

## Maintaining profitability in retained stubble systems on upper Eyre Peninsula

A joint EPARF and GRDC funded project.



### Guideline 1: Break crops in low rainfall farming systems

The intensity of cereal crops has been high in low rainfall zone rotations for several decades now. The use of other break crops such as canola or legumes has increased, with a reduction in pasture area, but these are still a small percentage of the arable area sown. Break crops are perceived to be higher risk crops in the low rainfall zone due to higher input costs, issues with marketability and variable yields, especially in dry seasons. As part of the 'maintaining profitable farming systems with retained stubble on upper Eyre Peninsula' project, EPARF and SARDI have been working to establish guidelines for farmers seeking to incorporate break crops into their farming system, to overcome constraints such as weeds or improve soil nutrition.

#### What are the benefits of break crops?

- ✓ Greater chemical control options for grass weeds
- ✓ Reduced cereal root disease levels if grass is controlled
- ✓ Increased soil nitrogen if a legume option is used
- ✓ Potential to conserve soil moisture for the next cereal crop
- ✓ Including one or two year break phases in low rainfall paddock rotations can increase profitability over maintaining a continuous wheat cropping sequence.

The GRDC funded Crop Sequencing trials have shown that including two year break phases in low rainfall crop rotations is a reliable management tool for increasing the yields of subsequent wheat crops, but only in rotations where agronomic constraints such as grass weeds, declining soil fertility or root disease are affecting the yields of continuous cereals. These wheat yield benefits accumulated to 1-2 t/ha over 2-3 seasons following the break phase. Including one or two year break phases in low rainfall paddock rotations increased profitability by up to \$100/ha/year compared to maintaining a continuous wheat cropping sequence. The key to increasing profitability was having at least one profitable break

crop option that relieved the agronomic constraints for production of subsequent wheat crops<sup>1</sup>.

#### When should I use them in my system?

If weeds, disease or nitrogen have become an issue and are limiting cereal yield in a paddock.

#### What crop do I choose?

When selecting a break crop to use within a crop rotation it is important to identify the key factor(s) limiting cereal crop production. If grassy weeds are the main issue, more competitive break crops and grass-selective herbicide options will be an important consideration; if nitrogen fixation is needed, a legume option should be considered, and grass free break crop for disease issues. Marketing and prices, soil type, machinery and crop use (grain, grazing or hay) will also be important in determining the break crop options in the rotation.

Aim	Best break crop option
Control grass weeds	Canola, medic pasture, hay oats, fallow
Increase soil N	Medic pasture, spray topped vetch, field peas, lentils, lupins
Reduce cereal root diseases	Grass free medic pasture, canola, vetch, field peas, lentils, lupins, fallow
Increase soil moisture	Fallow, spray-topped legumes

#### Grass weeds

The GRDC Crop Sequencing trial located on Minnipa Agricultural Centre from 2011-2015 showed that the major benefit of rotating sequences was clearly linked to grass weed control and weed pressure. A break crop of two years produced a better financial outcome than continuous wheat over a four year period of production where there were substantial pressures on wheat performance such as grassy weeds.

The benefit of a two year break had little to do with the phases chosen for those two breaks, providing that excellent grass weed control could be achieved in both. Wheat yields after a two year break were a significant step up from wheat crops following a one year break, which were in turn, much better than the continuous wheat. The break crop benefit of a one year break may only last one season if grass weeds are a significant factor.

The major benefit of breaks in these long term cereal paddocks was to reduce grassy weed pressures for subsequent wheat crop phases<sup>2</sup>. A recent national analysis concluded the maintenance of break crops or clean fallow providing two years of sequential breaks can provide beneficial grass weed control options, especially for herbicide-resistant ryegrass<sup>3</sup>.

### Nitrogen

The benefit of including a legume break crop will include improving nitrogen supply to the following cereal crop. On average, 20 kg N/ha is fixed for every tonne of legume shoot dry matter produced<sup>4</sup>. The actual amount of nitrogen fixed or supplied to the soil will depend on the initial soil nitrogen levels, the amount of plant growth and the amount removed in grain or hay. Other factors such as nodulation levels, phosphorus nutrition and herbicide applications may impact on nitrogen fixation. Soil nitrogen levels can be confirmed with a soil test prior to seeding the following crop.

*On average, 20 kg N/ha is fixed for every tonne of legume shoot dry matter produced<sup>4</sup>*

### Disease

Grass and cereal free break crops of medic, canola or pulses will not only reduce cereal disease inoculum for soil borne cereal diseases such as Take-all, CCN and Rhizoctonia (AG8), but also fungal diseases carried over by spores on cereal stubble such as yellow leaf spot and white grain.

Research on upper EP has shown grass free canola, Juncea canola, medic and vetch break crops lowered Rhizoctonia inoculum levels. These break crops also allow other weed control options, earlier sowing opportunities and eventually higher yields for the following cereal. However, the decline in Rhizoctonia inoculum level only lasts for one cropping season<sup>5,6,7</sup>.



Three fungal pathogens (*Botryosphaeria zeae* and two unidentified fungi) are associated with white grain in wheat in Australia<sup>8</sup>. White grain was first observed on EP in bread wheat in South Australia (SA) during the 2010 harvest and caused rejection and down grading of deliveries. A break from cereal in a paddock affected by white grain will lead to reduced numbers of air-borne spores present in that paddock in subsequent years. This disease is likely to be a continuing problem as the fungi causing white grain can survive on infected cereal residues for at least 24 months and spore production from infected residues occurs over an extended period in the growing season. Continue to consider white grain as a potential issue in any year where there is a wet spring<sup>8</sup>.

### Pests

Including break crops within crop rotations may increase pest levels (Table 1). Chemical control options may be necessary to control the pests in break crops depending on seasonal timing, pest density and other beneficial insects in the system.

### Stubbles

Retaining cereal stubbles reduces damage from wind erosion in regions characterised by light textured soils and where sheep are still a major component of the farming system. Sowing break crops into retained cereal stubble provides early protection of both small plants and soils from wind damage.

Research in the Mid North (Clare, SA) showed sowing pulses into standing cereal stubble can benefit yield, but no yield responses have occurred at Minnipa so far. However, in 2011 substantial differences in growth were achieved at Minnipa from stubble management; increased pea growth and height occurred in standing cereal stubble which may aid harvestability of field peas, particularly in shorter seasons with less biomass<sup>9</sup>. Similar results were achieved at Hart with lentils sown in stripper and medium standing stubble. Stubble resulted in

taller and more erect plants with higher pods improving harvestability<sup>10</sup>.

### Economics

At Minnipa wheat on wheat was the most profitable systems until grass weeds, nutrition or disease became an issue. The type of break crop chosen was not important as long as the issue causing the yield constraint was addressed. Wheat yield benefits following the break phase are commonly 1-2 t/ha over 2-3 seasons. Including one and two-year break phases in low rainfall paddock rotations can increase profitability by up to \$100/ha/year over maintaining a continuous wheat cropping sequence, providing the issue reducing the paddock yield of grass weeds, nitrogen or disease is addressed in the break crop phase<sup>1</sup>.

### Conclusion

In low rainfall crop rotations where agronomic constraints such as grass weeds, declining soil fertility or root disease are affecting the yields of continuous cereals, including a break phase is a reliable management tool for increasing the yield and profitability of subsequent wheat crops. The selection of the break crop to be included in the rotation (see Table 1 for break crop options, benefits and limitations) will depend on the agronomic constraint limiting wheat crop production.

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For more information contact: Amanda Cook, SARDI, 0427 270 154 [amanda.cook@sa.gov.au](mailto:amanda.cook@sa.gov.au)

References are available on the EPARF website, [www.eparf.com.au/publications](http://www.eparf.com.au/publications)

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**Table 1 Common break crops grown on upper Eyre Peninsula with considerations for impacts on weeds, pests, disease, N fixation, soil moisture following crop, ease of establishment into cereal stubbles and crop residue impacts on cereal establishment the following season.** Other options less widely grown include beans, lucerne, sulla, chickpeas, Juncea canola.

Break crop	2016 Price and average yield (low rainfall)	Weeds	Potential Pests	Diseases	Nitrogen (N) fixation	Soil moisture retained for following crop	Establishment into standing cereal (All options are good in standing stubble)	Stubble issue for following crop
<b>Medic pasture</b>	\$7-8/kg (Jaguar)  Average yield 3 t DM /ha	Good grass and broad leaved weed control options.	Aphids, Lucerne flea, Redlegged earthmite, snails, cutworm, pasture looper and army worm.	Grass free is a good break for Rhizoctonia, Take-all, CCN and Crown rot. Powdery and downy mildew ↑ if right seasonal conditions P. neglectus ↑ P. thornei ↓	✓	✓ if hay cut or brown manure.	Mostly regenerated. If sowing, small seeds system needed. Inoculation recommended.	Medic vine may be an issue. Chopper chain when dry or burning possible option.
<b>Canola</b>	\$480 Range \$300-600/t  Average yield 0.8 t/ha	Good grass weed control options .TT or CL canola allow alternative chemical groups to be used for weed control.	Aphids, Lucerne flea, Redlegged earthmite, snails and Diamond back moth. Chemical control of pests most likely needed.	Grass free is a good break for Rhizoctonia, Take-all, CCN and Crown rot. P. neglectus ↑ P. thornei ↓ Rhizoctonia ↓ Best break for Rhizoctonia – one year reduction of inoculum levels.	✗ Best choice if high soil N levels.	✗	Small seeds system needed. Open pollinated retained seed may lower input costs. Fertiliser toxicity may be issue - split seed and fertiliser.	Canola stubble not generally an issue.
<b>Field Peas</b>	\$330 Range \$200-420/t  Average yield 1.0 t/ha	Good grass weed control options. Medic control in crop an issue. Pre-emergent soil applied mix best.	Aphids, Lucerne flea, Redlegged earthmite, snails, cutworm, pasture looper and army worm.	Grass free is a good break for Rhizoctonia, Take-all, CCN and Crown rot. Blackspot - later sowing ↓ risk Powdery and downy mildew ↑ if right seasonal conditions P. neglectus ↓ P. thornei ↓	✗ depending on grain yield. Inoculate if not regularly grown.	✓ less if taken to grain	Standing stubble = taller plants and better harvestability.	Low stubble loads – erosion risk over summer. Grazing minimal or leave until following season (April).
<b>Vetch</b>	\$450/t Range \$200-\$700/t  Average yield 0.7 t/ha	Good grass weed control options . Medic and other broad leaf weed control may be an issue especially later in crop. Pre-emergent soil applied mix best option.	Aphids, Lucerne flea, Redlegged earthmite, snails, cutworm, pasture looper and army worm.	Grass free is a good break for Rhizoctonia, Take-all, CCN and Crown rot. P. neglectus ↑ P. thornei ↑	✓ depending on grain yield. Inoculate if not regularly grown.	✓ if brown manured or crop topped		More robust than peas but monitor grazing for erosion risk.
<b>Lentils</b>	\$1000 Range \$500-1000/t  Average yield 0.7 t/ha	Good grass weed control options. Medic a very large issue, and other broad leaf weed control may be an issue especially later in crop.	Aphids, Lucerne flea, Redlegged earthmite, snails, cutworm, pasture looper and army worm.	Grass free is a good break for Rhizoctonia, Take-all, CCN and Crown rot. P. neglectus ↓ P. thornei ↓	✓ depending on grain yield. Inoculate if not regularly grown.	✓ less if taken to grain.	Standing stubble = taller plants and better harvestability. Roll rocks for ease of harvest. Grow on better soil types with low subsoil constraints.	Stubble very flammable, higher risk of header fires. Low stubble loads but more robust than peas but still erosion risk over summer. Monitor grazing.
<b>Hay Oats</b>	\$190 Range \$120-180/t  Average yield 3.5 t/ha	Some grass weed options. High seeding rate gives excellent grass weed competition.		P. neglectus ↑ P. thornei ↓	✗	✗		Excellent grazing option.
<b>Fallow</b>	\$ chemical costs  No yield	Good mechanical and chemical weed control options	Nil	Nil	✗	✓	Not applicable	Nil, very high erosion risk.