

Southern Victorian break crop investment plan for Grain and Graze 2



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Summary

Identifying suitable break crop rotations is a major challenge for farmers and advisors in Southern Victoria. Canola has been the main break crop used, but the high input costs and susceptibility to frost and dry finishes makes it high risk. There is also a perception canola yields are declining with its repeated use in the rotation. Weeds, especially annual ryegrass, emerging herbicide resistance, root diseases and the depletion of soil nitrogen are major reasons for seeking alternatives to canola.

Reliable legumes are required, but to date there is no pulse or fodder legume that have been successfully integrated into a crop rotation. A recent national benchmarking report of 2,400 farmers with crop and livestock enterprises indicated the average amount of legume per farm in Southern Victoria was only 18 ha, the lowest (by % of farm area) of all cropping regions in the Australia. The report also found farmers and advisors in Southern Victoria had the lowest confidence in using legume break crops in a rotation.

To appreciate the current level of knowledge and experience in break crops, crop transition and in particular the use of legumes in the rotation, a small market research project was initiated. The market research provided an understanding of the current level of 'experimentation' with legumes in Southern Victoria, identified barriers to successful adoption and provided a framework for investment through Grain and Graze 2 (and potentially other programs).

In-depth telephone interviews were conducted with 16 progressive farmers and agronomists in Southern Victoria. This provided an opportunity for them to explore their philosophy and experiences and to voice the direction they thought research and extension should go. There was 141 years of experience with break crops between the 16 people interviewed.

Faba beans, field peas and chick peas were the three most common grain break crops used. Lupins, mung beans and lentils were mentioned less often. Legume based annual pastures were identified as a potential option, especially where livestock is an integral part of the farming business. Several interviewees also suggested the use of grass species (ryegrass, cereals) to use in fodder conservation, primarily for weed control. There are also some 'novel' break crop ideas including using millet and fodder brassicas to maintain groundcover and retain soil moisture. The potential livestock and whole farm system benefits from grazing or making fodder from break crops was poorly understood.

An important insight is that farmers and advisors want approaches that address **multiple** solutions during the break phase, however they accepted that these multiple benefits may need to be accumulated over time, allowing for a lesser benefit in one year to be 're-paid' in later years. Rotation length and sequencing of different break crop options needs to be considered, with analysis focusing on the net benefits over time and not simply one crop.

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Responses from the interviews revealed three significant variables that influenced the type of break crops that may be appropriate at any point in time. These were **preference** or inclination towards livestock, the **problems** that needed solving and the prevailing conditions or **opportunities** when the choice needed to be made. The opportunities were summarised as seasonal conditions, livestock prices and availability and the value of the current crop versus potential returns of future crops.

The results from this survey suggest there are numerous combinations of species, applications and desired benefits from a break crop phase. This creates a complexity because there is a multitude of 'right answers' depending on an individual farming circumstance. It also creates a challenge to identify investments in research and extension that will provide greatest returns.

The development approach to be used in Grain and Graze 2 is based on a participatory action research model. Key aspects of the work will include utilising break crops farmers were already going to implement, providing specialist agronomic and research capabilities to farmers, using local groups to determine best bet options and to interpret findings, case studies and by providing leadership to draw together complimentary findings from other relevant programs.

1. Preamble

Finding reliable crop rotations is an emerging issue for farmers in Southern Victoria. As cropping is a relatively 'new' activity, the transition to cropping has simply required the removal of pasture followed by a cycle of canola, wheat and barley. This three year rotation is repeated several times. However in the next few years more and more farmers will have completed a six or nine year crop rotation and will be looking for a break or non cropping phase to combat weed and disease build up and address a depletion of soil nitrogen (part of which was supplied from the previous pasture phase).

The reliance on canola in the three year rotation is also being questioned because it is a higher risk crop than cereals (additional input costs and less flexibility if yield is affected by frost or a dry finish to the season). Anecdotal evidence also suggests a slow decline in yields despite improved agronomic practices, through to be due to soil disease build up.

The current crop rotation in Southern Victoria does not include a reliable legume. A recent national benchmarking report of 2,400 farmers with crop and livestock enterprises, indicated the average amount of legume per farm in Southern Victoria was only 18 ha, the lowest of all cropping regions in Australia (Roberts Evaluation, 2010). The same report showed farmers and advisors saw legumes as highly appropriate in the crop rotation, but within the regions surveyed, Southern Victoria scored the lowest in their confidence to implement these rotations. To meet the legume adoption targets set in Grain and Graze 2, the report stated 'Southern Victoria may be challenged by the very limited marketability of legumes in the region'.

Finding alternative crops to canola **and** determining the appropriate place and application of these alternatives is critical to the longevity of cropping the Southern Australia. Given the current 'lifecycle' of many cropping phases, it is inevitable that farmers will be 'forced' to experiment. This experimentation is already starting to happen, with a rapid increase in legume experimentation (figure 1) and the trialling of lucerne. The SFS member survey (2008) indicated a rapid change in the number of farms with lucerne. In 2004 only 4% had lucerne on their farms but this was projected to reach 61% by 2008, albeit on a very small area.

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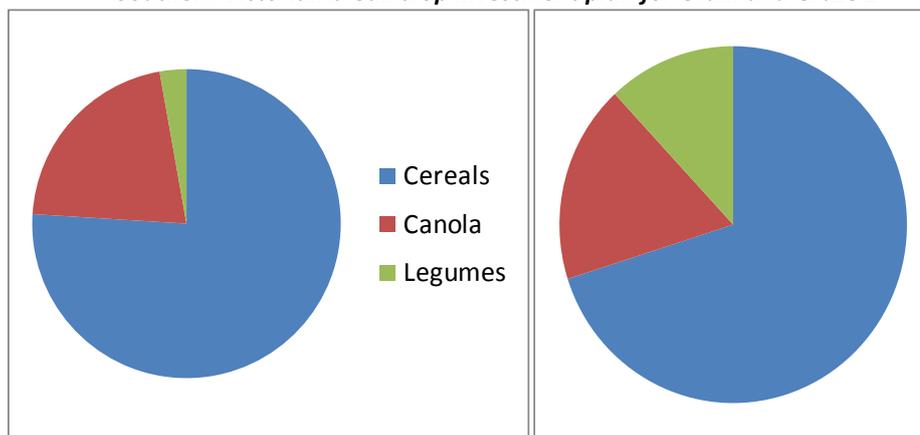


Figure 1: Proportion of cropped area sown to cereals, canola and legumes (2005/2006 left, 2006/2007 right): Source ABS

As indicated in the benchmarking report, farmers are experiencing difficulties in either growing legume crops eg peas, beans, lupins or realising the full potential from more common pasture legume crops eg short term use of lucerne or knowing the fit of potential new varieties such as Sulla and annual clovers.

A second critical aspect of the break phase is the short term implications for soil moisture and the longer term implications for soil structure¹. There may be opportunity to use annual legume crops and legume pastures in ‘novel’ ways to assist in moisture retention, groundcover, weed control and soil modification.

To appreciate the current level of knowledge and experience in break crops, crop transition strategies and in particular the use of legumes in the rotation, a small market research project was initiated. The market research provides an understanding of the current level of ‘experimentation’ with legumes in Southern Victoria and identifies barriers to successful adoption. This would provide a framework for investment through Grain and Graze 2 and also identify opportunities for other complementary investment eg Pulse Australia, GRDC crop sequencing project, MLA feedbase plan.

¹ It is unclear what impact the phase length of lucerne may have on soil water holding capacity and subsequent crops and pasture production. Investigations specifically looking at lucerne are being conducted in another part of the Grain and Graze 2 program.

2. Survey method

In-depth telephone interviews were conducted with 16 progressive farmers and agronomists in Southern Victoria who were recognised as being active in their search for better rotations and have been investigating or trialing alternative break crops. This was a select population and the interviews were designed to give them the opportunity to discuss their philosophy and experiences and to explore the direction they thought research should go (rather than to develop a technical understanding of 'best practice' rotations in the region).

A focused conversation method (Stanfield, 1997) was used to guide the interview questions (appendix 1). There were no right or wrong or multi choice answers and no agree or disagree type questions. Instead interviews was conducted to tease out ideas, thoughts and attitudes of leading practitioners and advisors.

The interviews lasted between 40 and 90 minutes. Every opportunity was given for the participants to explore ideas and experiences that would contribute to a greater understanding of the issues and requirements in the high rainfall zone. Confidentiality was assured to each participant.

Interviews were conducted by David Watson, principal of Agvise Services Pty Ltd over a three month period from mid August 2010. Agvise Services is an independent crop agronomy consultancy business located near Geelong.

3. Results

Many break crop combinations were discussed by interviewees. This included different species, multiple issues they wanted the break phase to help address and a range of possible applications depending on circumstances. There was 141 years of experience with break crops between the 16 people interviewed. A summary of these deliberations is presented (appendix 2).

The vast majority of interviewees believed viable break crops were essential in the high rainfall zone to ensure long term sustainability of the cropping system. It was felt the cropping system would come under increasing pressure from weeds, disease and rising input costs unless alternatives were found. One well travelled interviewee commented 'nowhere in the world are there long term cropping systems without break crops'.

There was strong support to develop a range of break crop options. As stated previously, canola is currently the only significant break crop in Southern Victoria and interviewees all said more options are required to suit the diversity of soil types, rotations, enterprise mixes and problems.

Faba beans, field peas and chick peas were the three most common grain break crops used. Lupins, mung beans and lentils were mentioned less often. Legume based annual pastures were identified as a potential option, especially where livestock is an integral part of the farming business. Several interviewees also suggested the use of grass species (ryegrass, cereals) to use in fodder conservation, primarily for weed control. There are also some 'novel' break crop ideas including using millet and fodder brassicas to maintain groundcover and retain soil moisture over summer.

Annual ryegrass control was the most common reason cited for needing suitable break crops (about 75% of all interviewed). Currently there are no well developed break crop options in the rotation other than canola to control annual ryegrass. This is further exacerbated by raised bed cropping systems where furrows and headlands provide the ideal environment for uncontrolled weed development. In addition spraying conditions and paddock trafficability in Southern Victoria often limits the capacity to apply herbicides when and where they are required. These factors in combination increase the significance of the annual ryegrass problem and hence farmers desire to find viable alternatives.

There was also a strong desire to reduce the dependence on nitrogen fertiliser through the use of perennial or annual legume crops. However many interviewees were skeptical about the amount of nitrogen accumulation believed to be derived from various legumes, especially in the high rainfall zone.

The potential livestock and whole farm system benefits from grazing or making fodder from break crops was poorly understood. While there were regular references to animal and

crop production synergies that *could* exist, the size of these net benefits and the management strategies to maximise the opportunities were not known. Quantifying these perceived benefits over a number of years and across a full crop rotation is required.

Many interviewees sought improvements in the productive capacity of the soil from the inclusion of break crops. They believed that current 'best practice' cropping systems are maintaining soil health, but there is great scope for improvement. Areas suggested for investigation include modification to subsoil structure and fertility and the manipulation of plant available water to influence rooting depth of subsequent crops.

4. Insights

The results from this survey suggest there are numerous combinations of species, applications and desired benefits from a break crop phase. This creates a complexity because there is a multitude of 'right answers' depending on an individual farming circumstance. It also creates a challenge to identify investments in research and extension that will provide greatest returns.

Responses from the interviews revealed three significant variables that influenced the type of break crops that may be appropriate. These are described as preference, problem and opportunity.

4.1 Preference

Preference refers to the farmer's inclination towards cropping or livestock. While there was a continuum in preference, at one end were those farmers who were **crop focused**. They do not have livestock in their enterprise mix and were unlikely to re-introduce them even if livestock were integral to implementation of some of the break crop options. Farmers with this preference were looking for crop only options eg pulses.

At the other end of the continuum were farmers who were **enthusiastic about livestock** as part of their enterprise mix. They were positive about some of the possible solutions involving livestock, even if it added additional management aspects to the animal enterprise. Solutions that benefit both the livestock and cropping phases were embraced. These farmers are flexible in their use of livestock and happy to use them if it is the most effective solution to their problems.

Between these two groups are those farmer who would **'tolerate' livestock** if benefits to the cropping system are realised in the long run. They may not be a strong supporter of livestock, but are prepared to retain some in the system to make different break crop options work.

4.2 Problems they want the break crop to help solve

There were a range of problems interviewees were trying to solve through using break crops. As mentioned previously the most common problem was annual ryegrass. There was a belief that as cropping programs mature and herbicide resistance become more common (as indicated by the results of recent SFS/SARDI random paddock sampling through South West Victoria), annual ryegrass would be the biggest threat to the long term viability of cropping. They strongly believe the control of annual ryegrass in the cereal and canola phases (primarily through herbicides) has limitations and alternatives to 'clean up paddocks', either through the use of a different group and timing of herbicides or by non herbicide means is required.

Other major benefits sought from the break crop phase were increases in **soil nitrogen**, improvements in **'soil health'** and **better utilisation of water** over the year. Less common responses were to help combat **root disease**, improve or maintain **groundcover** and enable an **increase in whole farm stocking rate**.

However the most important insight is that farmers and advisors want approaches that address **multiple** solutions during the break phase. For example they want to control weeds, provide a disease break and increase soil nitrogen. They accept that these multiple benefits may need to be accumulated over time, allowing for a lesser benefit in one year to be 're-paid' in later years. The aspect of combination is the key. This brings rotation length and sequencing of different break crop options into consideration.

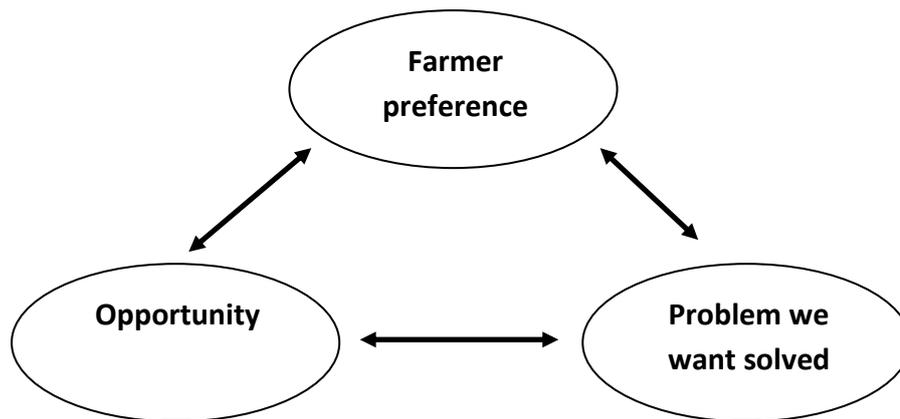
4.3 Opportunity

The third variable was opportunity. The type of break crop interviewees were looking for was influenced by the prevailing conditions when the choice needed to be made. These prevailing conditions could be summarised as:

- **The season.** Out of season rainfall may prompt an unintended decision to use a break crop (or a different break crop) because moisture is available. Rather than lose the moisture, a decision may be made to utilise this and at the same time achieve other potential benefits.
- **Livestock price and availability.** If farmers had livestock and prices were favourable, a decision may be made to sow a break crop to use either in a finishing operation or to enable stock to be carried over until the next season when they are sold during a period of short supply. If livestock prices were less favourable, the margin may be too small to warrant the break crop.
- **The value of the current crop verses future crops.** There is continual evaluation occurring between the 'value' placed on the current crop and having an eye to potential benefits in the future. This was especially the case when current crops were marginal, say though a very wet winter. There was a continual underlying questioning; wondering if it would be better to cut current losses and establish a summer crop early that could use the moisture and provide potential benefits that could not be realised if the existing crop was carried through to harvest.

These three variables, preference, problem and opportunity interact to shape the type of break crop option that is appropriate at any point in time. This can be represented diagrammatically (figure 1 and appendix 3).

Figure 1: The three variables that influence the choice of appropriate break crop option



It is critical to consider the time dimension with these three variables. The opportunity variable is constantly in flux and can change quite rapidly such as a major climatic event (eg rainfall, frost). In contrast the preference variable is slow to change (and often is entrenched between generations). The problem to solve variable often resides between these two extremes and generally develops over several seasons.

5. Investment approach

The combination of these three variables makes using the traditional research paradigm challenging because there is no appropriate break crop that meets all the requirements. There are multiple break crop solutions, that may only work in some years and under some circumstances. The combinations are almost endless and to try and test *all* of these combinations using 'white peg' type trialing is unrealistic because of cost and time. This conclusion was supported by those interviewed, who consistently commented that a replicated trial approach at a central location would not work. Trying to 'pick winners' would be equally challenging because the opportunities may make the break crops chosen unsuitable or unrealistic at that point in time. An alternative approach is needed that rapidly tests numerous alternatives under variable conditions.

The development approach to be used in Grain and Graze 2 is based on a participatory action research model (Whyte, 1991). This approach aims to generate information that is relevant to the end user through their involvement in identification of possible solutions, participation in the research phase and finally in the interpretation of the results. It taps into local knowledge and creates ownership of the possible solutions by the farming and advisory community. Above all the approach maintains flexibility and responsiveness required in this type of situation.

Characteristics of the participatory action research will include:

- Utilising break crops farmers were already going to implement, by imposing replicated or paired paddock treatments across them
- Providing specialist agronomic and research capabilities to ensure all necessary comparative information can be collected, collated and analysed
- Using local groups (existing or new) to determine best bet options and interpret findings (including cost benefit analysis)
- Enrolling local agronomists to work with clients on one or more break crop focus paddocks.
- Capturing as many case studies as possible to build the understanding of successful approaches to using break crops
- Providing leadership to draw together complimentary findings from Pulse Australia, the lucerne work in Grain and Graze 2 and other relevant investigations.

The focus of the work will be on those farmers who tolerate and/or are happy to use livestock. Work on pulses that does not involve livestock, either through direct grazing or grazing the stubble after harvest will be avoided, as this is already being investigated in the high rainfall zone through Pulse Australia and other interested parties. Work is also underway to investigate the impact of lucerne in the rotation through another component of Grain and Graze 2, so it is unlikely lucerne will feature in this work.

6. References

Roberts Evaluation (2010)

Grain and Graze 2 Benchmark Report (draft). A report prepared for the Grains Research and development Corporation

SFS (2008)

Regional awareness, participation and adoption survey. Results of a regional survey in the Corangamite / Glenelg Hopkins Region. Southern Farming Systems, Geelong

Stanfield, B. (1997)

The Art of Focused Conversation, Canadian Institute of Cultural Affairs, Ontario, Canada

Whyte, W. F. (1991)

Participatory Action Research, Sage, Newbury Park, USA

Appendix 1: Outline of structured interview approach

A semi-structured interview approach was adopted for this market research. The interview had four distinct steps

Step 1

After a brief introduction of the interviewer and the Grain Graze 2 program, a background statement was read out that outlined the focus and scope of the interview.

The Grain and Graze program believes break crops will be a crucial component of a mixed farming system in the future. By break crops we mean any type of farming activity including things like manuring and hay cutting that fit a farming system and provide advantages such as weed, pest and disease control, extra N, improved soil structure and maintaining groundcover. We are keen to talk to a number of progressive farmers who have thought about or are implementing practices to help focus our research work over the next four years

In mixed farming systems in the High Rainfall Zone, the use of break crops can have significant impact on both short and long term profitability of the system by influencing things such as;

- *Herbicide resistance in weeds*
- *Weed burdens & seed banks*
- *Soil nutrition (eg nitrogen)*
- *Soil structure in the topsoil & subsoil*
- *Livestock feed supply*
- *Ground cover*
- *Plant and soil disease*

We consider break crops as those used solely in the cropping rotation or as part of the livestock production system. In cropping they are typically thought of as pulses for grain production, but given our situation in southern Victoria, we could also be considering other non pulse annual & perennial legumes, green & brown manure crops and perhaps brassicas.

So with this in mind, could I ask you a number of questions to get your experiences and thoughts on break crops and legumes in your cropping system.

Step 2

Questions were asked to develop an understanding of current and historic practices and observations of each interviewee. Questions included:

- What types of break crops have you tried and how did they go?
- Why did you use this (these) break crop(s)?

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- What aspects of these break crops(s) worked and what difficulties did you encounter?
- How many years have you been trying?
- What other break crops do you have an interest in?
- What types of break crops have others tried that you think are interesting?
- What is stopping you from trying them?

Step 3

Questions were asked to context the responses in step 2. In this step interviewees were encouraged to think laterally about the broader concept of a break phase. It included questions such as:

- Where has this interest (motivation) come from?
- What attributes (benefits) do you think a break crop needs to have?
- If we don't find a break crop, what might this mean for your business?

Step 4

The last step narrowed down the interviewees areas of interest and priorities. It included questions such as:

- Which of the current options seem to have potential and what are their strongest attributes.
- Which of the current options don't seem to have potential and why?
- What are the current limitations we need to sort out?
- What would be the best way of doing this – who should be involved, (farmers, researchers) and how should it be delivered?
- If you could get some work happening tomorrow, what would you do first?
- Any other thoughts or suggestions?

The interview concluded with an acknowledgement of their contribution and an undertaking to forward summarised results when available.

Appendix 2: Summary of survey results (in rough order of popularity)

Compilation of responses from interviewees. These are comments made rather than an exhaustive list of all the possible benefits, attributes and issues.

Break crop (either used or with potential to be used in the future)	Why used and attributes	Issues to resolve to make it a more viable or attractive option in the future
Faba beans	<ul style="list-style-type: none"> • Nitrogen input • Ryegrass control by allowing use of different herbicide groups • Enables crop topping • Achieves very good results in drier years • Has feed value in a mixed operation (system fit) • Comparable gross margin to canola in good years • Cereal root disease break • Stubble grazing value with lambs • Used in conjunction with canola (as the second year break) 	<ul style="list-style-type: none"> • Achieving adequate disease control, especially in wet years • Optimum time of sowing • Optimum row spacing • As a stand alone crop, not profitable in year of production • Quantify nitrogen deposition • Soil amelioration effects and value to subsequent crops • Suitable varieties for the high rainfall zone • Withholding periods of fungicides • Reliability of production when different circumstances are encountered • Marketing of grain
Field peas, chick peas	<ul style="list-style-type: none"> • Nitrogen input • Ryegrass control by allowing use of different herbicide groups • Stubble hay is profitable 	<ul style="list-style-type: none"> • Understanding the nutrient balance and loss of N on hay removal • Poor yields if a dry finish • Susceptibility to disease • Susceptibility to frost
Short term legume pastures	<ul style="list-style-type: none"> • Excellent nitrogen input and ryegrass control • Excellent financial returns if used in conjunction with a profitable livestock system • Returns less volatile than other break crops 	<ul style="list-style-type: none"> • Winter productivity if there is a late break • Pasture & livestock management skills to maximise returns • Paddock size and grazing management
Lupins	<ul style="list-style-type: none"> • Ryegrass control • Can be grown successfully on well drained lighter country 	<ul style="list-style-type: none"> • Variable yields(and profitability) • Difficult to handle stubble loads at sowing • Unsuitable on heavier basalt soils • Susceptibility to disease • Difficulty in being able to apply sprays at idea time due to weather conditions
Rye grass (for fodder)	<ul style="list-style-type: none"> • Excellent ryegrass control because cutting enabling seed removal • 	<ul style="list-style-type: none"> • Nutrient removal in the fodder
Cereal hay (for fodder)	<ul style="list-style-type: none"> • Ability to spray top annual grasses • Ability to cut enabling seed removal • Ability to cut and then sow barley 	<ul style="list-style-type: none"> • Nutrient removal in the fodder

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	late to take through for grain , giving 2 crops in one year.	
Lucerne	<ul style="list-style-type: none"> • Nitrogen input • Ryegrass control • Long term effect on soil structure (water holding capacity of the soil) • Provides 12 month feed for animal production • Can be oversown with winter cereals to boost available fodder in winter 	<ul style="list-style-type: none"> • Appropriate winter activity when used in a rotation • Companion species • Soil moisture depletion and nitrogen interaction • Lucerne is perceived to be a difficult crop to grow with specific management requirements to get it right eg herbicide use, pest control, variety, grazing requirement • Length of time in rotation • Understanding of systems benefits and costs • Management on raised beds
Millet	<ul style="list-style-type: none"> • Low cost to establish • Possible fit to oversow canola stubbles • Provides fodder for grazing over summer • No apparent negative impact on subsequent crop when this was expected • Enables potential increase in whole farm stocking rate • Increase ground cover over summer 	<ul style="list-style-type: none"> • Impact on soil water balance • Effect on cereal root diseases • Soil compaction from grazing • Production in dry summer
Mung beans	<ul style="list-style-type: none"> • Nitrogen input • Weed control • Increase ground cover over summer • Provides a second grain crop over summer • Grain yield can cover the up-front cost of production, so there were added break crop benefits eg N, disease, weeds etc 	<ul style="list-style-type: none"> • Quantify nitrogen deposition • Soil compaction from grazing • Weed impact from grazing
Sorghum (+ lab lab)	<ul style="list-style-type: none"> • Is an opportunistic summer crop • Provides ground cover and reduces wind erosion on lighter soils • Provides grazing • De facto green manure crop 	<ul style="list-style-type: none"> • Impact on soil water balance • Effect on cereal root diseases • Soil compaction from grazing • Production in dry summer
Lentils	<ul style="list-style-type: none"> • Possibly suitable for light sandy country 	<ul style="list-style-type: none"> • The full agronomy / management package (many unknowns)
Vetch hay / Serradella hay	<ul style="list-style-type: none"> • Controlling cereal root disease • Nitrogen input • Ryegrass control by allowing use of different herbicide groups 	<ul style="list-style-type: none"> • Broadleaf weed control options • Crop nutrition requirements • Benefit / cost analysis • Marketing of grain

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<p>Fodder rape +/- millet</p>	<ul style="list-style-type: none">• Can be established immediately pre or post the harvest of a winter crop winter crop harvest• Provides potential year long grazing• Second 'kill' spray in Spring• Utilizes summer rain• Increase ground cover over summer	<ul style="list-style-type: none">• Broadleaf weed control• Effect on cereal root diseases• Soil water balance• Nitrogen balance• Sowing into heavy stubble loads
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Appendix 3: The three variables that influence the appropriate break crop option of a farm

