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COVERING CROPPING SYSTEMS OF SOUTHERN NSW, VICTORIA, TASMANIA,
SOUTH AUSTRALIA & WESTERN AUSTRALIA

Crop sequence in medium rainfall farming systems: Case study 1

DYNAMIC CROP SEQUENCES

The Department of Agriculture and Food Western Australia (DAFWA) in partnership with farmers, grower groups and the GRDC has been very successful in developing the lupin, pulse, oilseed and oat industries. Through applied agronomy projects focused on each of these commodities, robust management packages have been developed and a rigorous understanding of the factors driving their adoption has been gained.

The principles providing the foundation for these management packages apply to farming systems throughout southern Australia. In conjunction with *Australian Grain*, we will present a series of farm case studies outlining the practical and profitable inclusion of break crops into various southern Australian farming systems.

It is now time to integrate our acquired knowledge into cropping systems where break crops can make a better contribution to farm profits.

Current research at DAFWA aims to engage more farmers in actively managing crop sequences to increase the profitability of their production system. We are developing a capacity to assess the biophysical and economic consequences of a diverse range of crop rotations.

Researchers, advisers and farmers are constantly increasing their understanding of how weeds, diseases, nematodes and soil properties change in response to management and crop sequence. This is enabling farmers to better manipulate these sequences for more reliable and productive outcomes.

Dr Peter White, Project Manager, DAFWA

Lee & Wilkinson partnership, Bulyee

What have you done to in relation to farming systems over the past decade?

What is your underlining rotation philosophy?

The management of weeds is the number one reason why we grow break crops. Lupins were introduced as the first break crop for the farm to improve the yields and quality of wheat. Canola was then introduced as a cleaning crop in which we could use atrazine to control resistant ryegrass which had emerged as problem in the mid nine-ties. Now canola is grown as both a cash crop and a cleaning crop depending on the

market and what stage different paddocks are at in the rotation.

On the main farm, a typical rotation is wheat-canola-wheat-barley-lupins before going back into wheat. This has been the mainstay of the system where the two broadleaf crops introduce enough diversity in herbicide options to maintain their main grass selective herbicides – at least for now.

We primarily grow soft wheat in rotation with the canola on the sandplain soils and noodle wheat generally follows the lupins.

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TABLE 1: Typical crop mix at the Lee farm as a percentage of arable land

Wheat	40%
Barley	25%
Canola	15%
Lupins	15%
Hay/oats	5%
Pasture	0%

Break crop choice

What factors influence you to choose a crop, then a break crop?

What break crop benefits do you see in the system?

Lupin yields can be highly variable from one season to the next making it hard to manage returns. Also, the ability to control weeds, especially herbicide resistant ryegrass, is a major challenge with lupins.

A few years ago we tried 20 hectares

THE CASE STUDY FARM**FARMERS**

Ivan, Helen and Stephen Lee
Paul and Karen Wilkinson

PROPERTY SIZE

2900 hectares

LOCATION

Bulyee, Western Australia

ENTERPRISES

Grain (cereals, lupins, canola) and export hay

AVERAGE RAINFALL

Annual: 340 mm
Growing season rainfall: 290 mm

SOIL TYPE

Yellow sandplain and some shallow (20–30 cm) duplex

SOIL pH

Now about 4.8–5.5 (CaCl₂), but has been lower

HISTORY

Ivan and Stephen have been in continuous cropping for 18 years – and some paddocks for up to 25 years – on their family farm at Bulyee, east of Brookton (140 km south-east of Perth). They have been growing lupins since the eighties and first began growing canola in 1995 with the release of the first triazine tolerant canola, Karoo. Their underlining belief in farming systems is not to switch about in response to the market fluctuations but to manage a consistent rotation. Recently they have partnered with Paul and Karen Wilkinson and acquired a new block with heavier soil types.

of field peas but decided they were not suitable because of soil type. Besides, we needed to have a proper pea pick front for harvesting which was too much hassle and another item of machinery needed. Despite owning a small pick up front for canola swathes, this is not practical in harvesting pea crops.

Canola is not without its problems. It was a failure in 2007 with poor germination and ryegrass establishing early in the crop which then became a major problem. This meant more clean up in 2008.

Canola yields range between 1.1–1.4 tonnes per hectare with 40 to 45.5 per cent oil. Lupins average 1.43 tonnes per hectare and oat hay usually 5.5 tonnes.

The worst canola crop was in 2002 with an average of 0.6 tonnes per hectare and the worst lupin yield was also that year at 0.4 tonnes per hectare.

The input costs are higher for canola than cereals by about 20 per cent but the cleaning crop effect from canola makes up for this extra input. Canola can be slow to harvest and it is more risky as it requires more inputs.

In a continuous cropping system the break crops seem to suffer less from the insect pests than those farms around us which still have some pasture. We don't add any insecticides to the knockdowns and have a standard practice of applying a broad spectrum bare-earth insecticide after sowing canola and lupins. We don't use any insecticide on the oats.

The break crops do have more insect pest problems but with some simple measures, the problems are not insurmountable. Other than aphids, there are no really serious pests of lupins and canola in the district once the crops are up.

We did some aerial spraying at flowering to control aphids in 2007, and at the same time, sprayed to control budworm in lupins. We have seen red legged earth mites (RLEM) from time to time and we are aware that there are more problems following pasture with canola.

We have three classes of paddocks for wheat and canola:

- The top category paddocks will definitely go into either wheat or canola regardless of the how the season unfolds.
- The second and third classes can alter between canola, hay or canola and lupins depending on the soil type.

Paddock preparation for either lupins or canola is the same except that the herbicide options for triazine tolerant (TT) canola provide a more robust preparation in most seasons.

The key challenge is working out when the break is going to occur and then deciding what amount of each break crop to sow. This can be influenced by the seasonal outlook but is primarily driven by our rotation plans.

Canola follows wheat in a four year rotation with lupins and barley. Lupins are seeded into wheat stubble which does not present a problem for our Bourgoul seeder.

We see very little difference between the early to mid maturing canola varieties and will usually try 100 kg of a new variety when they are released. In general, we are happy with the lupin varieties except in good years when they grow all biomass and fewer pods.

We have been liming since 1994 – the soil pH has risen from as low as 4.4 to 5.2.

We conduct 10 to 12 paddock soil tests per year and on a rotational basis. We sample at GPS coordinates to monitor the nutrient removal and determine any trends.

Weed control

Oat hay is the number one cleaning crop in our system followed by canola then lupins a poor third. The main challenge comes from ryegrass and the levels of it in a paddock, have a significant influence on what crop we choose.

Barley grass, capeweed and wild radish are also present but we have been able to keep their numbers relatively low.

Wild oats have emerged on the new block. Canola will be a good crop to help manage this weed.

We still use grass selectives in both canola and lupins to manage ryegrass es-

TABLE 2: Crop costs and returns

	Canola	Oat hay	Lupins	Wheat	Barley
Cost of production*	\$250	\$340	\$200	\$230	\$190
Average yield	1.21	5.5	1.43	2.47	2.36
Price [#]	\$400	\$150	\$230	\$208	\$238
Av. net return estimate ¹	\$234	\$485	\$128	\$284	\$372

*Approximate production cost based on average over the past five years.

[#]Average of net grower returns before freight to port (Wilkins et al. DAFWA, 2008).

¹Freight from farm to port not included.



From left: Paul Wilkinson, Stephen Lee and Ivan Lee inspecting their crop of lupins. (Photo: Peter Maloney, DAFWA)



The weed and disease control benefits from growing canola, flow onto subsequent crops in the rotation. (Photo: Peter Maloney, DAFWA)

caples. With hot spots of radish, the current system seems to manage them but we are considering testing radish for resistance.

The canola does help manage resistance and swathing can also help to some extent to manage escapes. But swath timing does not always get the ryegrass before it matures.

Rotation drivers and profitability

What are the drivers for your rotations on the farm?

What is the relative profitability of the different systems on your farm?

The average cost of grain crop inputs, machinery and labour (before 2008) we estimate to be between \$170 to \$250 per

hectare, using contract rates for sowing and harvest (Table 2).

Of the break crops, canola has been a consistently profitable crop. The economic benefits from growing canola flow onto subsequent wheat and barley crops through better weed and root disease man-

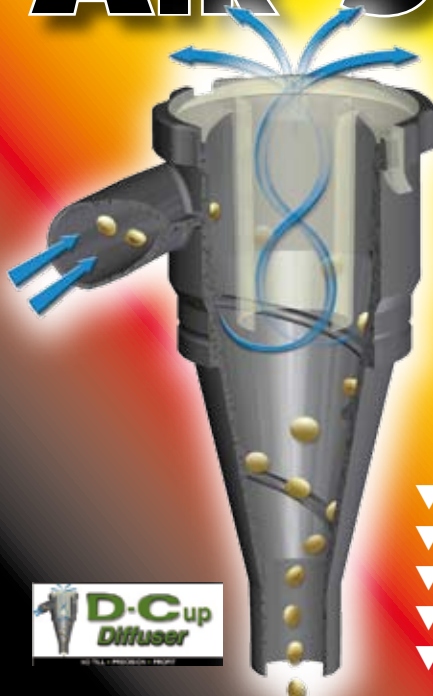
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agement. Ivan estimates a 10 per cent yield benefit from canola to the cereals. Even in a tight year like 2007, canola yields were surprising and strong prices meant that a good profit was still made.

With lupins as the break crop after canola, the yield benefit can be as much as 20 per cent above the cereal on cereal. We do not have a measure of the subsequent crop benefits from oaten hay other than a significant reduction in weed burden the following year.

Lupins have been a reliable break crop for improved nutrition management of the following cereal crop. But canola is by far a better cleaning crop in the system and this is how we use the crop. Canola is a bit of a risky crop compared to lupins and we will vary the area sown to canola more than lupins according to season and price.

Generally, canola yields about 50 per cent – and lupins 60 per cent – of our typical wheat yields across the farm.

After canola, the cleaner paddock is set up for soft wheat and does not need to be fertilised as much. Soft wheat nutrition involves 100 kg per hectare of compound fertiliser plus 40 L flexi-N at seeding with a top up of 40–50 kg of urea.

Seeding into the canola stubble has never been a problem.

A seven year rotation on class one paddocks typically consists of canola–wheat–barley–canola–wheat–lupins–wheat.

On the class two paddocks it is less intense with wheat–lupin–wheat–oats. And on the newly acquired heavy land it's wheat–barley–lupins–wheat.

Future systems

How do you see your farming system will change five years from now?

Together, our break crops make up to 15 per cent of the cropping program and even in 2008 with exceptional canola prices, we have not varied greatly from this.

We are happy with the balance break crops bring to the cropping program and the diversity they offer in the commodity markets. Grain prices don't always move in the same direction so it is good to have a mix.

With the exception of some rogue pest or disease outbreak, we don't foresee any major changes to the system. We feel it is fairly robust.

Further information: Paul Carmody, Development Officer, Break Crops, DAFWA, Ph: 08 9441 8107, Mob: 0427 997 878, E: pcarmody@agric.wa.gov.au ■



CROP DOCTOR SOUTH

With Peter Reading

SHINING THE LIGHT OF KNOWLEDGE ON FROST

Although the sun is shining, many WA grain growers are still counting the cost of a severe frost at -4°C on the night of September 22, 2008.

Overall financial loss to growers was around \$105 million, says consultant Garren Knell of ConsultAg.

One Kuerin, WA grower said the September frost caused yield loss from 10 to 90 per cent, depending on paddock position on his 2500 hectare property sown to wheat, barley, lupins, canola and field peas.

He indicated that the extended dry spell in August accelerated crop development, making the crop more vulnerable, although crops on deeper soils were not as badly affected.

Canola, usually robust, was extensively damaged, as were lupins. But field peas, usually regarded as vulnerable to frost, were less affected. Research and extension activities have aimed at minimising frost's impact by avoiding frost events through better management of flowering time by cultivar selection or time of sowing, or by growing less susceptible crops.

Yet many growers who experienced the September 22 frost have concluded that even with accepted frost management measures, they can't control the outcome of a rare and severe frost event. For the past 30 years in WA, the incidence of frost has increased. Growers are also planting more crops with higher inputs and higher yield and consequently potential per hectare losses are greater.

The Grains Research and Development Corporation (GRDC) has committed more than \$750,000 to frost research during the next four years and is investigating a range of strategies, including developing cereals with improved levels of frost resistance.

One project is based at Pingelly where Dr Ben Biddulph of the Department of Agriculture and Food WA (DAFWA) has begun a four year study to characterise the temperature associated with frost events and level of frost induced sterility experienced in barley and wheat in frost prone regions.

This GRDC funded project is a collaboration between DAFWA, University of Adelaide and Queensland Department of Primary Industries and Fisheries.

Ben says frost damage occurs at any time past booting, but is most devastating close to flowering as it causes aborted florets and damages heads and stems. All wheat and barley heads flowering on September 22 had significant frost damage, with more than 60 per cent sterility.

Flowering wheat is more susceptible to frost than barley, as -2°C caused more than 90 per cent sterility in wheat, but only minor damage to barley at similar developmental stages, according to Ben's research.

While too early to conclude if frost tolerant lines trialled at Pingelly last season have useful genes for breeding frost tolerant wheat and barley, Ben believes some lines look very promising and repeating trials in subsequent seasons will confirm if this is so.

More information is in the GRDC factsheet 'Managing Frost, Minimising Damage', available from www.grdc.com.au/uploads/documents/frost.pdf and the booklet *Managing Frost Risk – a Guide for Southern Australian Grains*, available from Ground Cover by emailing ground-cover-direct@canprint.com.au

The Crop Doctor is GRDC Managing Director, Peter Reading, Tel 02 6166 4500.

Further Information: Dr Ben Biddulph, Tel 08 9368 3431, Garren Knell, Tel 08 9881 5551



Garren Knell, ConsultAg, has been on the frost case for a long time. Here, he talks about frost during the 2005 GRDC Western Panel spring tour visit to the Corrigin Farm Improvement Group's Field Day.