

Increasing on-farm adoption of broadleaf species in crop sequences to improve grain production and profitability

Dr Guangdi Li, Richard Lowrie, Graeme Poile and Adam Lowrie NSW DPI, Wagga Wagga

Key findings

- » The rotation with canola as a single break crop (canola–wheat–wheat rotation) had the highest average gross margin (\$529/year) across three years.
- » The profit/cost ratio was the highest when canola was used as a single break crop (2:8) and the lowest for all brown manure treatments as well as continuous cereal without nitrogen input.

Introduction

Including break crops into cropping rotations can improve soil fertility and give growers more options to manage difficult weeds as well as control crop diseases. However, the high input cost and low/variable income from break crops give growers an impression that broadleaf options are not as profitable as cereals. Indeed, some of the management options, such as brown manuring grain legume crops, will result in nil income for the year. The question is whether the nitrogen (N) benefits to subsequent cereals from the break crops, and savings from weed control, could offset the loss of income from break crops in the longer term.

At the Graham Centre site at Wagga Wagga, a four-year crop sequence experiment was conducted from 2011–2014 that focused on the N benefits of break crops to subsequent crops. There were three sets of treatments phased across years with single break (break crop used once in four years) and double breaks (break crop used twice in four years) with a range of crop sequences.

The break crops were canola, lupins, field pea, vetch or high density legume pasture. Wheat–wheat–wheat with and without N were used as control. Field peas were harvested for grain or brown manured at peak dry matter (DM), vetch and legume pasture was cut for hay or brown manured at peak DM, and lupins and canola were harvested for grain.



Figure 1. Crop sequence experiment at Paddock 45 in spring 2013.

Results

Grain yield

Grain yield increased significantly for the first wheat crop following any break crop (field pea, vetch and pasture) when brown manured (Table 1). The benefit from break crops diminished in the second wheat crop (in year three (Y3)) although the grain yields tended to be higher on the brown manure treatment. When field pea was brown manured, grain yield from the first wheat crop in year two (Y2) was 10% higher than field pea harvested for grain in year one (Y1) ($P = 0.055$). In contrast, when pasture was brown manured, the wheat grain yield in Y2 was 18% higher than pasture cut for hay in Y1. There was no difference in grain yield when vetch was brown manured or cut for hay.

Table 1. Crop yield for the various crops under different crop management.

2011	Crop	2012	2013	Grain (t/ha)		
Y1	management	Y2	Y3	Y1	Y2	Y3
Field pea	Grain	Wheat	Wheat	2.5	3.5	3.5
	Brown manured	Wheat	Wheat		3.7	4.1
	Significance				P = 0.055	n.s.
Vetch	Hay cut	Wheat	Wheat		3.4	3.6
	Brown manured	Wheat	Wheat		3.7	3.8
	Significance				n.s.	n.s.
Pasture	Hay cut	Wheat	Wheat		3.1	3.5
	Brown manured	Wheat	Wheat		3.6	3.6
	Significance				P = 0.01	n.s.
Wheat+N	Grain	Wheat–N	Wheat–N	5.2	2.4	3.1
	Grain	Wheat+N	Wheat+N		3.5	3.6
	Significance				P <0.05	P <0.05

n.s. not significant.

Under brown manure treatments, there was no difference in wheat grain yield in Y2 between break crops (field pea, vetch and pasture) (Table 1). For the second wheat crop, the grain yield from the field pea brown manure treatment was significantly higher than those from vetch and pasture. For the hay cut treatment, wheat following vetch produced more grain than that following pasture (Table 1). There was no difference in grain yield whether wheat crops followed field pea or lupins in Y2 or Y3.

For continuous cereal (control), the grain yield was 48% higher on the 75 kg N/ha treatment (25 kg N/ha at sowing and 50 kg N/ha at tillering) compared with the nil N treatment (Table 1). The yield increase was lower in Y3 compared with Y2. However, the grain yield from the N treatment was much lower than those following break crops, indicating that the N benefit from break crops was greater than fertiliser N for at least two wheat crops after the break crop.

Gross margin analysis

Gross margin analysis showed that averaged across two phases, the rotation with canola as a single break crop (canola–wheat–wheat rotation) had the highest average gross margin (\$529/year) across three years (Table 2). Cutting for hay significantly improved financial return for the rotation including vetch (\$482/year) or pasture (\$453/year) as a break crop compared with the brown manure option, which is higher than the continuous-wheat option

with N fertiliser applied. Due to the loss of a year's income when break crops were brown manured, the gross margin was lower than grain harvested.

The profit/cost ratio was the highest when canola was used as a single break crop (2:8) and the lowest for all brown manure treatments as well as continuous cereal without N input (Table 2). Results indicated that the nitrogen benefit from the brown manured treatments itself could not offset the cost of establishment of break crops and loss of production. Nevertheless, the brown manure option could offer a great opportunity to reduce herbicide cost if the paddock has a weed problem, or had herbicide-resistant weeds.

In general, the double break crop option improves the gross margin of all the crop management options, particularly for the brown manure options. The gross margin increased more than \$100/year when canola was used as a break crop in combination with the brown manure option with pasture and pea, compared with rotation with a single break crop (Table 2).

Pasture cutting for hay with one canola crop as double-break crops had the highest gross margin (\$524/year), which is much higher than continuous cereals with N fertiliser. Double-break crops offer more opportunity to reduce disease incidence, as well as more options to control difficult weeds.

Table 2. Average gross margin analysis under different crop sequences at the Graham Centre site.

Crop management	Treatment	Income	Variable cost	Gross margin	Profit/cost ratio
Single break					
Brown manure	Pea	\$558	\$255	\$303	2.2
	Vetch	\$553	\$257	\$296	2.2
	Pasture	\$530	\$246	\$284	2.2
Hay	Vetch	\$825	\$342	\$482	2.4
	Pasture	\$776	\$323	\$453	2.4
Grain	Pea	\$695	\$287	\$407	2.4
	Lupin	\$682	\$279	\$403	2.4
	Canola	\$826	\$297	\$529	2.8
Double break					
Brown manure	Pasture	\$664	\$271	\$393	2.5
Brown manure	Pea	\$678	\$277	\$401	2.4
Hay	Pasture	\$853	\$328	\$524	2.6
Grain	Lupin	\$781	\$295	\$486	2.6
Grain	Pea	\$770	\$301	\$469	2.6
Continuous cereals					
Grain	+N	\$875	\$415	\$460	2.1
Grain	–N	\$663	\$274	\$390	2.4

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