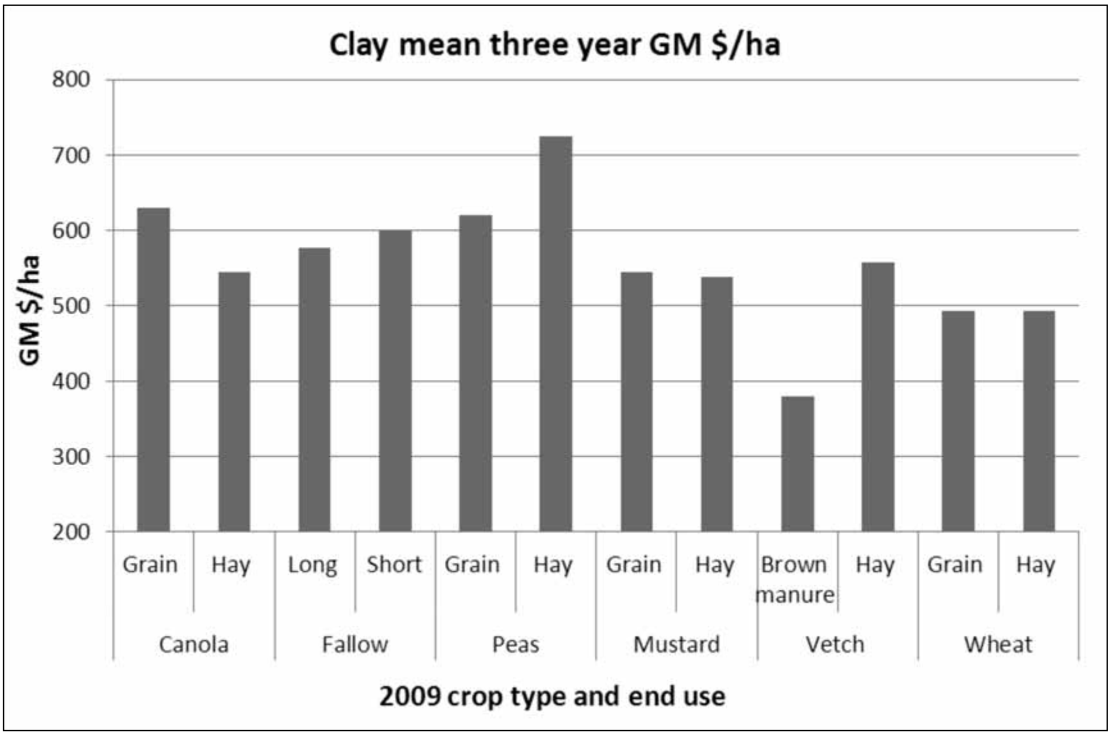

Figure 1. Clay site mean three year gross margin $/ha with crop type and end use grown in 2009 followed by Correll wheat in 2010 and 2011

At the sand site, canola grain, pea hay and vetch hay followed by wheat were more profitable than continuous wheat or fallow followed by wheat (Figure 2).

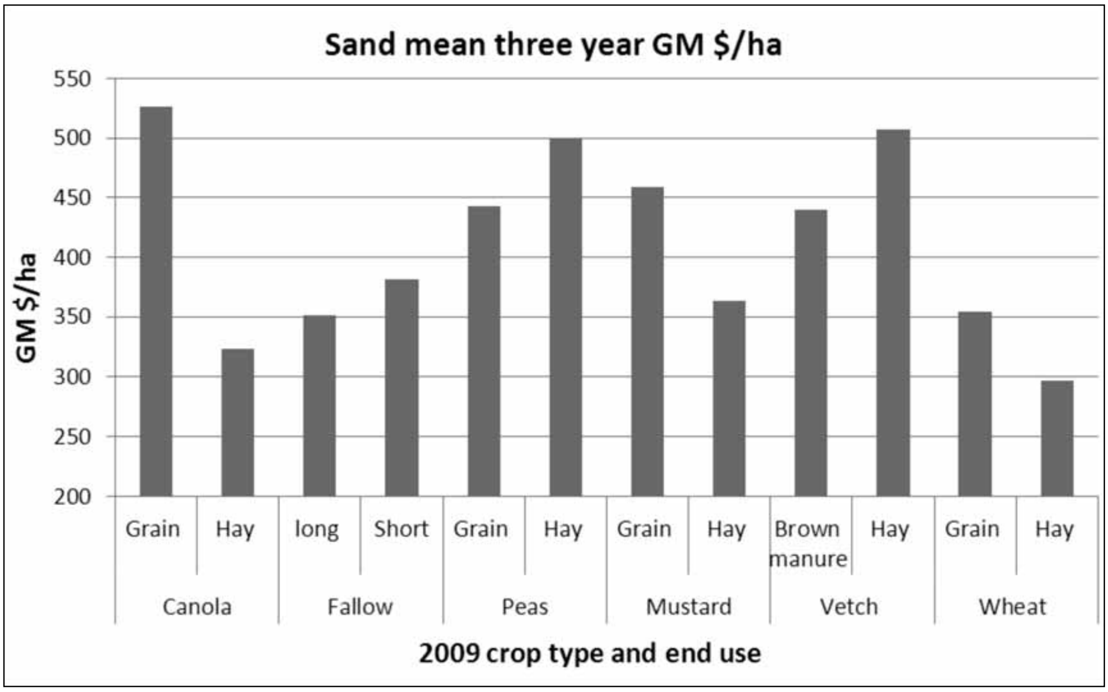

Figure 2. Sand site mean three year gross margin $/ha with crop type and end use grown in 2009 followed by Correll wheat in 2010 and 2011

Interpretation

At both sites, the yield response in wheat following break crops seems largely to be driven by nitrogen. Yields were higher after the two pulses (vetch and peas) and there was generally no difference between wheat grown after a brassica, fallow or wheat. Root diseases (crown rot, take-all, rhizoctonia), although measured at significant levels using DNA techniques prior to sowing in all three years in which the experiment has been run, did not appear to be adversely affecting yield. Similarly grass weeds were adequately controlled in the continuous wheat treatments, and adequate nitrogen was applied in 2010 and 2011 to meet the crops requirements.

Wheat following vetch has consistently been the best yielding treatment in this experiment. Vetch has been able to consistently fix more nitrogen than peas, probably because of its longer growing season and greater dry matter accumulation. However, vetch tends to use more moisture than peas and, had we experienced a particularly dry year, wheat grown on peas and fallow may have yielded more than wheat grown on vetch. This issue will be further explored using APSIM. Vetch hay has been more profitable than brown manure because of the income generated from hay, and the fact that wheat following each of these end uses yields the same. Peas for hay or grain were equally profitable in terms of a three year gross margin on either sand or a clay site. The inclusion of pulses in the rotation gave us the opportunity to increase grass weed control.

Canola grain followed by wheat has been a particularly profitable crop sequence. This has been because of the profitability of canola itself during the years in which the trial has run (all of which have featured stored soil water, early autumn breaks and high canola prices), not because of increased wheat yield following canola. This outcome may have been different if seasons had featured dry starts, late breaks and poor prices. Wheat-on-wheat over the three years was still profitable, despite having the lowest gross margin; this is largely due to high yields and high return in 2010.

Commercial Practice: what this means for the farmer

This experiment clearly shows that crop sequences involving a broad-leaf break crop between 2009 – 2011 were more profitable than continuous wheat. Crop sequences will be most profitable when break crops are grown in order to solve agronomic problems in cereal production (grass weeds, root disease, low N). The risk of losing money on break crops can be greatly reduced if growers remain flexible with their crop selection going into the growing season, and make final decisions on crop type based on amount of soil water, nitrogen and timing of the autumn break. Profitability can be further increased if inputs are kept to a minimum and applied in response to favourable conditions (e.g. top-dress N and S on canola based on Yield Prophet). End use should also be selected to match season conditions.

Figure 3 is an example of some rules-of-thumb or a 'decision tree' that could be used in the southern Mallee in order to ensure that production risk is kept to a minimum and chances of selecting the most profitable crop sequence are maximised.

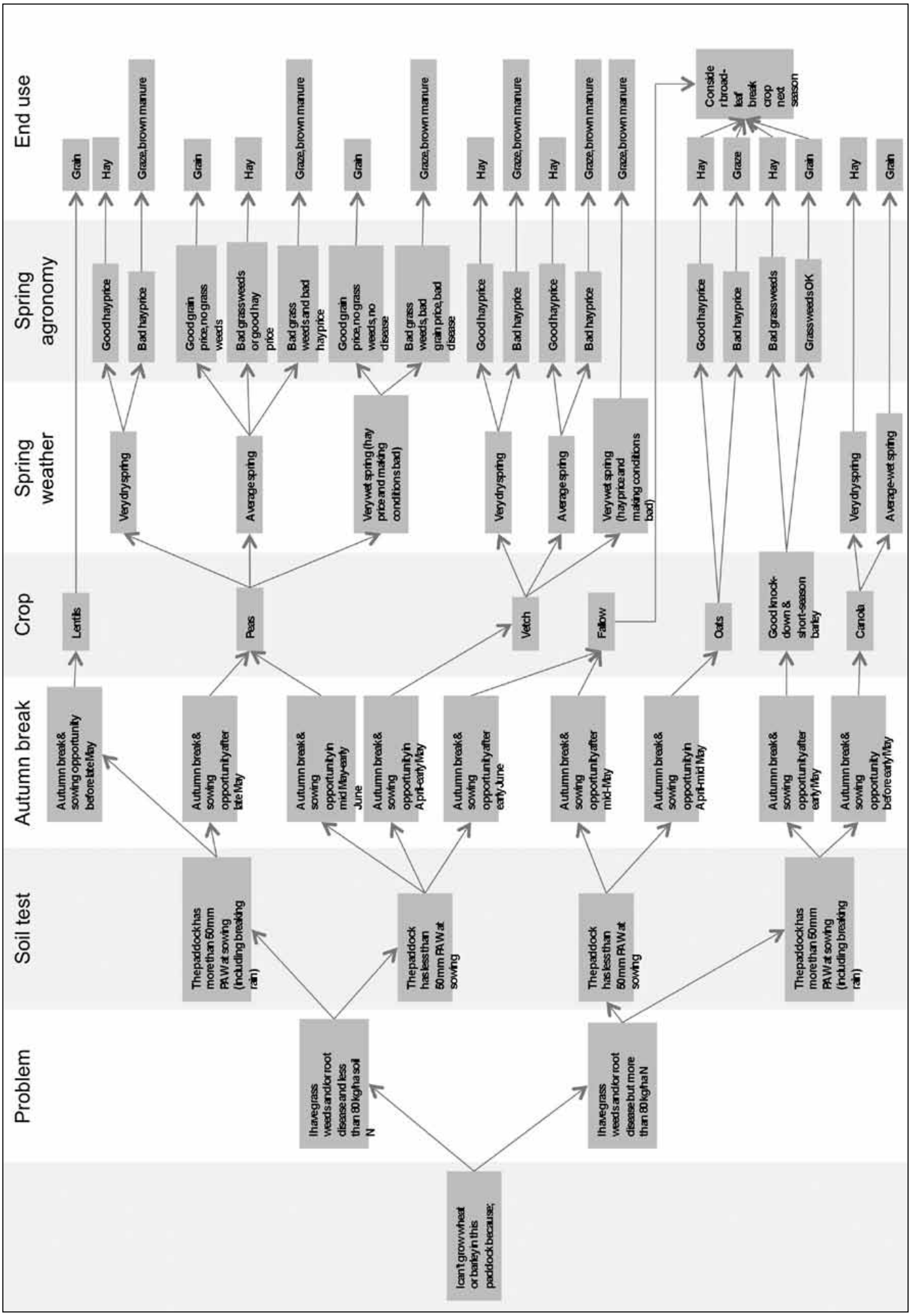

Figure 3. A decision tree for selecting break crops in the southern Mallee.

Acknowledgments

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