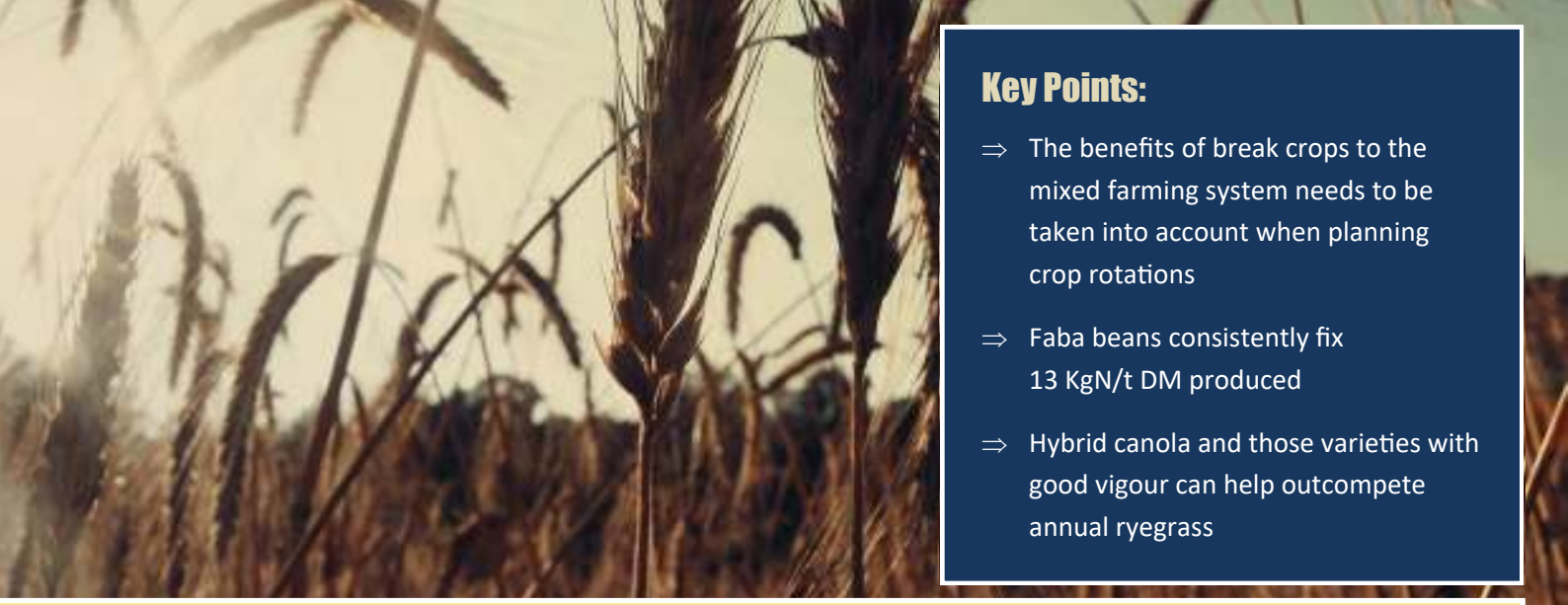


Key Points:

⇒ The benefits of break crops to the mixed farming system needs to be taken into account when planning crop rotations

⇒ Faba beans consistently fix 13 KgN/t DM produced

⇒ Hybrid canola and those varieties with good vigour can help outcompete annual ryegrass

Role of Break Crops in Retained Stubble Systems

Background

Break crops such as legumes, canola and hay crops have the potential to provide significant benefits to the farming system. A lot of the benefits achieved are done so by reducing the incidence of disease for subsequent cereal crops, providing alternative options and methods for controlling weeds, and in the case of legumes improving soil nitrogen. There are also benefits for mixed farming systems with break crops providing an opportunity for improved pasture management and increased livestock productivity.

Trial work conducted across the South-East region since 2010[1,2,3] has shown that the impacts of break crops (particularly that of legumes) can be experienced for several years. Break crops have the ability to be profitable in a single season, however it is the long-term cumulative positive effects on subsequent crops and resulting financial performance where the full benefits are realised.

To maximise the benefits of a break crop, a flexible approach is often required. The following key factors should be taken into account:

⇒ What agronomic issue are you trying to address?
- Increasing the amount of nitrogen in the system
- Controlling weed burdens
- Establishing a disease break for cereal crops

⇒ Do you have livestock in the system?
- Importance of stubble to livestock system

Introduction:

This guideline has been developed for the MacKillop Farm Management Group (MFMG) as part of the project "Maintaining Profitable Farming Systems with Retained Stubble in the South-East and KI regions", funded by the Grains Research and Development Corporation (GRDC) as part of the Stubble Initiative.

The Stubble Initiative involves farming systems groups in South Australia, Victoria, southern and central New South Wales and Tasmania, collaborating with research organisations and agribusiness to address challenges associated with stubble retention, including weeds, pests, disease, nutrition and the physical aspects of managing stubble.

Figure 1. Crop Sequencing Site at Lochaber, 2012

Increasing the amount of nitrogen in the system

The benefits of legumes to the system in providing nitrogen (N) to subsequent crops have long been recognised, with differences in the N efficiency of species identified. Trial work between 2011-2013 in the South-East assessed the annual N fixed across a range of break crops. Faba beans consistently fixed 13 kgN/t dry matter (DM) (Table1).

Table 1. Average nitrogen fixation results from selected break crops (2011-2013).

	Average 2011-2013			
Break Crop	**DM (t/ha)**	**% Total N**	**% N fixed**	**N fixed (kgN/tDM)**
Beans	8.1	2.8	50.3	13.3
Peas (winter)	10.4	2.3	46.3	10.7
Sub clover	8.0	2.3	30.3	6.3

Effectiveness of a break crop to fix nitrogen can vary greatly. Effective nodulation is a key factor in maximising the amount of nitrogen that is fixed. It has been shown that if effective nodulation is achieved, legume break crop benefits can last for more than one season, with a two year increase in cereal grain yields following faba beans being observed over multiple seasons at Lochaber.[1]

Legume nodulation issues (which impact on the plants ability to fix N) often arise on acidic soils, or soils with an acidic sub-soil layer. Figure 2 shows two faba bean plants from the same paddock and the varying levels of nodulation of each. The plant with poor root growth and nodulation was removed from an area of the paddock that was highly acidic (pH_{Ca} 4.43) compared with an area that was slightly acidic (pH_{Ca} 5.19) in the top 10cms of soil. Incorporating lime (to 10 cm) at recommended rates and inoculation of legume crops can assist in improving effectiveness of nodulation and therefore the benefits of legumes in these soils.

Figure 2. Effective (left) vs non-effective Faba Bean root growth and subsequent nodulation (right).

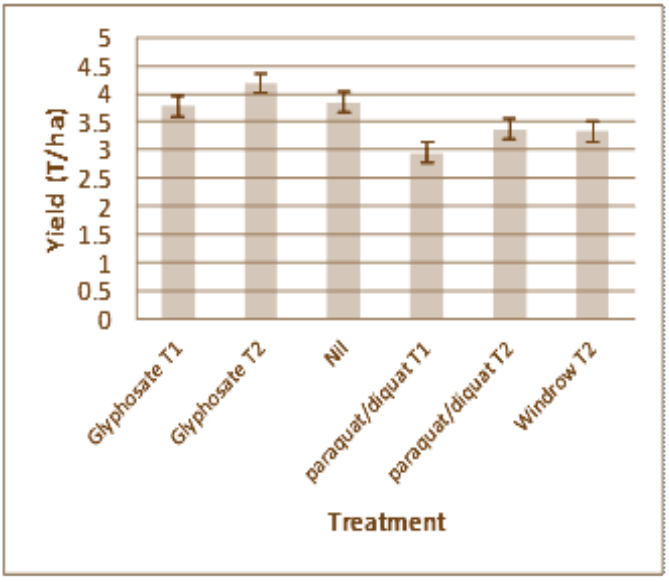
(Photo courtesy of Helen Burns, NSW DPI)[4]

Controlling weed burdens

Break crops allow for increased diversity and flexibility in weed control options. The ability to use grass selective herbicides and crop-topping in break crops, and windrow spraying in canola provides opportunities to reduce seed set. The use of other agronomic tools to provide increased crop competition can also assist in weed control.

Desiccation in pulses to reduce weed seed set

In 2012, MFMG conducted a pulse desiccation trial[5]. This trial evaluated desiccation application timings to control broadleaf weeds and to assist in the harvest process. The results from this (Fig. 3) showed that glyphosate was the most effective product evaluated resulting in no yield loss for timing 2 (20 % grain moisture) and only minimal yield loss at timing 1 (65 % grain moisture) when compared to the Nil treatment. Windrowing caused significant yield loss when compared to other practices evaluated. All treatments had no significant impact on bean seed viability when compared to the Nil treatment[5]. If spraytopping for annual ryegrass control, need to be aware of ryegrass maturity stage[6].



T1 - 65% grain moisture T2 - 20% grain moisture

Figure 3. Effect of desiccation on faba bean yield at Bool Lagoon in 2012[7].

Windrow-spraying and crop-topping in canola

With accurate timing, spraying under canola windrows has become an effective way to get an additional weed kill on annual ryegrass. Providing a grower has access to a self-propelled boom spray with sufficient clearance, crop-topping applications have been shown to be just as effective as a weed seed set control measure. However, these practices are increasing the reliance on glyphosate so growers need to ensure that glyphosate is not over-used in the rotation and include herbicide diversity where possible.

Table 2. Comparison of canola cultivar and herbicide treatment on seed set of clethodim resistant ryegrass at Roseworthy in 2015

Herbicide treatment	ATR-Stingray	Hyola 559TT	Hyola 750TT	
	Ryegrass seed heads (spikes/m²)			Mean
No herbicide (untreated control)	800	757	576	744a
Atrazine pre + clethodim post	148	83	72	96b
Propyzamide pre + clethodim + butroxydim + atrazine post	66	85	48	70b
mean	378a	298b	232b	
Interaction	0.35			
Cultivar	<0.001			
Herbicide treatment	<0.001			

Means with different letters within a column are significantly different (P=0.05).

Crop competition and varietal selection

Hybrid and high vigour canola varieties have been shown to reduce annual ryegrass seed set through crop competition throughout the growing season. Results from a trial conducted at Roseworthy in 2015[8] showed a significant reduction in the number of annual ryegrass spikes at harvest compared with open pollinated varieties (Table 2). The use of varietal choice used in combination with post-emergent herbicides reduced ryegrass seed set by 50%[8].

The ability to use RR and RT technologies in Victoria provides these growers with an additional tool. Work conducted at Neuarpurr by Kleeman et.al[9] in 2014-2015 highlights the ability to control Clethodim resistant ryegrass weed populations in a two year canola-wheat rotation by implementing high intensity management strategies. This research showed that reducing ryegrass seed set and seedbank replenishment in the 'break' year is crucial[9].

Establishing a disease break for cereal crops

Root Disease

Trial research conducted at Lochaber (2011-2014)[1] measured root disease inoculum in soil from rotations including break crops. Root disease pathogens present after selected crops as tested by the SARDI PredictaB test in 2011 are presented in Table 3. The presence of a break crop significantly affected the level of Take all and *Fusarium pseudograminearum* when compared with the inoculum remaining in the soil after the wheat crop. Increasing row spacing of wheat from 15 cms to 30 cms also resulted in lower levels of the soil pathogen *Fusarium pseudograminearum* inoculum.

Table 3. Effect of crop type on root disease pathogens

	Take all 'Test1' (Ggt+Gga) pgDNA/ g soil	*Pratylenchus neglectus* nematodes/ g soil	*Fusarium pseudograminearum* 'Test 1' pgDNA/ g soil
Barley (spring sown)	8	4	20
Beans	14	1	18
Canola (grain)	4	7	12
Sub clover (hay)	7	4	22
Wheat (0.3 m rows)	25	8	32
Wheat (grain)	117	13	224

Foliar Disease

Eyespot is an increasing issue in the higher rainfall zones of South Australia. Eyespot is carried over on cereal stubbles where it infects subsequent cereal crops. Heavy infections can result in up to 35% grain yield loss in susceptible varieties. Work conducted in the South- East from 2015-2017 has shown management strategies to reduce disease inoculum levels, however in high inoculum loads it is likely that more than one year of a break crop may be required. Eyespot management is discussed in more detail in the Disease Management Guideline.[10]

Figure 4. Eyespot damage in wheat
(Photo courtesy of Marg Evans, SARDI)

Importance of stubble to livestock system

Richard Kirkland farms with his wife Nikki and parents Don and Jo at Kangaroo Inn in the South-East of SA. They have a mixed farming operation, 70 % livestock and 30 % cropping, which they run on 2300 ha - a combination of owned and leased land.

Break crops play an integral role in their rotation with the cropping ground generally being in a wheat /bean rotation. Beans provide a good disease break, provide N for the subsequent wheat crop and contribute heavily to the livestock enterprise. Pasture may also be included in the rotation, or a hay or silage crop which is grown for annual ryegrass weed control.

"Not only do beans provide nitrogen and a disease break for the wheat crop, the retained stubble plays a large role in our livestock operation. We usually shear lambs just prior to putting them on bean stubbles so they have no pelt, otherwise they can heat up too much. The high protein in bean stubbles (including the beans that are left behind during the harvest process) result in great weight gains. We average around 350 g/day over a 6 week period. We put the lambs in at 35-40 kg and six weeks later we can market them at 55-60 kg. We do all this at a high stocking rate of around 5 lambs/acre."

Figure 5. Richard Kirkland at his farm, Kangaroo Inn (2018)

What do I need to be aware of when growing break crops in retained stubble systems.

⇒ **Residual herbicides / chemical management**
Numerous herbicides used in cereal crops have plantback periods before planting susceptible crops (often break crops). There is also often a rainfall requirement after application before planting susceptible crops. Always check the label and keep accurate records to ensure that plantback periods are observed.

⇒ **Increasing herbicide Clethodim resistance**
Herbicide tests taken in 2015 courtesy of Bayer Crop Sciences have shown moderate levels of clethodim resistance in annual ryegrass across the region. Knowing your resistance status, rotating chemistry and implementing alternative weed control methods will help prolong the use of this important group of chemistry.

⇒ **Pest Management**
Snail and Slug management is very different in break crops compared with cereals (particularly the management in canola). Refer to the Stubble Initiative Pest Management Guideline for further information.

Further Information

Guideline produced by Felicity Turner for the MFMG

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- Trent Potter, Yeruga Crop Research
- Sam Kleeman, Chris Preston, School of Agriculture, Food and Wine, Adelaide University

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[4]DAN00191 "Nitrogen fixing break crops and pastures for HRZ acid soils"

[5]Grazing withholding periods (WHP) and Export Slaughter Intervals (ESI) should always be adhered to when croptopping and dessicating pulse crops

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[10] Disease Management in Retained Stubble Systems, MFMG, 2018