

# final report

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## **Perennial grasses in pasture production systems: The 2013 Symposium by the Australian Grasslands Association**

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## **Abstract**

A symposium held in Canberra during May 2013 on perennial grasses in pasture production systems was the second in a series of regular technical events organised by the Australian Grasslands Association. This technical symposium brought together leading scientists and pasture experts to deliver a structured, broad based review of the main issues affecting perennial grass performance under livestock grazing via a symposium which includes invited review papers on specific topics.

The project aimed to develop a set of recommendations and priorities for future investment in perennial grass improvement and management for livestock industry investment by the public and private sector, including RDCs. These priorities will be useful for future government and private sector prioritisation of investment into pastures R&D.

The sentiments established during this symposium are being developed into a paper that will be published along with papers presented in a special edition of CSIRO's Journal of Crop and Pasture Science, in late 2013. Abstracts of papers presented at the symposium and full poster papers are available in the proceedings of the symposium.

## Executive summary

The Australian Grasslands Association is a partnership between three farmer-driven organisations: the Grassland Society of Southern Australia, the Grassland Society of New South Wales and Evergreen Farming of Western Australia. The Association's goals are to increase the involvement of those organisations with the scientific community by providing a forum through which current research can be published. One of the most important roles of this Association is to act as a conduit for feeding that research back into the farming sector (via the partner organisations).

Following on from the successful 2012 Australian Legumes Symposium, this event brought together key researchers and scientists from both the private and public sectors and provided a forum for current research within the perennial grasses area to be presented and debated and for ideas to be exchanged.

This symposium was attended by around 80 people, with a roughly even split between the public and private sector.

A number of papers were invited by the organisers of the symposium to review the topic area or specific areas of research, these included:

- A review of the introduction, use and development of perennial grasses in southern Australia
- Assessment of the economics of pasture production and persistence
- Recent research projects on a management approach to pasture productivity and persistence
- A review of the contribution of endophyte-infection to grasses in Australia
- Reviews of the use of tropical perennial grasses in sub tropical and temperate dairy and sheep/beef production systems and their potential for expanded use
- Economic-based methodology for valuing grass variety traits and productivity
- A review of themes and new approaches to perennial grass breeding
- Traits of importance for adaptation to future warmer and drier environments
- Updates on molecular tools and biotechnology innovations to support grass breeding and advancement.

Further, a number of papers were contributed by the scientific community addressing native pastures, breeding advances and research into specific species and traits and methodology for valuing the genetic gain of perennial grasses.

It was an important observation that other than the invited papers from Garcia and Moore (see Appendix 2), no additional papers on tropical perennial grasses contributed to the event. This may have been an indictment on how the symposium was pitched or inferred by the location or the fact that we can no longer include the Australian Tropical Grassland Society, because it has been disbanded.

One of the important outcomes of this symposium was a feedback session that was held on the final day of the event from which a set of recommendations for future research directions will be synthesised. This was structured as a survey in which 25

propositions were developed by delegates and the audience recorded an anonymous vote about their level of agreement or otherwise.

Propositions ranged across specific areas including species-based examples like “phalaris breeding has run its course” or trait-based propositions such as “persistence has been over emphasised as a trait in grass improvement”. Others addressed funding partitioning examples such as “the gap between potential and average farm performance means that we can substantially reduce investment in pastures research” while others probed industry issues including that “the increase in number of cultivars available has been of little benefit to the livestock industries.”

This survey will support those public and the private sector organisations that are investing in research or development of perennial pasture grasses to prioritise areas that are considered to be important by the leaders of the scientific community. That benefit will flow through the red meat sector

The results from this survey are being developed into a paper that will be published along with the presented papers in a special edition of CSIRO’s Journal of Crop and Pasture Science, later in 2013. The proceedings of the symposium containing abstracts of presented papers and full poster papers are available on the Australian Grasslands Association web site. [www.australiangrasslands.org.au](http://www.australiangrasslands.org.au)

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## 1. Background

The Australian Grasslands Association charter is to run a series of technical symposia to provide a forum for industry participants to review pasture R&D on a regular and recurring basis, and to make recommendations as to the future directions of investment in this space.

The landscape for pasture R&D funding is changing. As the public/private dynamic evolves (viz. intellectual property and value capture of public vs. private benefit) there has been an increasing focus on strategic decision-making around the way in which funding priorities are set. Couple that with a dwindling supply of graduate and post graduate students and an aging (and declining) population of pasture scientists and the result has been that pasture research appears to be increasingly conducted in isolated pockets with a corresponding decline in exchange of ideas. There are limited opportunities for within- and cross-discipline interaction by researchers who are increasingly scattered amongst different institutions and employers and often funding and/or time constraints further inhibit this activity. There is also an increasing tension between researchers' desire to publish and their need to complete projects and find the next source of funding, which results in less science being published.

This makes it difficult for the pasture industry to present a clear, well-grounded and broadly supported message about what the research priorities and funding directions should be.

In order to help meet the demand for food and changing social and climatic conditions we need to continue developing the pasture industry at a higher rate of improvement and in a more efficient manner. The Australian Grasslands Association proposed that a regular, structured, wide-ranging and critical review of the pasture industry can assist in that objective, taking into account past priorities and activities, the current status of research, the successes and failures and where we need to go next.

The purpose of this research project is therefore to create and document a regular series of symposia in which pasture industry participants can self-review and debate the issues faced. Further, the project will rotate through a range of topics, the goal being to provide regularity in these reviews and the ability to re-evaluate priorities.

To do this we intend to harness the collective power of the relevant scientific community in a series of symposia that enables them to contribute directly to the review of the industry, the development of industry wide investment priorities and make recommendations for the research agenda

## 2. Project objectives

This project will deliver a structured, broad based review of the main issues affecting perennial grass performance under livestock grazing via a symposium which includes invited reviews. This review will contribute to the long-term evaluation and review of MLA's Feedbase Investment Plan.

### **By 20th Feb 2014:**

1. Completed a structured, broad based review of the main issues affecting perennial grass performance under livestock grazing via a symposium which includes invited reviews. The review will include:

- Previous research
- Current research
- The challenges, gaps and market failures and their significance
- The opportunities and priorities for ensuring on-going, efficient and effective improvement in the grazing industries and the delivery of improved returns to end users of the technology.

2. Published review paper/s in a reputable, peer reviewed journal.

### **3. Outputs of the project**

A structured, broad based review in the format of a technical symposium that addressed the main issues affecting perennial grass performance under livestock grazing. The symposium included invited reviews and contributed papers.

The perennial grasses symposium was to have the following outputs:

- An actual symposia which will provide an opportunity for face-to-face interaction of industry participants, sharing of ideas and opportunities for private meetings
- A series of invited papers reviewing and summarising the objectives of the symposia in the context of perennial grass management
- A synthesis of participant's opinion regarding future investments in perennial grass management, research, development and extension.

The invited reviews addressed

- Previous research in the titled area
- Current research
- The challenges, gaps and market failures and their significance
- The opportunities and priorities for ensuring on-going, efficient and effective improvement in the grazing industries and the delivery of improved returns to end users of the technology.

Review papers presented at the symposium and the synthesis paper will be published in a reputable, peer reviewed journal. This will be in a special edition of the Australian Journal of Crop and Pasture Science.

### **4. Methodology**

Unlike the Grassland Society conferences which are farmer-focussed, Australian Grasslands Association events cater specifically for the scientific community by bringing together key researchers and scientists from both the private and public

sectors and providing a forum for current research within the topic area to be presented, debated and published and also for ideas to be exchanged.

There are several opportunities for pasture-related research to be presented and published within Australia. This symposium is somewhat unique, as its topics are specifically within the pastures space; topics to date have been legumes (2012) and perennial grasses (2013). Additionally one of the most important roles of this Association is to act as a conduit for feeding that research back into the farming sector (via its partner organisations, government and private sector extension providers).

The event used a conventional conference structure for most of the program with presentations by invited and contributed speakers with question time after each presentation.

However a feedback session was held in the final theme of the event from which a set of recommendations for future research directions will be synthesised. This was structured as an anonymous survey of delegates in which 4 areas of demographics were collected (age, employment sector, location and gender) before the audience recorded an anonymous vote signalling their level of agreement or otherwise on 25 propositions. Propositions were developed from comments and questions which were posted on a board in the venue by delegates during the symposium.

Responses by delegates were recorded on a 1-7 scale representing very strong agreement (1), strong agreement, agreement, undecided and the equivalent thresholds of disagreement down to 7 (very strongly disagree). Results were later analysed to determine the degree of consensus, such that questions with a low standard deviation demonstrated a profound degree of consensus.

## **5. Results and discussion**

There were 80 delegates in attendance at this symposium and based on the registrations database there was an even representation between employees of the public and private sectors.

The two day symposium that followed combined 24 invited and contributed presentations across seven themes with a number of high quality poster papers.

Themes for the symposium were:

- Perennial Grasses in Pasture Production Systems
- Developments and innovations in perennial grass agronomy and management
- Developments and innovations in perennial grass breeding
- Opportunities and roles for perennial grasses in a changing climate
- Quality and feed value in animal production systems
- What is the next quantum leap in perennial grass research?
- Australian perennial grass research – synthesis and future directions.



This final theme was one of the more important outcomes of this symposium as it constituted the feedback session from which a set of recommendations for future research directions will be synthesised.

This session was structured in two parts: firstly a summary of each session was provided by the relevant session chair, followed by a survey in which 25 propositions were developed from questions or statements posed to delegates, on which the audience recorded an anonymous vote about their level of agreement or otherwise. A full list of propositions developed by delegates is listed in Appendix 1

Propositions ranged across specific areas including species-based examples like “phalaris breeding has run its course” or trait-based propositions such as “persistence has been over emphasised as a trait in grass improvement”. Others addressed funding partitioning examples such as “the gap between potential and average farm performance means that we can substantially reduce investment in pastures research” while others probed industry issues including that “the increase in number of cultivars available has been of little benefit to the livestock industries.”

Further, several demographic questions were posed to assist weighting of any interpretation of responses. Drawing on data from the survey for which only 60 delegates were present, employment was variously from state departments of agriculture (25% of delegation), private companies (22%), private consultants (15%), the levy-funded Research and Development Corporations (15%), universities (13%), CSIRO (5%) and there were a handful of graziers present (5%).

Representation of Australia states was dominated by South Eastern Australia with delegates from Victoria (37%), New South Wales & ACT (37%). The other states Tasmania (5%), South Australia (4%), Western Australia (3%) and Queensland (3%), with the remainder from New Zealand. We are considering how to engage tropical agriculture from the Northern Feedbase who were not well represented. The mean age of delegates was 50-60 years and 90% were male.

The quality and depth of presentations was high and while the authors would like to outline the presented papers here, instead summaries of several of the invited review papers that were prepared for the event are given below. Where relevant, an appropriate proposition from the survey is quoted and responses outlined.

The opening presentation by Kevin Reed provided an important historical framework for the event by reviewing the introduction, use and development of perennial grasses in temperate Australian pastures and the groundswell in pasture science from the 1920s, through the subsequent era of agricultural growth which demanded pasture improvement to the modern era and proliferation of private plant breeding programs. The review also addressed the influences and enablers of that transformation.

Bill Malcolm from University of Melbourne gave an analysis of the economics of pasture persistence compared to pasture production, building some analysis around that question, which is commonly raised in pasture-related debates. Malcolm acknowledged that a range of assumptions had been made but highlighted that

pasture improvement represents a profitable use of additional capital on many farms and that persistence is a relatively minor determinant of pasture investment returns, despite there being little penalty associated with re-sowing pastures slower than the theoretical optimum rate. The delegation demonstrated a profound level of agreement to the proposition developed from this presentation that “we need to explore the balance between economic values of persistence versus short term productivity.”

Richard Rawnsley from the Tasmanian Institute of Agriculture presented outcomes from a multi-factorial trial which represented the first published assessment of the interactions between grazing management (interval and intensity), fertiliser and irrigation on pasture growth and tiller density hence persistence. An outline of the scale and significance of the interaction was given with some recommendations for grazing management to optimise both pasture biomass production and plant persistence. This presentation may have tempered the response to the proposition that “we know too little about the on-farm performance (yield, persistence) of perennial grass species/cultivars,” to which respondents demonstrated agreement, though with some dissent.

Yani Garcia’s presentation (University of Sydney) on the usefulness of kikuyu-based pastures was reflected by a high degree of agreement by delegates that “we are under utilising our current stock of available perennial grass species.” When considered with Geoff Moore’s (DAFWA) presentation on development of sub-tropical pastures in Mediterranean climates, the case for “...a bigger role for tropical grasses in temperate Australia” gained a moderate degree of agreement by delegates.

It is an important observation that other than the invited papers from Garcia and Moore, no additional papers on tropical perennial grasses contributed to the event. While a significant effort was made to attract contributions from research organisations working in regions in which those types of grasses are used, this may reflect the level of activity present in R&D in the northern half of the country or the locality of the symposium.

The speaker from Dairy New Zealand, David Chapman, who previously worked with the Victorian state Department of Primary Industries, presented on the development of a Forage Value Index (FVI) for New Zealand dairy farmers, which leverages information from the national pasture merit-testing program to provide an economically-based assessment of the relative merit of pasture varieties. This presentation outlined future plans for the FVI, which when reflected upon by the authors of this paper intends to address many of the propositions posed by delegates in this symposium. Importantly there was a very high degree of agreement that the Australian industry should “...collaborate with Dairy New Zealand and adopt an appropriately parameterised and tested FVI for Australia.”

Nick Roberts from the New Zealand crown-owned research institute AgResearch outlined a breakthrough in genetic engineering perennial grasses to increase animal performance by encapsulating plant oils in stable vacuoles within perennial ryegrass. In the same theme, CSIRO’s Helen Daily presented on high resolution and

throughput phenomics and the Victorian State Department of Primary Industries' Noel Cogan and Luke Pembleton respectively outlined the development of novel methodology using genomic and phenomic tools to support the next quantum leap in grass breeding. Despite these compelling scientific cases, there was a degree of uncertainty that "phenomics will deliver on-farm benefits over the next 15 years."

Florence Volaire from the French national research institute gave a very well received presentation via video link (Skype) on their European research program investigating the persistence and production of perennial grasses under droughts and heat waves, associated with climate change models. This program identified that a larger area in Europe under climate change will become more suitable for Mediterranean perennial grasses, but that there appears to be a lack of adapted cultivars for large areas of Europe.

Similarly Mark Norton's paper on the Australian experience in selecting grasses with greater tolerance to drought and heat appeared to divide the audience about it being "...better simply to change species than invest in improving heat and drought tolerance of perennial ryegrass," but garnered a moderate degree of strong agreement support of the "...need to understand the drivers of both yield and persistence to meet future pasture needs under climate change."

For other propositions, the degree of agreement varied from profound agreement on areas such as "...a need to develop a robust economic framework to help make decisions about investment for future R&D into grass development" through to quite low consensus levels on areas such as persistence being "...over emphasised as a trait in grass improvement." It is important to note that there was only a low level of correlation between the degree of consensus and the magnitude of agreement, disagreement or uncertainty of delegates' responses.

A full list of the presentations and posters is given in Appendix 2, and full results from the propositions survey are being developed into a paper that will be published along with the presented papers in a special edition of CSIRO's Journal of Crop and Pasture Science, later in 2013.

Proceedings of the symposium which contain abstracts of presented papers and full poster papers are available from the Association web site. [www.australiangrasslands.org.au](http://www.australiangrasslands.org.au).

## **6. Overall progress of the project**

This report represents the final report to MLA.

Consistent with the third milestone of this project, a full synthesis and discussion paper which draws on the summaries given by symposium session chairs and reports on the delegate responses from the propositions session will be published in a special edition of the Journal of Crop and Pasture Science along with presented papers from the symposium.

## 7. Recommendations and conclusion

The approach taken by the Australian Grasslands Association to present a pasture-focussed scientific symposium, providing an opportunity for research to be presented, peer-reviewed and published within a well-framed topic area appears to have been met with reasonable support from the industry. After two years of running events in this style there is a reasonable premise for events with this brief to continue operating and delivering those opportunities to the scientific community.

The event may have had a slightly different impact and responses in the proposition section if there was a higher representation of the farming community; there were 5% of respondents in the survey that identified as farmers and 15% as private consultants. However it is important to note that this event was pitched at the scientific community and the farmer-driven organisations (the Grasslands Societies and Evergreen Farming) along with public and private sector extension personnel and farm consultants are able to provide the farming community with extension messages.

However, the low attendance of private consultants was noted. One opinion expressed to the authors at the event (incidentally, the comment was made by a private consultant) is that the average farm consultant does not read the scientific literature, nor attend these kinds of events. Perhaps there is a way to increase the attractiveness or sense of relevance of this style of event to that sector, without diluting the scientific nature of the event.

The paucity of contributions on tropical grasses would ideally be addressed in the future to assist the pasture-based animal production industry from the northern half of Australia and its scientific community to benefit from the impact and relevance of this style of event. However the absence of papers is not due to an intentional focus on Southern Australia, or a lack of promotion of the event to potential contributors of papers. Perhaps it is reflective of the level of research activity in that space and the void left by the Australian Tropical Grasslands Society, though the authors are not sure which is the cause and which the effect.

Nonetheless, there appears to be enough interest from that segment of the pastures research community, and those in the temperate pasture zones of Australia for an ongoing program of regular, structured and wide-ranging and critical reviews addressing published science, current research projects, gaps in knowledge and opportunities for future research, for the momentum of this organisation to be maintained.

The challenge is to broaden the appeal to a wider audience and to ensure that all agro-climatic zones in which red meat and dairy is produced on pastures have access to participate in and, hopefully, the desire to benefit from this type of symposium.

## **In appreciation**

The Australian Grasslands Association would not have been able to deliver the symposium on perennial grasses in pasture production systems without the support of its sponsors Meat and Livestock Australia, Dairy Australia, AgResearch New Zealand, PGG Wrightson Seeds, Heritage Seeds, the Victorian Department of Primary Industries (with the Dairy Futures CRC and the Victorian AgriBioscience Centre) and the New South Wales Department of Primary Industries.

Further, the associates of the organisation, the Grasslands Society of Southern Australia, the New South Wales Grassland Society and Evergreen Farming, Western Australia make a valuable contribution by supporting and enabling the Association.

Finally, the symposium organising committee, who are the authors of this report, have worked very hard without personal financial gain to deliver this event.

## 8. Appendices

### Appendix 1: List of propositions posed to delegates

1	Phalaris improvement has run its course
2	Phenomics will deliver on farm benefits over the next 15 years
3	We should not alter the balance between breeding, agronomy and other science unless there is good evidence to do so - otherwise we risk large skill gaps in the future
4	Persistence has been over emphasised as a trait in grass improvement
5	It is better simply to change species than invest in improving heat and drought tolerance of PRG
6	Successful use of new technology in breeding will be held up by gaps in knowledge in ecophysiology
7	Perennial grass improvement should include evaluation with companion species
8	GrassGro needs to be updated to include parameter sets for modern cultivars and other species
9	We know too little about the on farm performance (yield, persistence) of perennial grass species/cultivars
10	We would be in a better position today in perennial grass improvement programs of the past had been maintained at the expense of ephemeral research programs (e.g. SGS) and CRCs
11	We need to understand the drivers of both yield and persistence to meet future pasture needs under climate change
12	The increase in number of cultivars available has been of little benefit to the livestock industries
13	RDCs should support private industry for 'maintenance' R&D/breeding of our main C3 species
14	There has been too much investment in PRG compared to other important perennial grasses in Australia
15	The gap between potential and average farm performance means that we can substantially reduce investment in research
16	Native grass improvement is not warranted - its all about management
17	Our models aren't able to predict persistence... more emphasis should be placed on understanding and predicting this
18	We need to explore the balance between economic value of persistence versus short term productivity
19	MLA and DA need to collaborate with DNZ and adopt an appropriately parameterised and tested Fvi for Australia
20	We know too little about the on farm performance of perennial grasses in terms of animal performance
21	There is a need to develop a robust economic framework to help make decisions about investment for future R&D into grass development
22	There is a bigger role for tropical grasses in temperate Australia
23	Seed production of cultivars of cocksfoot and other alternative species need to be addressed to improve their uptake
24	We are under utilising our current stock of perennial grass species
25	We (industry) have failed to achieve adequate adoption of improved grass species and their management.

## Appendix 2: List of presentation and poster paper titles

Theme 1: Perennial Grasses in Pasture Production Systems.		Chaired by Mark Norton
	Australian Grasslands Association	Robert Salmon
	Perennial grasses in temperate Australian pastures - their introduction, use and development	Kevin Reed
	Economics of pasture production and persistence	Bill Malcolm
	Ruminations of a Grassland Scientist	Hugh Dove
Theme 2: Developments & innovations in perennial grass agronomy and management.		Chaired by Phil Barrett-Lennard
	Quantifying the interactions between grazing interval, grazing intensity, and nitrogen on the yield and persistence of rain-fed and irrigated perennial ryegrass	Richard Rawnsley
	The potential of Kikuyu grass ( <i>Pennisetum clandestinum</i> Hoach ex. Chiov.) in modern beef and dairy pasture-based production systems: a review	S. Yani Garcia
	The development of sub-tropical grass based pastures in an Mediterranean environment	Geoff Moore
	Ecology of <i>Microlaena stipoides</i> in grazing systems of south-eastern Australia	Meredith Mitchell
Theme 3: Developments and innovations in perennial grass breeding		Chaired by Graeme Sandral
	Perennial Grass Breeding – continuing themes and new approaches	Syd Easton
	Recent advances in persistence traits in phalaris	Richard Culvenor
	High resolution and throughput phenomic screening technologies offer an opportunity to accelerate pasture breeding objectives	Helen Daily
	A phylogenetic framework for breeding cocksfoot	Alan Stewart
	Determining the value of genetic gain in perennial grasses	Kevin Smith
Theme 4: Opportunities and roles for perennial grasses in a changing climate		Chaired by John Ive
	Identifying perennial grass plant traits for future warmer and drier climates	Brendan Cullen
	Selecting pasture grasses for greater tolerance to drought and heat	Mark Norton
	Water-use efficiency of winter active and summer active pastures and binary mixtures	Malcolm McCaskill
	Persistence and production of perennial grasses under droughts and heat waves	Florence Volaire
Theme 5: Quality and feed value in animal production systems		Chaired by Joe Jacobs
	The interaction between plant physiology and pasture feeding value – The DairyNZ Forage Value	David Chapman

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	Agronomic advances to endophyte-infected grasses in Australia	David Hume
	New insights into the clinopathological mechanisms and presentation of perennial ryegrass toxicosis in Australian	Martin Combs
Theme 6: What is the next quantum leap in perennial grass research?		Chaired by Mike Stephens
	Genomic Selection of Forage Grasses	Noel Cogan
	Precision agriculture innovations for perennial grass management	Mark Trotter
	Advanced Phenomics and Genomics-Assisted Breeding of Ryegrass	Luke Pembleton
	The Good Oil – Engineering the Accumulation of Triacylglycerol in Ryegrass	Nick Roberts
Theme 7: Australian perennial grass research – synthesis and future directions		Chaired by Stuart Kemp
	Summaries, highlights and discussion from each session	Presented by session chairs
	Propositions session	Jim Virgona
Poster Papers		
	Twenty years of searching for an alternative temperate grass species for low to medium rainfall environments in Tasmania	EJ Hall, AM Hurst, RR Reid
	The removal of <i>Lolium rigidum</i> from newly sown perennial grass seed crops with different selective grass herbicides	A Leddin
	Potential of common wheatgrass, <i>Elymus scaber</i> , to hybridise with wheat and produce a perennial cereal species	M Newell, R Hayes, J Virgona, P Larkin
	The effect of sowing binary mixtures of perennial pastures on their establishment and density in the first two years	MC Raeside, R Behrendt, SG Clark, C MacDonald, A Byron, M McCaskill, N Mathers
	Persistence of perennial pastures subjected to rotational grazing and different livestock systems: results from a long term experiment	MC Raeside, R Behrendt, SG Clark, C MacDonald, A Byron
	Seasonal variation of the ergot-alkaloid, ergovaline, in perennial ryegrass ( <i>Lolium perenne</i> ) infected with standard and novel endophyte	D Mason, RD Hill, MG Norriss, L Walker, JC Sewell
	An improved method for recovering and quantifying neurotoxic alkaloids from endophyte-infected ryegrass	PA Weston, JC Quinn, LA Weston