final report

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Prepared by: Greg Bender
AbbotlInnovation Pty Ltd

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Meat and Livestock Australia Limited
Locked Bag 991
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Priorities for Improving Pasture Persistence Workshop Report

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9.30am to 4.00pm, 15 December 2011, Mercure Hotel, Sydney Airport

BACKGROUND & CONTEXT

MLA is running a series of workshops to inform and develop the MLA Feed-base Investment Program.

The persistence of desirable pasture species – in mixed pastures and under grazing - has been identified by MLA surveys as one of the most important issues for red meat producers. Consequently, persistence is also a factor in the selection of species/varieties for re-sowing pastures.

Two discussion papers have been drafted to investigate the issue of pasture persistence as a potential area for research investment:

1. Exploring the Issue of Pasture Persistence (a background paper)
2. Developing MLA Investments to Improve Pasture Persistence (including a straw man for discussion)

PURPOSE OF THE WORKSHOP

Both discussion papers were circulated to participants before the workshop. Participants were asked to:

1. Check and confirm the findings and ideas contained in the background paper and make the necessary changes to ensure it is an accurate description of the pasture persistence issue
2. Test the Straw Man paper towards developing priority research areas for MLA to consider as potential investments within their Feed-base Investment Program.

The desired outcome from the workshop was a Research Plan and Project Outlines that are sufficiently detailed to allow MLA and partners to agree in principle to a project and to move immediately to contracting. MLA needs to identify who are the key R&D groups that need to be involved and where are the locations for strong producer interest in participatory R&D opportunities.

DEFINING PASTURE PERSISTENCE: Producer perspectives

For red meat producers pasture persistence occurs when the preferred pasture species or mix of species dominates and persists over time in a nominated area. The period of

persistence should extend for the required interval without the need to re-establish the pasture during this time.

Comments from Participants

- Pasture establishment and management in year one are critical for success. Going back to re-sow reduces the bottom line.
- District agronomists are surprised at the lack of producers who do NOT do the economics
- How do we reduce the cost of pasture establishment as well as reduce the cost of pasture failure?
- The “payback period” needs to be better defined. Include opportunistic returns as well as costs because producers are seeing returns in less time than the EverGraze calculator may suggest
- Weed control from establishment needs greater attention
- Pest and diseases can greatly influence pasture persistence
- Persistence of the legume content in mixtures is critical
- Preparation for sowing a new pasture is critical. A paddock should be prepared two years before sowing. Management pre-sowing is as critical as post sowing
- There is a constant trade-off between persistence and income
- Software is available to assist decisions
- The number one decision is selecting the right plant genetics
- Stocking rate continues to be a management issue, especially in relation to phosphorous fertility

DEFINING PASTURE PERSISTENCE: Research perspectives

The persistence equation

Within the discussion papers, pasture persistence is broken down into the following component parts with the nominated weightings for importance.

Persistence = 50% management + 30% plant selection + 15% environment + 5% genetics

Comments from participants: The equation weightings are not correct. Plant selection should be number one, management and genetics are an equal second, and environment is third. Also, the weightings will change based on the circumstances. Environment is changeable and has to be managed within the season.

Other models for persistence

CSIRO PI has developed a cumulative stress model for persistence. The core assumption is that persistence is a function of total plant stress. Any pasture will persist if sown in the right

place and carefully nurtured. However, if stress is applied, the degree to which a plant will persist is compromised. The occurrence of one stress, for example reduced soil moisture, may be tolerated but the addition of other stresses such as pest or disease pressure or overgrazing will lead to a total stress level that is beyond the resources of the plant. When this happens, the plant will reach a point where it will not persist. The model can be used as a tool to analyze pasture persistence as a function of cumulative plant stress for any given pasture mix and situation. Using the cumulative stress model it is possible to consider each component of the persistence equation, separately. Perhaps we need a 'persistence tool' to calculate the tally of all the contributing factors.

Comments from participants: A decision tree model is a better approach. Depending on plant genetics, the other factors, such as grazing or soil fertility will influence persistence. The decision tree can be used to identify the big issues district by district.

TESTING THE STRAW MAN

The purpose of this session was to determine the extent to which workshop participants are comfortable with the straw man. The question for the workshop is:

Does the straw man include all the issues that are important and that you have brought to the workshop to be addressed and included in the Research Plan if the workshop deems them important enough?

The rationale for selection of the nominated research areas is covered in detail in the Straw Man discussion paper "Developing MLA Investments to Improve Pasture Persistence".

The Straw Man: Nominated Research Areas for discussion

Research Area One	Knowledge management and communication
Research Area Two	Better measurement of persistence
Research Area Three	Understanding pasture persistence
Research Area Four	Improving the persistence of phalaris
Research Area Five	Improving the persistence of sub clover
Research Area Six	Improving the persistence of medic
Research Area Seven	Improving the persistence of legumes in SE Queensland

Comments from participants

Communication

- Harvest anecdotal information / experiences from farmers and advisors and get that into the information that goes out with seed sales
- We should formalize anecdotal evidence rather than collect hearsay and put it out as fact
- Draw on local experiences of producers who have had success
- Include case studies by regions with economics and methodology (what were the major factors that had contributed to their success?)
- The end game in persistence is performance on farm
- NVT does give some information but not mixed swards and not for grazing
- Communication must be driven by the intended purpose of the pasture. By selecting purpose, the information received will be focused and useful
- The benefit, bother, risk equation needs to be addressed
- Estimate the value of good pastures
- Persistence is a function of …..
- Getting the right plant is critical; getting the right companions
- Establishment process is the key to persistence
- Post establishment management (manage multiple stresses, react to led indicators)

<u>Genetics</u>

- We need to understand interaction of G x E x Management. There are still gaps
- Progressing the genetics of persistence will require the collection of accurate phenotypic information
- What do persistent phenotypes have in common, can we have a predictive phenotype?
- Genotype lines then intensively phenotype as much as possible, then match the two areas
- Phil Nichols can see the value of genotyping to assist breeding in sub clover
- John Forster to work with breeders on the matching of genotypes and phenotypes
- Richard Culvenor can use markers and improved processes in phalaris breeding
- MAS should be explored, but we must have the phenotype
- Exploring traits that contribute to persistence is more important than finding the “persistence gene”, in other words, seek to address the stresses
- Markers for pest and disease resistance would be useful
- Felice Driver, sow a range of cultivars, identify alleles that differ, genotype and monitor to identify what contributes to persistence
- Link NVT and genotype and have anecdotal evidence about performance of those varieties as well as meta data
- Dream experiment: New variety, restricted genetic base (limited parents; sow many paddocks and regions, graze and monitor overtime). Sampled original populations – need baseline. However, need to consider what sort of management is applied in the long term trial (sward, grazing, fertilizer, etc)
- Select only the key species (annual legume, a grass) for genetics
- Find a way of gaining phenotypic information to inform genetic information

- Develop markers for various persistence species for key species.

National Variety Trials

- Run the NVT longer to generate persistence information
- A grazing approach is more relevant than cutting
- Input is required from John Forster and Felice Driver on NVT
- Anecdotal evidence is very valuable
- Controlled experiments but limit stresses to look at one variable only

The “ecology of phalaris persistence” experiment conducted by Richard Culvenor

- Can this be expanded and linked with the MAS?
- Phenotypes are required from a broader region
- Variety testing must go for six years (after established) to be done in combination with other activity
- Are there ways we can get an indicative answer in a shorter time ? (like the heavy grazing approach with lucerne to force differences sooner)
- Set up this type trial over several locations with different species as an adjunct to NVT (eg phosphorous difference, management difference)
- New varieties benchmarked against those in the current trials

Does the Straw Man cover all the issues regarding persistence?

- Dry-land lucerne is important, not just perennial grasses and annual legumes
- Understanding persistence is the only area which is truly a research issue
- Is it possible to introduce a ryegrass endophyte into phalaris?
- The persistence of rhizobia for legumes is also an issue not be forgotten
- The sowing of mixtures will provide relevant information
- Farmers would take a reduction in productivity to get an increase in persistence
- Rainout shelters can be used to simulate drought
- Pull apart multiple influences, for example varieties x stocking rate x phosphorous level
- Differences are observed between varieties but we do not understand why. We need more understanding of why something is happening
- Management guidelines are required to allow producers to remain in the envelope even with changes between seasons
- Lead indicators would be useful so producers can avoid being stuck with a lot of sheep in a dry season, for example. Indicators would help decide what paddocks (with various mixes) need specific management (eg stop grazing paddock A, paddock B is okay, etc
- Simple management processes, done right on time, are an effective strategy. These need to be demonstrated clearly and communicated
- Persistence requires compatibility between varieties in the pasture mix (sward)
- Each district will have different issues with different species
- Define the persistence issue and drill down to develop workable solutions

- Once a decision is made on a species, it is too costly to go back and start again. The producer is committed to managing this pasture for at least (say) five years.

PRIORITY RESEARCH AREAS IDENTIFIED BY THE WORKSHOP

Workshop outcomes: Nominated Research Areas

Research Area	Focus	Outputs	Agencies
1. Communication	Pasture "purpose" defines information selected	Website & app. Case studies supported by structured comparison of genotypes Build in "stress model", "decision tree" & "pasture picker"	Lead agency & external specialist
2. Perennials	Genetic tool box Traits Faster evaluation	New varieties based on superior parent material Faster evaluation and release	CSIRO, DPIs, SARDI, TIAR, UA
3. Annuals	Genetic tool box Traits Faster evaluation	New varieties based on superior parent material Faster evaluation and release	DAFWA, SARDI, DPIs
4. Mixtures	Survival of legumes in mixes with grasses	A pasture legume for buffel grass A pasture legume for kikuyu	DEEDI, DAFWA, SARDI

Notes on changes made to the Straw Man

- Research Area One, no change, communication remains a top priority.
- Research Area Two, perennials, combines the following areas from the Straw Man: Better measurement of persistence (2); Understanding pasture persistence (3); Improving the persistence of phalaris (4)
- Research Area Three, annuals, combines the following areas from the Straw man: Better measurement of persistence (2); Understanding pasture persistence (3); Improving the persistence of sub clover (5); Improving the persistence of medic (6)
- Research Area Four, Mixtures, is a new priority area which includes the improvement of persistence for legumes in mixes with tropical and temperate grasses (7)

CONCLUSIONS

The success of the red meat industry in Australia is testament to the outstanding efforts of producers, agronomists and researchers. A major driver has been the adoption of

introduced pastures supported by new agronomic practices and ongoing breeding programs.

Persistence of exotic pastures under Australian conditions has always been important. The issue is that persistence is now even more important because of a combination of current circumstances including the viability of the farm business, the cost-price squeeze, and unreliable rainfall. Producers have been adjusting to a decline in their terms of trade for decades. Sowing a new pasture is expensive and persistence is required to recover the expense of pasture establishment. In many cases, more than five years is required before the investment starts to pay off. The costs of soil preparation, seed, chemicals, machinery and labour are well known. Less well understood is the opportunity cost of lost production during the establishment phase and the cost of failure if a pasture does not establish.

Pastures that can provide sufficient feed when it is needed and persist through droughts are more profitable. Producers need to maintain production without the cost of re-sowing. Pasture persistence requires the selection of the right plants and good management of grazing, plant nutrition, weeds, pests and diseases. Selection of the right plants is critical, however, selection will become the major driver if producers can choose far superior genetics in new varieties.

RECOMMENDATIONS TO MLA

There are good reasons why red meat producers place persistence at the top of their list of priorities for pastures. To provide red meat producers with “more of a good thing” to meet future challenges, the following research investments are recommended for consideration by MLA.

Note. Recommendations for projects in pasture persistence will be considered within the context of the overall investment portfolio for the Feed-base Investment Plan.

Rationale

Understanding the genetics of persistence (Priority Two) has been re-established as a separate Research Area. This area is fundamental in bringing about significant genetic gain for plant breeding for persistence in Perennials (Priority Three) or Annuals (Priority Four). In addition, genetic tools for accelerated measurement or prediction of gains in persistence are a high priority.

The persistence of mixtures has been removed as a research priority. The identification and evaluation of legumes to keep pace in mixtures with buffel grass or kikuyu is being considered in other MLA research programs. The persistence of mixtures in temperate regions is a complex and multi-faceted topic perhaps better left to agronomy and grazing management within the Feed-base Investment Plan.

Priority One **Communication of knowledge and experience**

There is ample evidence demonstrating both good and poor persistence for the same species/varieties and mixes on farms across all key red meat production regions in Australia. This observation suggests considerable variation in pasture management expertise and professional advice.

Therefore, there is an immediate opportunity to improve the overall level of pasture persistence through the pooling and communication of collective knowledge and experience. Access to the pool could be made through a website or application. The initial points of entry should be the "purpose" of the pasture, the type of enterprise ( ) and the region where the farm is located.

The collection, collation and communication of knowledge and experience should be managed by an agricultural extension specialist. It is recommended that specialist advice on suitable communication models be obtained from inside or outside the pasture industry. MLA should take advantage of advances already made in other industries

The "shop front" in regions could be local agronomists. The experience of the Agricultural Merchandise industry shows that producers prefer face-to-face contact at a local level. Agronomists would be selected by MLA for training and accreditation in the scheme. The scheme should be branded. The incentive for agronomists to be involved could be exclusive access to the information pool to differentiate their service offering from local competition.

Project management:	Open tender to appoint external expertise in similar models
Project duration:	Two years (July 2012 to June 2014)
Budget:	$150,000

Priority Two **Understanding the genetics of persistence**

Our present understanding of persistence is defined by observations on farms, management strategies, performance of species/varieties over time and the selection of desirable phenotypes for breeding purposes. In addition, there is some knowledge of the physiology and biochemistry of persistence.

Our understanding of the genetics of persistence is very limited, particularly for the most widely adopted pasture species in Australia. Understanding can lead to rapid advances, the rationale being that a detailed understanding of a process or phenomenon enables manipulation of same for defined purposes. With persistence identified as a top priority by producers there is justification to explore the genetics of pasture persistence in more detail.

In terms of potential impact for red meat producers, the project should focus on understanding the genetic basis of:

1. Persistence under drought or tolerance to low soil moisture and heat stress
2. Persistence under grazing pressure, particularly during times of drought
3. The rapid evaluation or prediction of persistence under field conditions to reduce the need for 5-10 year field trials

Specific addition of traits conferring persistence such as acid tolerance or resistance to a specific pest or disease should be addressed in the breeding projects under priorities three and four.

Project management:	Commissioned with lead agency (DPI Victoria and others)
Project duration:	Three years (July 2012 to June 2015)
Budget:	$750,000

Priority Three **More persistent perennial pastures**

Project Three needs to work closely with Project Two to develop highly persistence parent material for breeding programs. The preferred species for attention are phalaris and cocksfoot. Phalaris has a reputation for persistence under good management through drought but there is room for improvement. The case for cocksfoot will require an evidence-based assessment to justify allocation of funds.

Methodologies have been developed to identify and quantify the expression of drought tolerance traits. Pre-breeding work needs to be done with a wide range of germplasm to lay the foundation for development of future cultivars of greater resilience and persistence. This project will use the germplasm lines identified as parents to then develop more resilient, persistent pasture cultivars. And the addition of traits such as acid tolerance and grazing tolerance to highly persistent parent material would increase adoption of this useful species into other regions.

Summer dormancy appears to be the trait that confers the greatest level of drought tolerance and survival. However, there are other strategies. Dehydration avoidance includes deep rooting and/or the ability to close leaf stomata when soil water is limiting. Dehydration tolerance (rather than avoidance) is associated with the ability to withstand a greater degree of internal cellular dehydration. Substantial variation for dehydration tolerance has been demonstrated within any one perennial grass species.

From a producer perspective, dehydration avoidance and dehydration tolerance have advantages over summer dormancy. Plants can still grow after rain should it fall in summer. Pre-breeding activities to identify and quantify the level of summer dormancy, dehydration avoidance and dehydration tolerance will feed into breeding programs to ensure the future availability of pasture grasses well-adapted to climate variability and change.

Perennial grass species in the tropics and sub-tropics already have a high degree of persistence. Notable examples are buffel grass in Queensland and kikuyu in south-west Western Australia.

Project management: Commissioned with lead agency (CSIRO PI and others)
Project duration: Three years (July 2012 to June 2015)
Budget: $600,000

Priority Four **More persistent annual pastures**

Project Four needs to work closely with Project Two to develop highly persistence parent material for breeding programs. The preferred species for attention are sub clover and medic. However, other annual legumes may assume priority depending upon evidence-based assessments of potential market impacts.

Annual legumes generally escape drought by restricting their growth and reproduction to those times of the year when moisture is not limiting. Therefore selection of the correct flowering time and level and rate of breakdown of hard seed has been central to developing sub clover and medic cultivars well adapted to the range of Australian rainfall zones.

The challenge for annual legumes is to increase content in pasture mixes. Low content has lead to low legume dry matter production and reduced nitrogen fixation. The situation has arisen because of the general rundown of seed reserves in soil, false breaks in summer and prolonged droughts. The situation is exacerbated by poor pasture management, particularly in cropping enterprises where pastures are a low priority.

Increasing the level and stability of the seed bank is a top priority. Greater and more reliable seedling regeneration densities at the right time of year will deliver improved persistence for annual legumes.

There is an urgent need for productive and persistent legumes to keep pace in mixtures with buffel grass and kikuyu in Queensland and south west Western Australia, respectively. This issue is under consideration in other areas of MLA investment.

Project management: Commissioned with lead agency (DAFWA and others)
Project duration: Three years (July 2012 to June 2015)
Budget: $600,000

PARTICIPANTS

Name	Organisation	State	Sector	Email
Jake Howie	SARDI	SA	Public	jake.howie@sa.gov.au
John Forster	DPI	Vic	Public	John.forster@dpi.vic.gov.au
Richard Culvenor	CSIRO	ACT	Public	richard.culvenor@csiro.au
Richard Simpson	CSIRO	ACT	Public	richard.simpson@csiro.au
Mark Norton	NSW DPI	NSW	Public	mark.norton@csiro.au
Steve Clarke	DPI	Vic	Public	steve.clarke@dpi.vic.gov.au
Phil Nichols	DAFWA	WA	Public	phil.nichols@agric.wa.gov.au
Rob Shea	Farmer	Vic	Private	vadin@netconnect.com.au
Morgan Sounness	Farmer	WA	Private	tamgaree@bigpond.com
Greg Bender	Facilitator	ACT	MLA	gregbender@grapevine.com.au
Warren Mason	Consultant	NSW	MLA	warren@rpcsolutions.com.au
Cameron Alan	Manager	NSW	MLA	callan@mla.com.au
Felice Driver	Manager	NSW	MLA	fdriver@mla.com.au