Crop sequencing project reveals potential of broadleaf break crops

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Key point

- Data collected from two research experiments between 2012 and 2013, and on-farm data collected during 2014 indicates that pasture legume hay, faba beans and canola can be as profitable, and often more profitable, than wheat.

Aim

There is a wide-spread perception among growers and their advisors that broadleaf break crops, such as legumes and canola, are higher risk and/or not as profitable as cereal crops.

The aim of a recent Grains Research and Development Corporation (GRDC)-funded break-crop project (CSP000146) was to challenge this notion, and to partner with seven grower groups across the GRDC Southern Region to re-examine the relative profitability of canola or legume crops and pastures, and to quantify the potential beneficial impacts of break crops on the longer-term financial performance of subsequent wheat crops.

This paper presents the key findings generated from experiments carried out through participatory research between Riverine Plains Inc and CSIRO, which specifically focused on the question: "Can break crops be as profitable as wheat?".

Break crop profitability

Research experiments (2012 and 2013)

During 2012 and 2013, experimental trials were established on the Inchbold family property at Yarrawonga South, Victoria to address the renewed grower interest in growing break crops, and to help identify which break crop might be the most profitable in the Riverine Plains area.

Soil characteristics were: soil pH (0–10cm) ranged between 5.3–5.9 ($CaCl_2$) and increased with depth. Colwell P (0–10cm) ranged from 9–22 mg/kg and soil mineral nitrogen (N) (0–60cm) was 40–50kg N/ha.

Trial details are outlined in Table 1.

During both trial years (2012 and 2013) all crop and pasture species were sown with MAP @ 80kg/ha in plots 20m x 1.42m (2012) and 20m x 1.5m (2013), replicated four times in a randomised-block design.

Sowing was carried out either early May (faba beans, canola, arrowleaf clover, sub-clover and vetch), or early June.

All legumes were inoculated with standard peat inoculant and treatments were grown according to best practice management.

Both wheat and canola included a nil and plus nitrogen fertiliser treatments — 180kg urea (82.8kg N/ha) during 2012 and 200kg urea (92kg N/ha) during 2013.

Hay cut yields were calculated at 70% of peak biomass values. Grain crops were harvested at physiological maturity. Weeds, such as soursob, ryegrass and marshmallow, were an issue in some plots and were removed by hand.

On-farm case study (2014)

In addition to the experimental trials carried out on the Inchbold family property at Yarrawonga during 2012 and 2013, three paddocks on the Glover farm at Wilby (South of Yarrawonga), were sown as a commercial case study to: faba beans (Rana), lupins (Mandelup) and clover (mix of Mintaro clover and Balansa sub-clover for hay).

TABLE 1 Experimental break crop trial details, Yarrawonga South, 2012 and 2013

Year	Crop type and variety	Crop output (grain/hay)	Sowing rate (kg/ha)
2012	Faba beans cv Rana	Grain	160
	Chickpeas cv Slasher	Grain	130
	Canola cv Tawriffic	Grain	3
	Wheat cv Young	Grain	90
	Field peas cv Oura	Hay	130
	Vetch cv Morava	Hay	40
	Arrowleaf clover cv Zulu	Hay	8
	Sub-clover cv Antas	Hay	8
2013	Faba beans cv Rana	Grain	160
	Canola cv Tawriffic	Grain	3
	Wheat cv Young	Grain	90
	Sub-clover cv Antas	Hay	8

Soil tests taken during February 2014, in the lupin and faba bean paddock, showed that soil pH in the top 10cm ranged from 5–5.1 $CaCl_2$, Colwell P ranged 69–110 mg/kg and soil nitrate 19–22mg N/kg (about 24kg N/ha). Each paddock had 1t/ha lime applied during March 2014.

The clover mix was sown @ 8kg/ha during mid April and the lupins were sown @ 80kg/ha during late April. All pulses were inoculated with standard peat inoculant just before sowing. Both crops were sown using an RFM airseeder with MAP @ 90kg/ha on 22.5cm row spacings. The faba beans were broadcast (which is not recommended) at 160kg/ha during late April and worked in with MAP @ 90kg/ha. Although broadcasting seed is not ideal, good germination and plant establishment was still achieved due to excellent rainfall after sowing. However, lack of sowing depth did contribute to plants lodging during the season, which subsequently caused issues at harvest.

Grain yield and biomass was recorded for each faba bean, lupin and clover paddock, and grain yields were collated across the whole farm for wheat and canola. The costs of production were determined from the grower's own records and the value of grain or hay at the time of harvest were used to calculate gross margins.

Results

Experimental crop yields and gross margins (2012)

Flooding rainfall preceeded the 2012 growing season, with more than 300mm recorded during late February–early March. This rainfall provided excellent sub-soil moisture at sowing. However, growing season rainfall (GSR — April to October) was 213mm, which was below average.

The arrowleaf clover and sub-clover hay cuts provided higher gross margins than wheat due to the combination of high dry matter (DM) yields and high hay prices (Table 2).

The clover hay treatments have multiple advantages for subsequent crops because they are likely to contribute to higher available soil nitrogen, better weed control and higher soil water reserves due to the earlier cessation of water use during the growing season than the neighbouring grain crops that grew through to maturity.

Above-average prices were achieved for most grains; in particular wheat, faba beans and canola, which resulted in excellent gross margins for 2012.

Wheat yields showed a marked response to additional nitrogen, with a significant difference between the plus nitrogen fertiliser treatment (4.8t/ha) and the nil fertiliser treatment (4.1t/ha), but there was no significant effect of nitrogen fertiliser on canola yields.

Experimental crop yields and gross margins (2013)

The 2013 season had a dry start and finish, but rain fell at just the right time resulting in an average GSR (296mm; decile 5). An exceptionally late and severe frost on 18 October 2013 devastated some cropping areas in the region, and while the trial site was affected, the extent of damage was not as bad as other local crops.

Sub-clover hay provided the highest gross margin, which was buoyed by high hay prices. Wheat plus nitrogen fertiliser provided the second highest gross margin, followed by wheat without additional nitrogen. The canola and faba bean yields may have been more affected by the frost than the wheat (Table 3).

TABLE 2 Comparisons of grain yield, hay production, income, variable costs and gross margins at Yarrawonga South, 2012*

Treatment	Grain or hay yield (t/ha)	Gross income ($/ha)	Total variable costs ($/ha)	Gross margin ($/ha)
Arrowleaf clover hay	4.3	1,324	229	1095
Sub-clover hay	4.0	1,252	229	1023
Wheat + nitrogen	4.8	1,310	323	987
Wheat - nitrogen	4.1	1,066	215	851
Faba bean	3.0	1,170	347	823
Canola + nitrogen	2.2	1,206	415	791
Canola - nitrogen	1.8	965	307	658
Vetch hay cut	3.5	815	224	571
Chickpea	1.7	799	265	534
Field pea hay	2.8	614	244	371

Crops arranged in order of descending gross margin.
Note: Grain and hay prices used in the calculations were current at the time of harvest. Variable costs were based on local practice and prices and are estimated as a guide only.

TABLE 3 Comparisons of grain yield, hay production, income, variable costs and gross margins at Yarrawonga South, 2013*

Treatment	Grain or hay yield (t/ha)	Gross income ($/ha)	Total variable costs ($/ha)	Gross margin ($/ha)
Sub-clover hay	3.8	1,064	221	843
Wheat + nitrogen	4.6	1,164	323	841
Wheat - nitrogen	4.0	1,012	215	797
Canola + nitrogen	2.4	1,200	415	785
Faba beans	2.9	1,160	377	783
Canola - nitrogen	2.0	1,000	307	693

* Crops arranged in order of descending gross margin.
Note: Grain and hay prices used in the calculations were current at the time of harvest. Variable costs were based on local practice and prices. These figures are estimated as a guide only. Results were taken from only three reps of 15m x 1.5m due to weed infestations. Lupin and field pea treatments/ results were dropped due to poor (patchy) establishment.

Commercial crop yields and gross margins (2014)

The 2014 growing season had a very wet start, recording 115mm during April with above-average rainfall persisting until July causing significant waterlogging at times during winter. August was exceptionally dry, recording only 2mm; however, there was follow-up spring rain, resulting in a total GSR of 325mm.

Faba beans did well in the wet winter conditions and the combination of high yield and excellent commodity prices resulted in the highest gross margin. This was despite additional growing costs from aerial applications of fungicide and insecticide due to poor trafficability.

Wheat had the second highest gross margin followed by canola, both of which received a total of 200kg urea (92kg N/ha) over the season.

The clover paddock grew and yielded well, although the return on hay was reduced by additional growing costs in comparison to previous years. The lupins also grew well on a well-drained paddock, but the yield was disappointing compared to how bulky the crop looked towards the end of spring.

The lupins were harvested a bit late so pod shattering during harvest, leading to grain losses, were likely to have contributed to the lower-than-expected yield (Table 4).

Conclusions

Results from experimental trials and a farm case study undertaken by GRDC Project CSP00146 in conjunction with the Riverine Plains Inc (two experiments and one on-farm case study 2012–14; reported here), Birchip Cropping Group in the Victorian Mallee (six experiments across two soil types, established sequentially between 2009–11; detailed results presented elsewhere) and FarmLink in southern NSW (four experiments established between 2011–13; results presented elsewhere) have demonstrated that given the environmental conditions and commodity prices that have prevailed since 2009, canola and legume break crops were frequently as profitable, and in a number of instances considerably more profitable, than wheat. While legume hay and faba beans proved to be the most profitable break crops in the Riverine Plains area, canola was generally the most profitable crop elsewhere.

The research team recognises the economic performance of break crops relative to wheat observed during the project reflects the favourable rainfall for growth, and/or the high prices received, for either canola, clover hay or faba bean in various years, and depressed prices for wheat.

TABLE 4 Comparisons of on-farm grain yield, hay production, income, variable costs and gross margins for commercial crops grown at Wilby, 2014*

Treatment	Grain or hay yield (t/ha)	Gross income ($/ha)	Total variable costs ($/ha)	Gross margin ($/ha)
Faba beans	3.5	1,715	453	1,262
Wheat + nitrogen	4.3	1,161	323	838
Canola + nitrogen	2.8	1,232	415	817
Sub-clover hay	4.3	1,075	292	783
Lupins	2.5	1,025	297	728

* Crops arranged in order of descending gross margin.
Note: Grain and hay prices used in the calculations were current at the time of harvest. Variable costs were based on farmer records. These figures are estimated as a guide only.

The team is currently interrogating project results from all seven collaborating grower groups and plans to apply various simulation models to predict long-term trends in production and financial returns for different rainfall, cropping and grain price scenarios to extrapolate the findings beyond the growing seasons experienced during the project. These simulation runs will also be used to assess the relative risk of including break crops in otherwise cereal-dominant cropping sequences. Regardless of the outcomes growers and their advisors need to remember that in addition to their contribution to farm profitability, canola and legumes have been shown to provide less expensive and more effective control of herbicide-resistant ryegrass than is achievable in wheat, and that legumes also result in higher concentrations of soil mineral nitrogen for the benefit of subsequent cereal crops.

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