Long-term farming systems analysis in the southern Mallee and northern Wimmera.

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Abstract

Farming systems in the southern Mallee and northern Wimmera of Victoria are diverse, with most farmers having a keen interest in profitability and the identification of key biophysical parameters of sustainability. In order to satisfy this need the Birchip Cropping Group (BCG) established a long term farming systems trial in 1999. Four systems were scrutinised *viz*. being zero-till, reduced-till, fuel burners, and hungry sheep.

Through this project the BCG aims to encourage change that will create environmentally sound and economically viable farming systems for the dryland farming regions in the 300 to 450mm annual rainfall zone in Southern Australia.

Key words

Crop rotation, livestock, Birchip Cropping Group

Introduction

Farming systems in the southern Mallee and northern Wimmera are very diverse and discussion in the farmer community regularly focuses on which systems are most sustainable on bio-physical and economic bases.

Farmers are seeking clarification on issues such as disease and weed pressure resulting from different farming systems, cultivation versus zero tillage, fallowing versus continuous cropping, the role of livestock in a farming system, stability of rotations which include pulses versus those which are cereal-based, and the effect of heavy grazing on soil structure and long term cropping productivity. To address these issues, the BCG established a 'Farming Systems' site in 1999 with four systems being scrutinised *viz*:

1. Zero-Till - 100% crop intensity (cereals, pulses and oilseeds), controlled traffic, wide rows, full stubble retention, one-pass knife-point seeding, no livestock.

2. Reduced-Till – 80% crop intensity (cereals, oilseeds and pulses), aim for stubble retention and minimum tillage but remain flexible in cultivation practices and stubble management, livestock (including goats).

3. Fuel Burners - 60% crop intensity (cereals, with pulses grown irregularly) mechanical fallow, cereal-based, livestock/pasture.

4. Hungry Sheep – 70% crop intensity (cereals and pulses) combined with intensive grazing pressure from livestock.

Each of these four farming systems has a champion and a farmer group associated with it. The champion and associated farmer group, make all the management decisions including input and rotation selection.

To identify the success of each farming system, the BCG project integrates biophysical and economic research into an analysis of whole farm outcomes. The main focus is to compare the results of agronomic practices for economic viability and risk, soil-water relationships, soil biological activity, changes in weed

type and populations, changes in disease levels, the dynamics of the soil nutrient store, and physical characteristics of the soil.

Materials and Methods

The site comprises 32 one-hectare paddocks (individually fenced and watered), situated 30km north of Birchip on the property of Ian and Warwick McClelland in Victoria's southern Mallee district. The site is on a typical southern Mallee clay loam (Sodosol). Organic carbon in the topsoil (0-5cm) ranges from 0.9 – 1.3%. Soil boron (9-63ppm), chloride (500-1320ppm) and sodicity (ESP 9-53%) analysis revealed concentrations toxic to root growth across the site at depths ranging from 0.1 – 0.7m. Each of the four farming systems had five paddocks randomly allocated within the site – this allows each phase of their rotation to be represented every year. Replication of these 20 paddocks does not occur owing to the prohibitive cost of additional land, capital and labour. The remaining 12 paddocks have been established as a 'standard rotation' (four year rotation of fallow/canola/wheat/field peas). The standard rotation is replicated three times across the site enabling spatial variability to be measured.

Prior to handing the management of the site over to the 'champions' the following measures were made: soil characterisation; soil organic matter; bulk density; weed seeds in the soil; and biological activity in the soil. These parameters will be measured again after Year 5 and 10 of the project.

Prior to sowing each season, deep soil nitrate, plant available water and root disease levels (using the DNA test) are measured. Assessments of crop development, weeds and crop diseases are also undertaken. Grain yield and quality are assessed at harvest. All inputs are recorded to enable accurate analysis of the financial performance of each system.

Results and Discussion

2001 rainfall and seasonal conditions

The total rainfall received at the site was 261mm for 2001, with 197mm falling during the growing season (April-October)(Table 1). This corresponds to a decile 2.3 season. The break of the season occurred on 5th June when 13mm of rain fell. Although the first five months of the year were dry (60mm rain), spring rain in 2000 (142mm) ensured some stored soil moisture.

A mild winter compensated for the late break, allowing crops to develop rapidly. The cool weather in October and November produced an extended grain filling phase – average daily maximum temperatures were 1-2?C below the long-term average with only 3 days above 30?C recorded.

Table 1: Monthly rainfall, growing season rainfall and total for 2000 and 2001 seasons

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	GSR	Total
2000	2	35	2	44	24	16	50	21	44	39	59	11	238	347
2001	18	5	29	0	8	25	57	47	41	19	10	2	197	261

2001 production trends

In 2001 all the 'champions' chose low risk, cereal-based options as a result of the late break, high barley prices and relatively poor pulse crop performance in 2000.

2001 yield results

Wheat yields averaged 2.5 t/ha (Table 2) at the site and ranged from 2 t/ha in a resown Reduced Till paddock ('dry sown' and the grain went mouldy) to 3.1 t/ha in a Fuel Burner paddock (sown on fallow). Barley averaged 2.5 t/ha. Interestingly, the highest yielding barley crop (Hungry Sheep 3 t/ha) and the lowest yielding (Zero Till 2.1 t/ha) had the same rotation (pulse/wheat/barley). The difference was variety selection - the Hungry Sheep systems grew Barque feed barley and the Zero Till system grew Sloop malt barley. Barque barley has higher tolerance to boron than Sloop.

Pulse and canola crops all yielded poorly, <1 t/ha (Table 2), owing to the late break, low growing season rainfall, subsoil constraints and frost damage. The Zero Till lentil crop suffered from Simazine damage.

Table 2: Average yields (t/ha) for each crop type during 2001 (number of paddocks in brackets).

Crop	Site average	Fuel Burner	Hungry Sheep	Reduced Till	Zero Till
Wheat	2.53 (11)	2.98 (2)	2.26 (2)	1.97 (2)	2.09 (2)
Barley	2.54 (5)	2.87 (1)	3.00 (1)	2.38 (2)	2.08 (1)
Canola	0.55 (4)				0.36 (1)
Lentil	0.38 (2)		0.43 (1)		0.32 (1)
Field pea	0.93 (3)				
Stock rate*	2.4	1.3	8	1.3	No stock

* Stocking rate = DSE/ha - assuming a DSE to be a medium framed 50 kg dry sheep.

Emerging weed issues

The major weeds present during the 2001-growing season were wild oats (*Avena fatua* L.), annual ryegrass (*Lolium rigidum* Gaudin.), Indian hedge mustard (*Sisymbrium orientale* L.), barrel medic (*Medicago truncatula* Gaertn.) and whip thistle (*Lactuca serriola* L.). Brome grass (*Bromus diandrus* Roth), barley grass (*Hordeum leporinum* Link) and sow thistle (*Sonchus oleraceus* L.) were also significant weeds.

Volunteer wheat was a major problem in those paddocks dry sown to barley following wheat. Contamination levels were sufficient to cause down grading to feed (provided grain protein fell within acceptable limits for malting barley).

Weeds that may cause management problems in the future:

- Marshmallow (*Malva parviflora* L.) detected in two Zero Till and two Reduced Till paddocks
- White ironweed (*Buglossoides arvensis* L.) detected in one Zero Till paddock.
- Wild radish (*Raphanus raphanistrum* L.) detected for the first time at the site – in Hyden canola growing in a Standard paddock.
- Pressure from populations of wild oats, annual ryegrass, brome grass and, to a lesser extent, barley grass will be challenging to all systems. These grass weeds dominated weed populations in cereals this season, especially in paddocks dry sown.

Disease issues

Root disease: Cereal root disease was detected in 4 of the 16 paddocks sown to wheat and barley in 2001. The diseases identified were Take-all (*Gaeumannomyces graminis*) and *Pratylenchus* spp. (Table 3).

In the Fuel Burner system, where all three paddocks have a similar history with a rotation of cereal/break (peas or medic/fallow)/cereal, Take-all was present in low levels in all three cereal crops. Low numbers of volunteer cereals, wild oats and barley grass during the non-cereal phase were sufficient to host the Take-all fungus and carry it through into the 2001 cereal crops.

Pratylenchus was at low-moderate levels in two of the three Fuel Burners cereal crops and at low-moderate levels in one of the Hungry Sheep wheat crops. All of these paddocks have a *Pratylenchus* susceptible/resistant/susceptible crop rotation. Low background wild oats populations during the resistant break crop phase allowed the nematode to survive and be present in the 2001 cereal crops.

Table 3: Detectable cereal root disease issues in 2001 crops

Paddock	System	Take-all	*Pratylenchus* spp.
10	Fuel Burners	Low levels	Low→Moderate levels
18	Fuel Burners	Low levels	Below detection
26	Hungry sheep	Below detection	Low→Moderate levels
29	Fuel Burners	Low levels	Low levels

Foliar disease: Foliar disease was present at low levels in all crops during 2001 but the impact was minimal. Foliar diseases identified at the site were Spot Form of Net Blotch in barley, Yellow Leaf Spot in wheat, Ascochyta in Field peas, Ascochyta in lentils (no Botrytis Grey Mould) and Blackleg and Altenaria in canola.

Economic performance

The Hungry Sheep system has been the most profitable system based on the 2-year average gross margins for 2000 and 2001 (Table 4).

The Zero Till system has had the greatest area sown to pulse and canola crops over the past two seasons, with an average of 50% of the available area sown. This system has delivered the lowest returns to date indicating increased exposure to both production and business risk when growing non-cereal crops in the southern Mallee (Table 4). Fuel Burners (10%), Reduced Till (10%) and Hungry Sheep (20%) have sown far less of the available area to pulse and canola crops.

Table 4: 2-year average gross margin for each system over the 2000 and 2001 seasons.

Fuel burner		Hungry sheep		Reduced Till		Zero Till	
2000	2001	2000	2001	2000	2001	2000	2001

Income	286	349	375	356	274	338	224	294
Variable costs	118	81	115	94	100	113	159	136
Gross Margin	168	268	260	262	174	225	65	158
2-yr av. GM	**218**		**261**		**200**		**112**	

Livestock gross margin figures were based on a medium-frame merino ewe flock with 90% lambing (Table 2). The gross margin was estimated to be $25.30/DSE for all systems except the Hungry Sheep system - this was estimated to be $19.80/DSE due to the higher costs of establishing oat and medic pastures and supplementary grain feeding.

The BCG is currently undertaking whole farm economic performance including machinery costs, finance costs and risk sensitivity.

Conclusions

It is too early to tell if the profitability and sustainability trends observed to date will be maintained. However, regardless of this fact, the BCG's Farming Systems research site has heightened discussion on the topic of 'what a profitable and sustainable farming system looks like', and is sure to facilitate many practice changes, leading to improved profitability and long term viability of Mallee and Wimmera communities.

Acknowledgments

The BCG would like to acknowledge and thank the Grain Growers Association as the major funder of this research. We also acknowledge the contribution of our many partners, especially GRDC, NRE, CASE – JJ O'Connor, Hardi and Cyclone.