final report

Feed Demand Calculator Development

Abstract

This project was carried out to improve MLA's Feed Demand Calculator, a learning tool in the form of an Excel spreadsheet developed as part of the *More Beef from Pastures* programme. The tool was extended with new pasture data, new options for displaying feed demand and feed supply, new performance indicators, improved help text and several other changes. These enhancements were made in response to user feedback from producers and others, with the aim of allowing the tool to better meet the needs of industry in supporting relevant decision-making processes.

Executive summary

MLA's Feed Demand Calculator is a learning tool developed by MLA and the CSIRO as part of the *More Beef from Pastures* programme. The calculator allows producers to gain an appreciation of the pattern of feed supply and demand over a twelve-month period, the location of "feed gaps" and the ways in which modifying the livestock enterprise might help to close these gaps.

Since development, feedback has been obtained from producers and other users of the tool as to how it might be improved to better meet the needs of users. This project sought to refine and enhance the tool in line with this feedback.

Changes made to the MLA Feed Demand Calculator include the following:

- Graphs displaying the relationship of feed demand and feed supply were enhanced by allowing the user to select whether results should be expressed in terms of tonne/farm or tonne/hectare. The user is also given the option of displaying the data in a "spider-web" (radar) graph, which may more clearly reveal annual patterns in the supply/demand relationship.

- When the user has indicated that the pasture is composed of a mixture of pasture types, a new output chart of pasture supply is provided to better indicate the contributions of each pasture type.

- The in-built pasture curve data was reviewed and extended. These data were provided via Dr Geoff Saul, of PSA Services, Hamilton, Victoria.

- An option was provided to allow the user to specify levels of supplementation for each month of the year.

- Several new key performance indicators were added, providing greater emphasis on natural resource management considerations.

- Tool-tips and other in-built help have been rewritten and improved to provide better assistance to users of the tool.

The revised Calculator can be released by MLA from their web-site and for use in their advisory programmes. Producers who make use of the tool will benefit from access to an improved tool for learning about their feed supply and demand.

Contents

1   Background

In MLA project MBfP.037, CSIRO developed the "MLA Feed Demand Calculator", a software tool that enables producers to better understand the way in which the numbers and classes of livestock on their properties affect the total demand for pasture. This calculator was built upon CSIRO's expertise with the prediction of feed intake from pastures embodied in (amongst other things) the GrazFeed decision support tool. This initial design met its functional requirements and was a successful "proof of concept" (Moore and Freer 2005). The Calculator was refined by CSIRO in MLA project MBfP.044 to make it simpler to use and more compact to download (Moore and Zurcher 2006), then further improved in MLA project B.MBP.0041 to eliminate minor "bugs" and add the capability of dealing with a range of different pasture types (Moore and Zurcher 2008).

As with any computer software, use and feedback from users resulted in suggestions as to how the tool could be further improved to better meet the needs of users. This project sought to refine and extend the tool in line with the feedback that has been received.

2   Project Objectives and Outputs

The objectives of this project were to refine the MLA Feed Demand Calculator spreadsheet by add several new features and refinements. These refinements are intended to:

1. Upgrade/develop the tool to better meet the needs of industry in supporting relevant decision-making processes.
2. Provide better support structures for individuals when using the tool to ensure the full capacity of the tool is utilised.
3. Implement a process of continuous improvement around the tool that engages next and end users in the process.

Specific outputs that were sought included the following:

1. Improvements to the feed demand vs. supply graph.
2. Addition of new pasture curves.
3. Accounting for supplementation within the system.
4. New key performance indicators providing greater consideration of natural resource management issues.
5. Improved tool-tips and help.
6. Expanded options for buying and selling livestock at different times of the year.

3   Modifications to the Calculator

3.1   Improvements in charting feed demand

Several enhancements were made in the graphical presentation of feed demand and supply. Earlier versions presented these values in terms of tonnes of DM / farm. The user is now provided with the option of expressing these values in the units of tonnes/ha (Figure 1). The user can easily choose between these alternatives.

Earlier versions presented feed demand in the form of a stacked bar graph. An option has been added to allow the user to present the results as a "radar" (or "spider-web")

graph, which may show seasonal patterns more clearly (Figure 1). A drop-down control allows the user to switch easily between these two styles of charting.

Figure 1. The Feed Demand tab in the revised Feed Demand Calculator spreadsheet, illustrating display as a "radar" graph. New drop-down controls which allow altering the scaling and nature of the chart are indicated by the red ellipses.
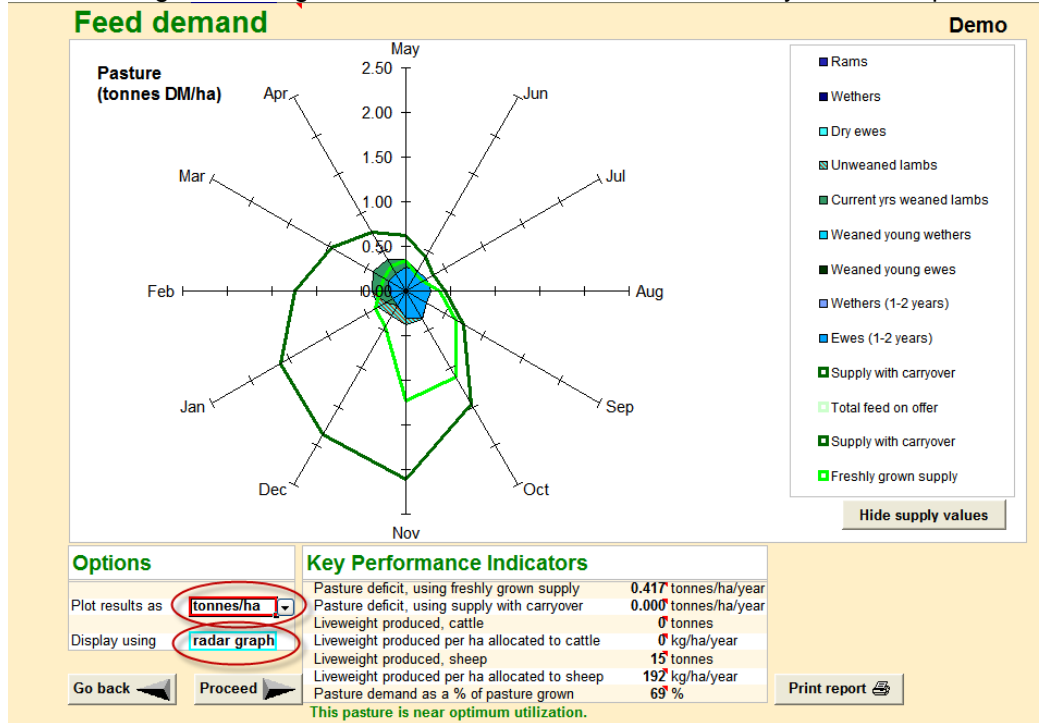
3.2   Plotting of feed supply

A new output tab has been added which appears only when the user is combining a set of different pasture types. Like the Feed Demand tab, this tab displays feed supply and demand across the months of the year, but it has a different emphasis. The feed demand tab attempts to make clear the demand arising from each class of animal, in comparison to the total supply. The new Feed Supply tab tries to show the contribution of each pasture type (including carryover) to supply, in comparison to the total demand (Figure 2).

This tab displays the same Key Performance Indicators as the Feed Demand tab, and provides similar options for selecting the units of measurement and chart type.

Figure 2. The Feed Supply tab in the revised Feed Demand Calculator spreadsheet, which illustrates the seasonal contributions of different pasture types to the overall feed supply.
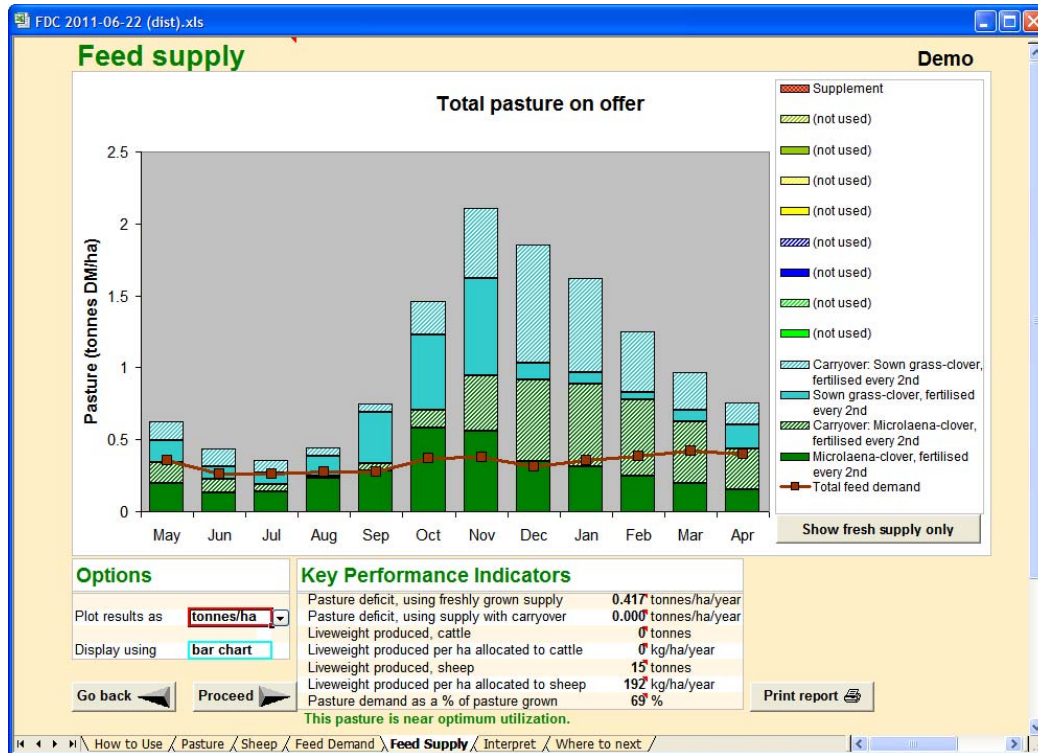
3.3   Revision of carryover logic

During the round of changes made to the Calculator under the scope of MLA project MBfP.044, logic was added to allow for the carryover of ungrazed pasture to subsequent months. The proposal for that project described an algorithm for calculating these values. However, on advice from David McNeill, *More Beef from Pastures* coordinator at the time of the project, a different calculation of "carryover feed" (described in Moore and Zurcher 2006) was introduced that was intended to emphasise the overall constraint imposed by the annual production of pasture.

Since that time, feedback from users has indicated they have had difficulty interpreting these carryover values. As a consequence, this release of the Calculator has returned to the algorithm originally proposed for the calculation of carryover values. That algorithm may be summarised as follows:

(i)   For each month, compute the demand for DM not satisfied from current growth.

(ii)   For each month, compute the carryover DM from one month ago as the excess of growth one month ago over demand one month ago, decreased by a percentage *p* to allow for herbage disappearance.

(iii) Demand met by consumption of herbage carried over one month is the positive difference between (i) and (ii).

(iv) Repeat steps (i)-(iii) for herbage carried over two months, three months etc. For example, the carryover DM from two months ago in a given month equals

(v) { [(growth rate two months ago) – (demand two months ago)] x (1.0 - p) - (excess of demand over growth one month ago) } x (1.0 – p)

(vi) Compute the demand that can be satisfied from carryover herbage as the sum of the demands met from each age of carryover herbage.

A further consideration is that the rate of herbage disappearance, p, is not constant throughout the year. To address that problem, the user is now allowed to choose two different rates of loss, or "wastage rates". The first indicates the rate of loss from actively growing pasture, the second the rate of loss from senescent pasture. On advice from Geoff Saul, the second factor is applied during those months in which either pasture production is less than 10% of peak growth, or the amount of carryover brought into the month is greater than 2 tonne/ha.

3.4 Labelling of simulations runs and paddocks

Users are now provided with the ability to provide identifying labels for an overall simulation "run", and for individual pasture types (if they have chosen the option of combining pasture types). The labels appear on output pages where appropriate.

3.5 Addition of new pasture curves

The database of pasture growth curve information embedded with the calculator was revised and extended by Geoff Saul. In many cases, the naming of regions was clarified by adding the name of a town centrally located within the region being described.

The final set of locations and pasture types incorporated into this version of the Feed Demand Calculator is given in Appendix 1.

3.6 Accounting for supplementation

A new set of input columns was provided on the Pasture tab to allow the user to enter the amount (in units of kg/ha/day) and quality (in units of MJ ME / kg DM) of supplement provided for each month of the year. These values are incorporated into the calculations of the spreadsheet, and also appear on the Feed Demand and Feed Supply charts.

3.7 Flagging of NRM issues

A new indicator was added to flag conditions under which the overall proportion of pasture eaten is regarded as too high to be sustainable. This proportion is a function of soil type and slope, and new controls have been added in which the user provides this information.

The range of overall utilization rates considered "optimum" for each combination of soil type and slope is given in this table:

	Slope		
Soil type	Level	Undulating	Steep
Clay	65-75	60-70	50-60
Clay loam	60-70	55-65	45-55
Sandy loam	55-65	45-55	35-45
Sand	45-55	35-45	30-40

If the utilization rate exceeds the maximum of the applicable range, a warning message appears at the bottom of the Feed Demand and Feed Supply tabs (Figure 3). If the rate is below the minimum, a more muted message appears informing the user that the pasture may be under-utilised. If it falls within the range, the message indicated that utilisation is near optimum (see the bottoms of Figures 1 and 2).

Figure 3. The Feed Demand tab in the revised Feed Demand Calculator spreadsheet, warning the user that the rate of pasture utilization may be too high.
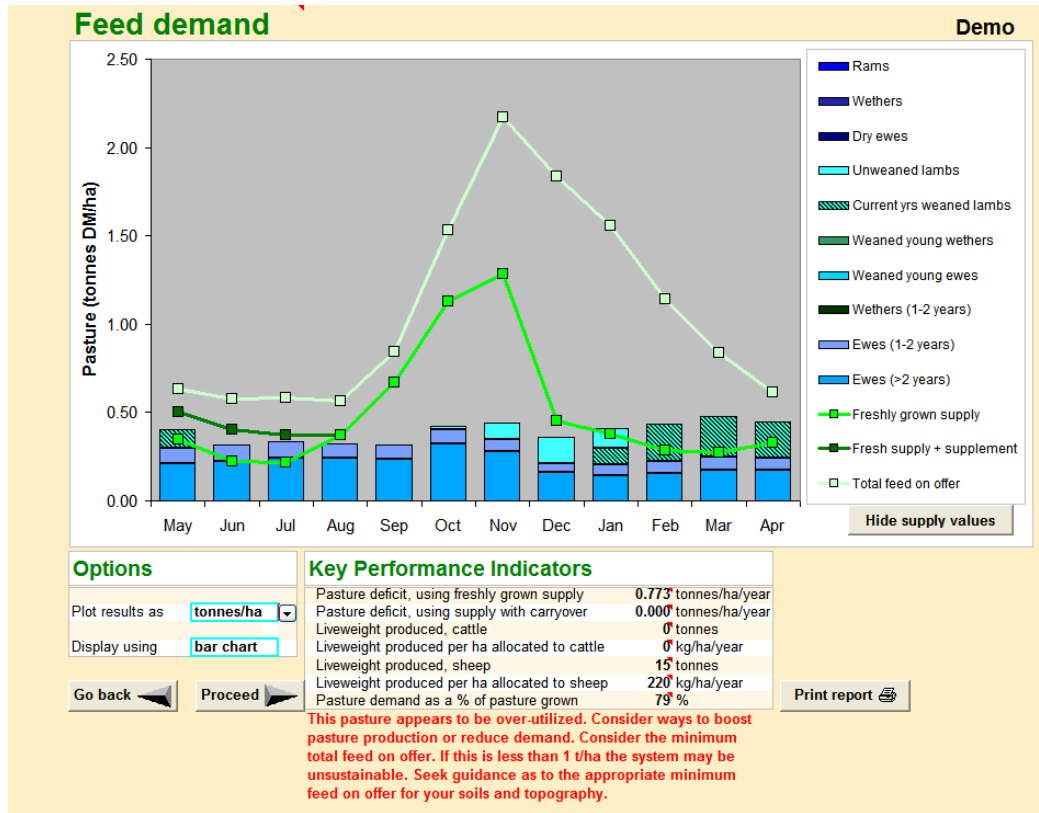
3.8 Improved tool-tips and help sheets

A number of changes were made to help sheets and to pop-up "tool-tips" to better support users in entering appropriate data, and asking appropriate questions of that data.

4 Success in Achieving Objectives

The objectives have been met. However, it may be noted that one output which was sought, but which was not addressed by changes to the calculator, was that of "expanding the number of options for buying and selling livestock at different times of the year". This request appears to have been in part a misunderstanding of the capabilities of the calculator; as a specific example, the trading of wether lambs can be easily done by indicating an appropriate age and weight for "wether" stock. The use of the terms "wether" and "ewe" as labels of the trading stock categories may have misled users into thinking that lambs could not be traded. Clearer labelling should address this problem.

5 Conclusions and Recommendations

The Feed Demand Calculator has been well received, both within the *More Beef from Pastures* programme and in other MLA-funded activities such as *Grain and Graze* and *Making More from Sheep*. The modifications to the Calculator carried out in this project will allow it to be more easily applied, which should further enhance its value as a learning tool.

As with any piece of software, the design of the Feed Demand Calculator reflects a trade-off between power and ease of use. Given its role as a learning-support rather than a decision-support tool, the current version of the Feed Demand Calculator has, in our view, reached a point at which further increases in its complexity would result in it becoming less and not more useful. We recommend that no further features be added to the Feed Demand Calculator. (An exception to this is the addition of further locations and/or pasture types, which can be done without increasing the overall complexity of the Calculator.)

We also note that a chronic problem with use of the Calculator has been advising users how to install it so that the use of Excel macros (which are crucial to its functioning) is enabled. This is complicated somewhat by different versions of the Excel program having different mechanisms by which this is achieved. This problem may be alleviated in either of two ways: (1) a complete re-write of the Calculator (either as a standalone application or web application) so that it no longer depends on Excel; or (2) purchasing a license for a digital signature from a recognised code authority, which could be used to "code sign" the macros within the Calculator. Otherwise, MLA should take care to ensure that users are properly informed about the steps needed to enable the use of macros in their version of Excel without jeopardizing the overall security of their computers.

6 Bibliography

Moore AD and Freer M (2005). *Algorithms for a feed demand calculator.* Report to Meat & Livestock Australia, project MBfP.037. 19pp.

Moore AD and Zurcher EJ (2006). *User interface for a feed demand calculator.* Report to Meat & Livestock Australia, project MBfP.044. 18pp+CD.

Moore AD and Zurcher EJ (2008). *Improvement to the MLA Feed Demand Calculator Tool.* Report to Meat & Livestock Australia, project B.MBP.0041. 17pp+CD.

Appendix 1 - List of pasture types

A "Y" in the '**Year types?'** column indicates that separate entries are provided for "Good", "Standard" and "Poor" years. In addition to the pasture types listed here, each location has "pasture types" for stubbles and for forage crops (with no variation according to year type).

Locations	Pasture types	Year types?
NSW - North West Slopes	Phalaris, clover - Standard year, Fertiliser	N
	Lucerne - Standard year, Fertiliser	N
	Premeir diget grass - Standard year, Fertiliser	N
	Rhodes grass - Standard year, Fertiliser	N
	Swan Forest bluegrass - Standard year, Fertiliser	N
	Forage sorghum - Standard year, Fertiliser	N
	Forage oats - Standard year, Fertiliser	N
	Danthonia, clover - Standard year, Fertiliser	N
	Summer grass dominant - No Fertiliser	N
	Native perennials - Standard year, No fertiliser	N
NSW - Northern Tablelands	Tall fescue, clover - Fertilised	Y
	Phalaris, clover - Fertiliser	Y
	Redgrass - No fertiliser	Y
	Microlaena, clover - Fertiliser	Y
	Perennial ryegrass, clover - Fertiliser	Y
NSW - Central Tablelands	Sown perennial grass, clover - Fertlised	Y
	Chicory, clover - Standard year, Fertilised	N
	Microlaena, clover - Fertilised	Y
	Microlaena - No fertiliser	Y
	Summer grass, clover - Fertilised	Y
	Summer grass - No fertiliser	Y
	Annual grass, clover - Fertilised	Y
NSW - Southern Tablelands	Sown grass-clover, fertilised every 2nd year	Y
	Microlaena-clover, fertilised every 2nd year	Y
	Redgrass, kangaroo grass, no fertiliser	Y
	Sown grass-clover, annual fertiliser	Y
NSW - Upper Hunter	Phalaris-clover	Y
	Summer grass	Y
	Austrodanthonia-clover	Y
	Lucerne	Y
	Sub clover pasture	Y
	Medic pasture	Y
	Tropical grass, low clover	Y
NSW - Central West Slopes	Temperate grass, clover - Fertilised	Y
	Sub clover - Fertilised	Y
	Summer grass - Not fertilised	Y
	Lucerne, clover pasture - Fertilised	Y
	Lucerne - Fertilised	Y
	Annual grass, clover - Fertilised	Y
	Tropical grass - Fertilised	Y
NSW - South West Slopes	Phalaris, clover - Fertilised	Y
	Cocksfoot, clover - Fertilised	Y
	Lucerne, clover - Fertilised	Y
	Annual grass, clover - Fertilised	Y

	Native grass - Not fertilised	Y
	Native grass - Fertilised	Y
NSW - North Coast	Naturalized carpet grass, No fertiliser	Y
	Naturalized carpet grass, clover, Fertiliser	Y
	Kikuyu	Y
	Kikuyu, N fertiliser	Y
	Setaria, rhodes grass, clover	Y
	Annual ryegrass, N fertiliser	Y
NSW - Mid North Coast & Lower Hunter	Naturalized carpet grass- No fertiliser	Y
	Naturalized carpet grass, clover, Fertiliser	Y
	Kikuyu	Y
	Paspalum	Y
	Setaria	Y
	Annual ryegrass, N fertiliser	Y
NSW - Warialda	Sown grass	Y
	Native grass	Y
	Forage sorghum	Y
	Lablab	Y
	Lucerne	Y
	Oats	Y
VIC - Western (Hamilton)	Perennial ryegrass, phalaris, clover, annuals, Fertiliser - Standard year	Y
	Annual grass, low clover, Fertiliser	Y
	Summer active perennial rye, clover, Fertiliser - Standard year	N
	Fescue (summer active), clover, Fertiliser - Standard year	N
	Chicory, clover, annuals, Fertiliser - Standard year	N
	Lucerne (Winter active), clover, annuals, Fertiliser	Y
VIC - Western (Balmoral)	Perennial ryegrass, phalaris, clover, Fertiliser	Y
	Annuals, onion grass, low clover, Fertiliser	Y
	Lucerne - Standard year	Y
VIC Western (Edenhope)	Perennial ryegrass, phalaris, clover, Fertiliser	Y
	Annuals, onion grass, low clover, Fertilised	Y
VIC - Central West (Ballarat)	Perennial grass, clover pasture, Fertiliser - Standard year	N
	Bent grass, No fertiliser - Standard year	N
VIC Central West (Lismore)	Perennial ryegrass, phalaris, clover, Fertiliser	Y
	Annuals, onion grass, low clover, Fertilised	Y
Vic Central (Ararat)	Perennial ryegrass, phalaris, clover, Fertiliser	Y
	Annuals, onion grass, low clover, Fertilised	Y
	Danthonia, annuals, low clover, no fertiliser, Standard year	N
Vic Central (Seymour)	Phalaris, clover, Fertilised	Y
	Phalaris, clover, High fertility	Y
VIC Central (Maryborough)	Lucerne, annual grasses, clover, Fertiliser - Standard year	N
	Phalaris, clover	Y
	Annual grass	Y
VIC - North East (Bonnie Doon)	Lucerne - Fertilised	Y
	Perennial rye - Fertilised	Y
	Phalaris (winter active), clover, fertilised	Y
	Annual grass & weeds - No fertiliser	Y
	Danthonia, annual grass & weeds - Not	Y

	fertilised	
	Microleana, danthonia, annual grass	Y
VIC - North West (Boort)	Annual grass & weeds, clover, lucerne, Fertiliser - Standard year	N
	Phlaris, annuals, clover, weeds, Fertiliser - Standard year	N
VIC - Gippsland (Ellinbank)	Perennial ryegrass, clover, Fertiliser	Y
	Lucerne	Y
VIC - Gippsland (Maffra)	Dryland perennial ryegrass, clover, Fertiliser	Y
	Lucerne	Y
VIC - Gippsland (Bairnsdale)	Annual grass, clover, Fertiliser	Y
	Kikuyu, annuals, clover - Standard year	N
TAS - North West (Elliott)	Perennial ryegrass, cocksfoot, clover, Fertiliser - Standard year	N
	Lucerne	Y
	Perennial ryegrass, clover - Fertiliser	Y
TAS - North Central (Cressy)	Perennial ryegrass, cocksfoot, clover, Fertiliser - Standard year	N
	Lucerne	Y
	Perennial ryegrass, clover - Fertiliser	Y
	Annual grass, clover	Y
TAS - Central Midlands (Ross)	Native pasture, clover, Fertiliser - Standard year	N
TAS - Southern Midlands (Jericho)	Annual grass, clover, Fertiliser - Standard Year	N
	Cocksfoot, phalaris, clover, Fertiliser - Standard year	N
	Lucerne	Y
	Perennial ryegrass, clover - Fertiliser	Y
	Annual grass, clover - No fertiliser	Y
SA - Mount Gambier	Aust Phalaris, clover, annuals, Fertilised - Standard year	N
	Annual grass, clover, Not fertilised - Standard year	N
	Lucerne, Fertiliser - Standard year	N
	Perennial ryegrass,clover, Fertiliser	Y
SA - Lucindale	Aust Phalaris, clover, annuals, Fertilised - Standard year	N
	Lucerne, annuals, fertiliser - Standard year	N
	Annual grass, clover	Y
SA - Keith	Aust phalaris, clover, annuals, Fertilised - Standard year	N
	Lucerne, annuals, Fertilised - Standard year	N
	Lucerne, No annuals, Fertilised - Standard year	N
	Annual grass, clover, fertiliser	Y
SA - Adelaide Hills Mt Barker	Phalaris, clover, annuals, Fertilized - Standard year	N
	Lucerne, annuals - Standard year	N
	Perennial ryegrass, clover, Fertilised - Standard year	N
	Annual grass, clover	Y
SA - Fleurieu Peninsula (Inman Valley)	Perennial grass, clover, No fertiliser - Standard year	N
	Phalaris, clover, annuals, Fertilised - Standard year	N
	Lucerne - Standard year	N
	Annual grass, clover	Y
SA - Fleurieu Peninsula (Mt Barker)	Phalaris, clover, annuals, Fertilised - Standard year	N

SA - Kangaroo Island - Parndarna	Annual grass, clover, Fertilised - Standard year	N
	Annual grass, low clover, Not fertilised - Standard year	N
	Kikuyu, clover, annuals, Fertiliser - Standard year	N
	Lucerne - Standard year	N
	Perennial ryegrass, clover, Fertilised - Standard year	N
SA - Mallee - Lameroo	Medic, annuals - Standard year	N
SA - Mid North- Roseworthy	Medic, annuals - Standard Year	N
SA - Mid North - Crystal Brook	Medic, annuals - Standard year	N
SA - Mid North - Booborowie	Medic, annuals - Standard year	N
	Lucerne, annuals, Fertilised - Standard year	N
SA - Eyre Penninsula (Minnipa)	Medic, annuals - Standard year	N
SA - Eyre Penninsula (Koppio)	Cocksfoot, clover, annuals - Standard Year	N
SA - Yorke Penninsula (Minlaton)	Medic, annuals - Standard year	N
WA - West Midlands (Dandaragan, Gingin)	Annual grass & weeds, clover - Standard year	N
WA - West Midlands (Irwin)	Annual grass & weeds, clover - Standard year	N
WA - West Midlands (Moora, Three Springs)	Annual grass & weeds, clover - Standard year	N
	Lucerne	Y
WA - Central (Northam)	Annual grass & weeds, clover, No fertiliser - Standard year	N
	Lucerne	Y
WA - Southern (Bussleton)	Annual grass & weeds, clover, Fertiliser - Standard year	N
WA - Southern (Boyup Brook)	Annual grass & weeds, clover, Fertiliser - Standard year	N
WA - Southern (Katanning, Lake Grace, Narrogin)	Annual grass & weeds, clover, Fertiliser - Standard year	N
WA - Southern (Manjimup)	Annual grass & weeds, clover, Fertiliser - Standard year	N
	Lucerne - Standard year	N
	Kikuyu - Standard year	N
WA - Southern (Plantagent, Mt Barker)	Annual grass & weeds, clover, Fertiliser - Standard year	N
	Lucerne	Y
	Kikuyu	Y
WA - Southern (Wellstead)	Annual grass & weeds, clover, Fertiliser - Standard year	N
	Lucerne	Y
	Kikuyu	Y
WA - Southern (Ravensthorpe, Esperance)	Annual grass & weeds, clover, Fertiliser - Standard year	N
	Lucerne	Y
	Kikuyu	Y
QLD - St George	Sown grass	Y
	Native grass	Y
	Forage sorghum	Y
	Lablab	Y
	Lucerne	Y
	Oats	Y
QLD - Roma	Sown grass	Y
	Native grass	Y
	Forage sorghum	Y
	Lablab	Y

	Lucerne	Y
	Oats	Y
QLD - Goondiwindi	Sown grass	Y
	Native grass	Y
	Forage sorghum	Y
	Lablab	Y
	Lucerne	Y
	Oats	Y