Grassland Society of NSW Inc

Newsletter

Another year over and as I seem to say every year - where does the time go? It only seems like yesterday that it was September!

This issue of the newsletter we see a return to a 16 page format - thank you to those who contributed or assisted with articles - I hope you enjoy the diverse range of articles.

In this newsletter we have a very interesting and topical paper by Dr Tim McLaren from the University of Adelaide on "Improving phosphorus efficency in pastures" (page 2). This paper looks at the short- and long-term fate of phosphorus fertiliser in pasture and the results might surprise you.

We also have a report on the last of the successful Grassland Society of NSW Pasture Updates for 2015 - held at Mandurama in September (page 6). Keep your eye on the website for upcoming Pasture Update events near you in 2016.

We also conclude the two part article on Number and nitrogen fixation capacity of rhizobia in soils (page 10). Other interesting topics include detector dogs for find weeds, the potential of desmanthus and a report from a field day supported by the Grassland Society of NSW in the Hunter.

As always I am on the lookout for papers, articles, letters or ideas for articles so if you have any thoughts please let me know - the best way to contact me is by email at carol.harris@dpi.nsw.gov.au The deadline for submissions for the next newsletter is February 26 2016.

Once again mother nature in 2015 has been kind to some, but not so kind to others - our thoughts got out to the many affected by bush fires recently. I wish you and your families a Merry Christmas and a happy and year full of good seasons in 2016.

Carol Harris

Editor

In this newsletter

ANNUAL CONFERENCE GOES BIENNIAL

After much deliberation it was decided at the most recent state branch committee meeting (November) to change from an annual conference to a biennial conference with no conference to be held in 2016.

This decision was not taken lightly and member feedback was taken into consideration. The conference is an important event in the Grassland Society of NSW calender, and will remain so, but as it is harder to resource the conference each year - both in terms of people to run the event and securing funding - it was decided to hold a conference every two years. The next Grassland Society of NSW conference will be held in 2017.

Feedback from members in recent years has indicated that you would like to see more regional and local activities/events - we believe that the Pasture Update Series around the state ticks this box and we will be concentrating on bringing you more of these activities in 2016. Keep an eye on the website for Pasture Update events near you.

Improving phosphorus efficiency in pastures

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Abstract: Fertiliser phosphorus and leguminous pastures are important components of many pastures in the high rainfall zone of south-eastern Australia. However, the fertiliser phosphorus-use efficiency of leguminous pastures is not known. This paper provides a brief overview of research findings that identify the fate of fertiliser phosphorus in pastures over the short- and long-term. Over the long-term, the majority (approximately 85 per cent) of fertiliser phosphorus that was applied to pastures could be recovered in the 0–20 cm soil layer. However, over the short-term, a large proportion (up to 50 per cent) of the fertiliser phosphorus could be recovered by subterranean clover pastures in the year of application. This suggests that much of the applied fertiliser phosphorus is available to pastures but is subsequently returned to the soil surface (e.g. plant decay/trampling and animal faeces/urine). In general, the highest pasture production and recovery of fertiliser phosphorus by clover pastures occurred when fertiliser phosphorus was applied to the soil surface early in the growing season and with an initial soil phosphorus fertility that was maintained at the agronomic optimum level for pasture growth.

Background

For over 100 years, the application of fertiliser phosphorus (P) to leguminous pastures has been a successful strategy for high pasture production in the high rainfall zone of south-eastern Australia (Schefe *et al*. 2015). This strategy has generally involved the application of single superphosphate to the soil surface of pastures containing subterranean clover at a rate of between 9 to 12 kg P/ha/year. However, the fate of fertiliser phosphorus in Australian pastoral soils is not known.

It is often assumed that the fertiliser phosphorus-use efficiency of pastures is low (approximately 10 per cent); that is, only a small amount of the fertiliser phosphorus is taken up by the pasture in the year of application. This is largely based on soil phosphorus audits (indirect methods) of long-term field experiments that show a large proportion (approximately 90 per cent) of the fertiliser phosphorus can be accounted for in the upper layers of the soil profile under permanent pasture (McLaren *et al*. 2015b). Consequently, a low uptake of fertiliser phosphorus by pastures is thought to be due to the majority of fertiliser phosphorus becoming 'fixed' by the soil upon application.

However, there are two possible scenarios that could explain this (Figure 1), including: 1) Scenario 1 – much of the fertiliser phosphorus is 'fixed' by the soil upon application, which limits the amount of fertiliser phosphorus that is available for plant uptake, or; 2) Scenario 2 – much of the fertiliser phosphorus is taken up by the pasture, but is then later returned to the soil surface (e.g. plant decay/trampling and animal faeces/urine).

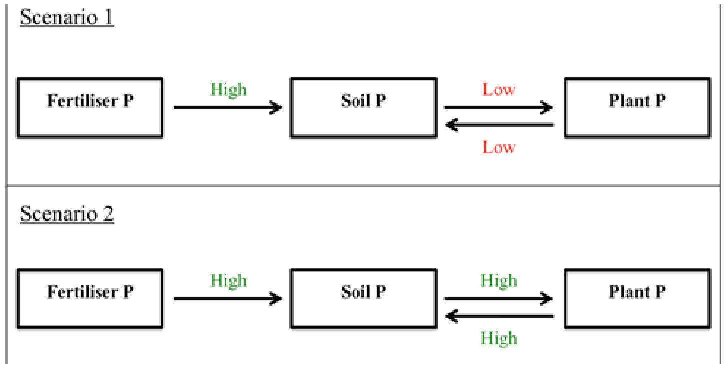

Figure 1. Two possible scenarios that explain the accumulation of phosphorus in fertilised soils under pasture.

This paper provides a brief overview of some of the research findings within the Feedbase Investment Plan (Project B.PUE.0102 "Phosphorus reactions and fluxes in pasture soils"), co-funded by MLA and AWI. Specifically, this research aimed to:

1) Identify the forms of soil phosphorus (inorganic and organic) that accumulate in fertilised soils under pasture.

2) Determine the recovery of fertiliser phosphorus in components of the pasture system under field conditions.

3) Investigate the 'best' management strategy for maximum pasture production and recovery of fertiliser phosphorus in pastures.

Long-term fate of fertiliser phosphorus in pastures

To determine the long-term fate (over 13 growing seasons) of fertiliser phosphorus in pastures, we carried out a soil phosphorus audit (collected in 2007) at the long-term fertiliser-by-grazing permanent pasture experiment at the CSIRO Ginninderra Experiment Station (near Hall, ACT) (McLaren *et al.* 2015b). The experiment was established in 1994 and includes treatments designed to maintain soil phosphorus fertility in the topsoil layer (0–10 cm).

The treatments were:

1) P0 – Fields receiving no phosphorus fertiliser (4 to 6 mg Olsen P/kg);

2) P1 – Fields receiving fertiliser phosphorus to maintain a soil phosphorus fertility of between 10 to 15 mg Olsen P/kg, and;

3) P2 – Fields receiving fertiliser phosphorus to maintain a soil phosphorus fertility of between 20 to 25 mg Olsen P/kg.

Each level of soil phosphorus fertility was grazed with sheep at a stocking rage of 9 dry sheep equivalents per hectare (SR09). The P1 level of soil phosphorus fertility is the agronomic optimum for pasture growth, whereas the P2 level of soil phosphorus fertility is above that of the agronomic optimum for pasture growth. Experiment details and soil chemical properties can be found in McLaren *et al*. (2015b), George *et al*. (2007) and Simpson *et al*. (2010).

On average, pools of inorganic P, organic phosphorus and residual phosphorus accounted for 19, 31 and 50 per cent of total soil P, respectively (Table 1). In soils of acidic pH, forms of inorganic phosphorus are likely to include phosphorus sorbed to Al- and Fe-oxyhydroxides, and Al- and Fe-phosphates, whereas the forms of organic phosphorus are likely to be predominantly that of humic phosphorus (associated with soil organic matter). The forms of residual phosphorus in soil remain uncertain.

Pools of inorganic P, organic phosphorus and residual phosphorus were higher in the topsoil (0–10 cm) layer than in the subsoil (10–20 cm) layer (Table 1).

Table 1. Concentrations (kg P/ha) of inorganic phosphorus, organic phosphorus, residual phosphorus and total phosphorus in soil fractions of the Ginninderra long-term field experiment. The cumulative phosphorus input was approximately 4, 200 and 242 kg/ha for the P0, P1 and P2 levels of soil phosphorus fertility, respectively (Source: McLaren *et al*. (2015b)).

Soil depth (cm)	Level of soil phosphorus fertility	Inorganic soil P	Organic soil P	Redsidual soil P	Total soil P
		kg P/ha			
0-10	P0	72	143	195	410
	P1	134	202	211	547
	P2	164	204	206	574
10-20	P0	33	68	174	275
	P1	45	81	173	299
	P2	52	79	184	315

[A] Residual soil phosphorus refers to forms of soil phosphorus that cannot be easily identified as being inorganic or organic.

Some of the main sources of phosphorus to the topsoil layer include:

1) fertiliser phosphorus (mineral and manure);

2) the deposition of manure phosphorus and urine phosphorus from grazing animals, and;

3) phosphorus from decaying or trampled plants (Simpson *et al*. 2011).

Approximately 85 per cent of the applied fertiliser phosphorus was recovered as total phosphorus in the 0–20 cm soil layer (Figure 2). On average, 31 per cent and 30 per cent of the applied fertiliser phosphorus was recovered as inorganic phosphorus and organic phosphorus, respectively, in the 0–10 cm soil layer at the P1 level of soil phosphorus fertility (Figure 2). A larger proportion of the fertiliser phosphorus accumulated as inorganic phosphorus (38 per cent) than as organic phosphorus (26 per cent) if soils were maintained above the agronomic optimum level of soil phosphorus fertility (P2) in the 0–10 cm soil layer (Figure 2).

Short-term fate of fertiliser phosphorus in pastures – timing and placement

To determine the short-term fate (over one growing season) of fertiliser phosphorus in pastures as affected by placement and timing, isotopic experiments were carried out at two field sites (near Inman Valley in SA, and near Hall in the ACT) (McLaren *et al*. 2015a). This involved using radiolabelling techniques that can give single superphosphate a unique fingerprint, which can be tracked within the pasture and provide a direct measure of fertiliser phosphorus-use efficiency (McLaren *et al*. 2014).

Treatments include:
1) no fertiliser phosphorus added to clover pastures (control);

2) the addition of 33P-labelled single superphosphate to clover pastures at early-season on the soil surface (early-season surface);

3) the addition of 33P-labelled single superphosphate to clover pastures at mid-season on the soil surface (mid-season surface), and;

4) the addition of 33P-labelled single superphosphate to clover pastures at early-season placed 6 cm below the soil surface (early-season deep).

Fertilised treatments involve the application of 20 kg P/ha to subterranean clover pastures.

The early-season application of fertiliser phosphorus occurred in late April at the Ginninderra field site and in early June at the Inman Valley field site. The mid-season application of fertiliser phosphorus occurred in August at both the Ginninderra and Inman Valley field sites. Irrigation was only needed at the Inman Valley site to ensure that the cumulative rainfall was at least decile 5 (average rainfall). Some of the soil chemical properties of the two sites are shown in Table 2.

Cumulative biomass removal and phosphorus uptake into clover shoots for the fertilised treatments was higher than in the unfertilised treatment at both field sites (Table 3). In general, cumulative biomass removal and phosphorus uptake in clover shoots was highest in the early-season surface treatment compared with that in the mid-season surface and early-season deep treatments (Table 3).

Recovery of fertiliser phosphorus in clover shoots was up to 42 per cent in the year of application (Table 3).

In general, the recovery of fertiliser phosphorus in clover shoots was highest (approximately 40 per cent) in the early-season surface treatment compared with that of the mid-season surface and early-season deep treatments (Table 3).

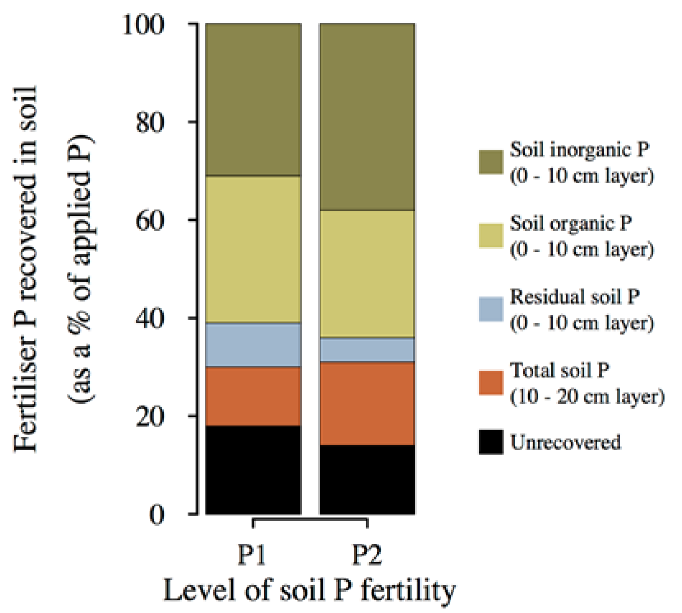

Figure 2. The fate of fertiliser phosphorus in soils under pasture (as a per cent of applied P) at the Ginninderra long-term field experiment (Source: McLaren *et al*. (2015b)).

Table 2. Some chemical properties of the soils used in this study (Source: McLaren *et al*. (2015a)).

Location	Depth (cm)	pHw (1:5)	ECw (µS/cm; 1:5)	Total carbon (%)	Colwell phosphorus (mg kg-1)	PBI
Ginninderra–P0	0 – 10	5.2	80.3	2.0	17.5	49.5
Inman Valley	0 – 10	5.7	38.1	1.6	14.0	18.8

Table 3. Cumulative biomass removal (t DM/ha), clover phosphorus uptake (kg P/ha), and recovery of fertiliser phosphorus (as a % of applied 33P-labelled single superphosphate) for clover shoots (> 0 cm above the soil surface) at the Ginninderra and Inman Valley field sites (Source: McLaren *et al.* (2015a)). Values in parentheses are standard errors.

Field site	Treatments				
	Timing of fertiliser phosphorus application	Placement of fertiliser phosphorus	Cumulative biomass (t DM/ha)	Cumulative phosphorus uptake (kg P/ha)	Recovery of fertiliser phosphorus (as % of applied)
Ginninderra	Early-season	Surface	14.8 (0.7)	17.9 (0.6)	38.4 (2.1)
	Early-season	Deep	14.3 (0.3)	17.7 (0.6)	40.0 (1.5)
	Mid-season	Surface	11.1 (0.4)	13.7 (0.6)	28.5 (0.5)
	Nil	Nil	8.0 (0.4)	7.0 (0.8)	-
Inman Valley	Early-season	Surface	11.3 (0.3)	25.5 (0.7)	42.4 (1.1)
	Early-season	Deep	9.5 (0.6)	21.8 (0.8)	27.3 (2.3)
	Mid-season	Surface	11.4 (0.8)	28.3 (1.3)	28.6 (1.3)
	Nil	Nil	8.8 (0.7)	15.2 (0.8)	-

[A] Five biomass cuts were collected at the Ginninderra field site and four harvests collected at the Inman Valley field site.

Although, at the Ginninderra site, the recovery of fertiliser phosphorus in clover shoots for the early-season surface treatment was similar to that of the early-season deep treatment (Table 3). Some of the reasons for a relatively high recovery of fertiliser phosphorus in clover shoots might include: 1) a high density of roots in the soil surface, which is where the fertiliser phosphorus is placed; 2) the majority of fertiliser phosphorus is water soluble and available for plant uptake; and; 3) favourable growing conditions (e.g. soil moisture).

Short-term fate of fertiliser phosphorus in pastures – initial soil phosphorus fertility

A similar experiment to that described above was carried out across the three levels of soil phosphorus fertility (P0, P1 and P2) at the CSIRO Ginninderra Experimental Station (McLaren et al. 2015a). The aim of this experiment was to determine the short-term fate of fertiliser phosphorus in pastures as affected by the initial soil phosphorus fertility.Cumulative biomass removal in clover shoots at the P1 and P2 levels of soil phosphorus fertility were higher compared with that at the P0 level of soil phosphorus fertility (Table 4). The cumulative phosphorus uptake in clover shoots increased approximately two-fold in pastures from the P0 level of soil phosphorus fertility to that at the P1 level of soil phosphorus fertility, and then slightly more at the P2 level of soil phosphorus fertility (Table 4). Recovery of fertiliser phosphorus in clover shoots was highest (46 per cent) at the P1 level of soil phosphorus fertility (Table 4).

Overview of short-term fate of fertiliser phosphorus in pastures

To provide a general overview of the fate of fertiliser phosphorus in pastures over a single growing season, further analyses to that described above was carried out (i.e. on root, soil and granule residues).

Figure 3 shows an overall summary of the fate of fertiliser phosphorus in components of the pasture system. In general, recovery of fertiliser phosphorus in clover shoots was 42 per cent and 45 per cent at the Ginninderra and Inman Valley field sites, respectively (Figure 3).

An additional 7 per cent and 10 per cent of the fertiliser phosphorus was recovered in clover roots (Figure 3). Approximately 26 per cent and 18 per cent of the fertiliser phosphorus was recovered in the 0 – 4 cm soil layer in the year of application at the Ginninderra and Inman Valley field sites, respectively (Figure 3). The majority of fertiliser phosphorus in soil fractions was in an inorganic form (Figure 3). Concentrations of fertiliser phosphorus in soil fractions below 4 cm from the soil surface were too low for detection.

Conclusion

Our research reveals that clover pastures have a relatively high capacity to recover

Table 4. Cumulative biomass removal (t DM/ha), clover phosphorus uptake (kg P/ha), and recovery of fertiliser phosphorus (as a % of applied from the ^{33}P-labelled single superphosphate) for clover shoots (> 0 cm above the soil surface) across three levels of soil phosphorus fertility at the Ginninderra field site (Source: McLaren *et a*l. (2015a)). Values in parentheses are standard errors.

Field site	Level of soil phosphorus fertility (early-season surface)	Cumulative biomass (t DM/ha)	Cumulative phosphorus uptake (kg P/ha)	Recovery of fertiliser phosphorus (as a % of applied)
Ginninderra	P0	15.3 (0.4)	19.9 (1.5)	40.3 (1.3)
	P1	18.0 (0.6)	41.7 (2.3)	45.5 (0.8)
	P2	20.5 (1.1)	51.9 (2.6)	42.5 (1.5)

fertiliser phosphorus (up to 50 per cent) in the year of application. High pasture production and recovery of fertiliser phosphorus by clover pastures was generally found when fertiliser phosphorus was applied to the soil surface of established clover pastures at early-season, and in soils that were maintained at the agronomic optimum level of soil phosphorus fertility. In addition, our research reveals that if soils are maintained above the agronomic optimum level of soil phosphorus fertility, the additional fertiliser phosphorus will largely accumulate as stable forms of soil phosphorus that will be less 'plant-available' than that contained in the fertiliser at application.

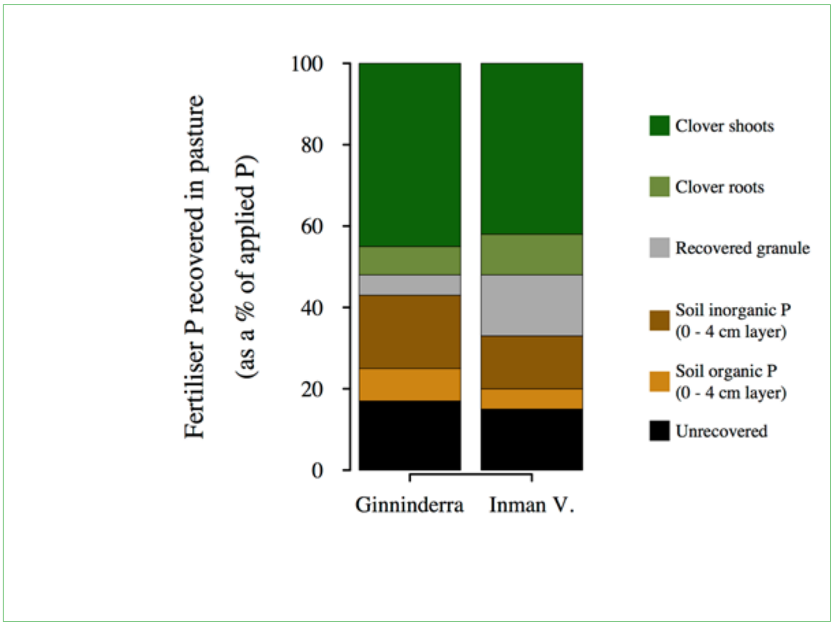

Figure 3. An overall summary, from isotopic field experiments, of the fate of fertiliser phosphorus applied to pasture soils at the Ginninderra and Inman Valley field sites.

Acknowledgements

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Grass roots research reaching local producers

Over a hundred people attended the latest Grassland Society of NSW Pasture Update at "Chesney" near Mandurama on the 15th September. Local producers are obviously keen to find out about the latest local research on pastures.

The hosts, Stuart and Gemma Green, outlined their vision for Chesney Pastoral which included triple bottom line principles of social, environmental and financial objectives. Resilience was also at the core of their business philosophy.

"Building resilience into every aspect of our grazing enterprise is a big part of what we do at Chesney Pastoral. Our pastures are predominately phalaris and sub clover, but we are keen to try different species to fulfil a niche in our overall production system, particularly finishing livestock to meet market specs," said Mr Green.

The theme of resilience and persistence continued with David Harbison's presentation on "Persistent Perennials". The Meat and Livestock Australia (MLA) funded national variety pasture trial of cocksfoot, phalaris, perennial ryegrass, lucerne and sub clover trial conducted east of Blayney, was managed by Mr Harbison. It showed some large variations in persistence between species. However, there were a few newer perennial ryegrass species that performed quite well over the two and half years of the trial. Mr Harbison said "the results from the trial will be available soon on the MLA website and will give producers a good indicator of variety performance in their local area."

NSW DPI Livestock Research Officer, Dr Gordon Refshauge autopsied some dead neonatal lambs, which gave producers a great insight into the primary cause of lamb mortality. Dr Refshauge said, "perinatal lamb mortality cost the Australian sheep industry approximately $540 million. Across the national flock, the primary cause of death is related to oxygen deprivation during birth. Nearly half of the lambs that die, do so on the day they were born.

Additionally the majority of the losses are from the minority of ewes. This is why the simple practice of wetting and drying ewes at lamb marking should be a non-negotiable management custom in every sheep breeding enterprise".

Mr Green agreed saying "in our first cross lamb enterprise, profitability is driven by the way we manage 70% of our ewes, for only 8 weeks of the year. Managing feed availability, paddock size, mob size and ewe fat score in the multiples mob is critical to our success".

Pasture update attendees in a paddock sown to a chicory, sub clover, plantain, lucerne, phalaris and cocksfoot mix aprroximately 18 months ago.

The old shearing shed at Chesney

Stuart Green (centre) uses the highly productive pastures to finish lambs and trade cattle.

For more information on livestock production and management issues, please call Brett Littler on 02 6378 1708. For information on pastures, call Phil Cranney on 02 6363 7888.

Central Tablelands Local Land Services are committed to supporting these events that help connect local research to local farmers.

Farmers gain tips on maximising beef production per hectare

Frank McRae, Product Development Manager, Auswest Seeds discussing oat varieties

Matching good paddock preparation and management with a targeted livestock health regime will maximise beef production per hectare.

This was the key take-home message for how to develop productive pasture systems at a recent field day delivered by Hunter Local Land Services (LLS) in Scone.

Hunter LLS Land Services Officer, Sarah Giblin said more than 70 local farmers attended the free event, held at the new LLS office at Scone TAFE, which saw industry experts provide advice on managing pasture systems in a variable climate.

Sundown Pastoral Company manager, Mathew Monk encouraged graziers to concentrate on taking the time to get the whole production package right.
'Don't cut corners with pasture and cereal sowing – preparation is vital for high performance pasture systems that maximise water use efficiency,' Mr Monk said.

'Sowing rates and row-spacing, seed treatments, insect damage, weed infestation, all need monitoring.
'Match good preparation and pasture management with good livestock nutrition and health management and the result will be maximum kilos of beef produced per hectare.'

Mr Monk emphasised the importance of attention to detail, yard weaning and finely tuning stock health programs for feeder cattle, combined with careful planning of stock movements, avoiding over-grazing pastures or bloat problems.

'The next six weeks is the danger period for bloat, a very stressful time for managers, when all stock on lucerne and clover based pastures need checking twice per day,' he said.

'There are lots of myths, but there is no sure way to prevent bloat in cattle, it comes down to management.'
Strategic management options include vaccinating cattle with correct boosters and repeating doses as required; never putting hungry stock on high-risk pastures; ensuring bloat licks or blocks were available; restricting stock movements to the middle of day when cattle were full; never moving stock in a hurry; taking care when grazing stock on flowering or regrowth lucerne; and permanently removing individual stock that appear 'bloated' off pastures.

Auswest Seeds Product Development Manager, Frank McRae reminded farmers of the importance of selecting the right winter wheat or oats variety for an individual production system.

Crop sowing rates, ongoing monitoring and grazing management were again proven to be key factors in maximising pasture production and the return on investment.

The field day was supported by NSW Grassland Society and Auswest Seeds, and included a tour of trial sites in Aberdeen and cereal and pasture systems in Scone.

For further details or advice on managing a pasture system, or to register interest in attending similar field days, contact Sarah Giblin at the Hunter LLS Scone office on 6540 2414.

The event was one of many initiatives supported by Hunter LLS for local primary producers.

Sundown Pastoral Company Manager Matthew Monk discussing pasture establishment

Sarah Giblin from the Hunter Local Land Services and field day attendess in the paddock.

Research Update

Keeping you up-to-date with pasture and grassland research in Australia. Abstracts of recently published research papers will be reprinted as well as the citation and author details in you wish to follow up the full paper.

Native Australian shrub legume species may provide an alternative feed source for livestock

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Abstract. The feed quality of a variety of native shrub and herbaceous legume species from the Riverina area of southern New South Wales was determined to provide an indication of their potential use in livestock grazing systems. Fifteen species were sampled from each of two locations (chiefly low fertility roadsides or travelling stock reserves) at four times within a 12-month period viz. August, November, February and May according to the most likely plant parts to be consumed by grazing animals for each species. Digestibility was estimated using an in vitro rumen fluid digestion assay and crude protein was estimated from nitrogen analysed using the Dumas combustion method. Digestible organic matter in the dry matter (DOMD) was greater than 550 g/kg dry matter (DM) for seven of the native legume species and was highest for *Daviesia* spp. (*D. latifolia* 696.2 ± 15.0, *D. leptophylla* × *latifolia* 642.5 ± 15.1 and *D. leptophylla* 622.7 ± 15.4), *Glycine* spp. (*G. clandestina* 628.2 ± 18.1, *G. tabacina* 621.9 ± 28.0 and *G. canescens* 580.4 ± 25.4) and *Indigofera australis* (617.8 ± 15.3). Crude protein content was greater than 80 g/kg DM for all species analysed, suggesting that these plants are able to fix nitrogen under low phosphorus fertility conditions. Studies examining grazing management as well as nitrogen fixation and nitrogen transfer to companion grasses are required in order to optimise the management of these plants in grazing systems.

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Opportunities and challenges for improved management of foliar pathogens in annual clover pastures across southern Australia

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Abstract: Foliar pathogens result in significant losses in herbage and seed yields and regeneration capacity in annual clover pastures, the last leading to their rapid deterioration and lack of persistence. The most important pathogens include *Kabatiella caulivora* (clover scorch), *Cercospora zebrina* (cercospora), *Uromyces trifolii-repentis* (rust), *Erysiphe trifoliorum* (powdery mildew), and *Leptosphaerulina trifolii* (pepper spot).
Several other foliar pathogens on annual clovers, in particular *Phoma medicaginis* (black stem and leaf spot), one or more *Stemphylium* spp. (stemphylium leaf spot), *Pseudopeziza trifolii* (common leaf spot), *Stagonospora* spp. (stagonospora leaf spot), *Colletotrichum trifolii* (anthracnose) and *Sclerotinia trifoliorum* (sclerotinia), occur widely and together contribute to reduce productivity in some localities. Severe attack by the most important pathogens (e.g. *K. caulivora, U. trifolii-repentis, E. trifoliorum*) not only greatly reduces winter–spring pasture production but frequently also coincides with the critical feed shortage across autumn–winter, leading to significantly decreased autumn–winter biomass production in regenerating stands. Approaches to disease control include a range of management strategies. Wider utilisation of cultural and fungicidal control strategies offers producers greater management flexibility, particularly in conjunction with deployment of cultivars with useful resistance. Host resistance offers the greatest potential for delivering the most cost-effective and long-term control. Many of these foliar pathogens co-occur, magnifying losses; this highlights the need for individual host genotypes with resistance to multiple pathogens and unique geographic locations such as Sardinia offer enormous scope to select such clovers. Future research opportunities and critical priorities to improve management of foliar pathogens in annual clover pastures across southern Australia include the need to: (i) define pathogen strain–race structures, particularly for *K. caulivora* and *U. trifolii-repentis*, and determine associated host resistances against specific strains–races to allow strategic deployment of host resistances; (ii) define relative resistances to major fungal foliar pathogens of all parental and near-release breeding genotypes and all commercial cultivars across important annual clover species; (iii) identify new sources of host resistance, particularly genotypes with cross-resistance to multiple pathogens, for breeders to utilise; (iv) identify and demonstrate the benefits to farmers of effective cultural (e.g. grazing, removal of infested residues) and fungicidal control options that allow greater management flexibility to reduce the impact of fungal foliar diseases; and (v) determine current incidences and impacts (losses and economic importance) of major fungal foliar diseases in the different agro-climatic regions across southern Australia.

Failure to address these critical issues leaves livestock industries carrying the risks from release of new varieties of unknown susceptibilities to one or more of the major foliar diseases, and the risks from continued use of older varieties exposed to new pathogen races; with few if any flexible management options during periods of critical feed shortage; and without the basic information on current disease impacts that is needed to make sensible management and funding decisions.

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Desmanthus showing promise in northern inland NSW

Trudie Atkinson, Development Officer, NSW DPI Trangie

Research evaluating companion legumes for tropical perennial grasses on the North West Slopes of NSW is starting to show desmanthus as a promising legume option. Legumes can provide nitrogen to sown tropical grass based pasture, which boosts forage production and improves crude protein and digestibility of the grasses.

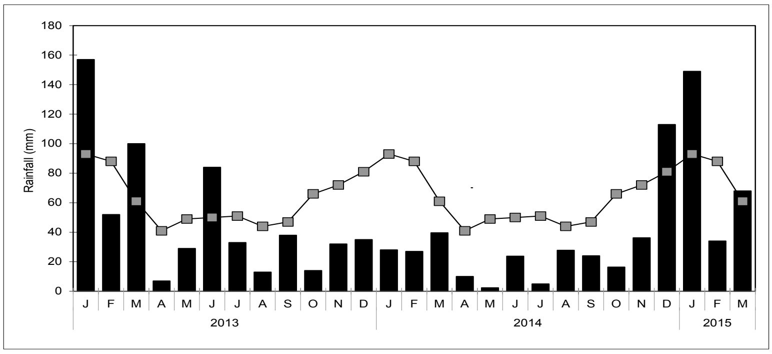

Figure 1. Monthly rainfall (mm) from January 2013 to September 2015 (solid bars) compared to the long-term average (line) at the Bingara site.

Desmanthus is a summer-growing perennial legume, growing from spring to autumn, in areas of inland NSW with annual average rainfall greater than 550 mm. Frost will stop its growth over winter, although it is tolerant to cold and will recover from frost damage. Desmanthus is productive on a wide range of soil types, including alkaline, sodic, saline and heavy clay soils.

The legume is highly palatable to livestock and no animal health issues have been reported in livestock grazing desmanthus. Cattle can graze desmanthus without the risk of bloat, as the plant contains 2 to 3% condensed tannins. Desmanthus can be heavily grazed, as the plant will regrow from the crown and regenerate from seed.

In January 2013, desmanthus lines were sown with premier digit grass in experiments at Bingara and Manilla. Two commercial cultivars of desmanthus are available, Marc (Progressive seeds) and Progardes (Agrimix). Progardes consists of five lines of desmanthus from three species (*D. virgatus, D. leptophyllus* and *D. bicornatus*). The experiments are evaluating the six lines individually- Marc and the five lines of demanthus contained in Progardes.

During the study, researchers have noted desmanthus's ability to;

- respond quickly to available soil moisture
- respond to moderate falls of rain
- persist over sustained periods of below average rainfall
- recover from the crown
- regenerate from seed set in the previous summer; and,
- produce significant amounts of biomass, although production varies among lines.

At the Bingara site in the summer after establishment (summer 2013-14), performance was severely limited by low rainfall, during an extended very dry period. From July 2013 to November 2014, the experimental site had 17 consecutive months of below average rainfall (Figure 1). During this period, the desmanthus did respond to a moderate amount of rainfall in March 2014 by producing good quantities of herbage mass and setting seed.

In summer 2014-2015, low rainfall in late spring and early summer limited growth (Figure 2 (left)). However, desmanthus responded quickly to above average rainfall in December 2014 and January 2015.

Herbage mass production was notable with some desmanthus lines producing up to 1360 kg DM/ha, which contributed up to 40% of the total pasture biomass (Figure 2 (centre)).

The plants recovered from the crown of existing plants and regenerated from seed set the previous season. Seedling recruitment has occurred in all the desmanthus lines. These seedling plants are expected to boost herbage mass production and contribute to the seedbank in the future.

Desmanthus growth was again low during drier conditions in February and March 2015 Figure 2 (right)). The experiment will continue until the end of the 2015 to 2016 growth season. After this time, recommendations about the best companion legumes for tropical grasses will be available for producers.

Experiments are also investigating seed softening rates, and optimal sowing rate and depth, which will allow practical recommendations for establishing the desmanthus with tropical perennial grasses.

This work is funded by Meat and Livestock Australia.

For more information contact Carol Harris, Research Scientist NSW DPI Glen Innes - carol.harris@dpi.nsw.gov.au or Suzanne Boschma Senior Research Scientist NSW DPI Tamworth suzanne.boschma@dpi.nsw.gov.au

Figure 2. Production of desmanthus cv. Marc was severely limited in November 2014 (left) and March 2015 (right), but responded to rainfall in December 2014 and January 2015 (centre) at the Bingara experimental site.

Number and nitrogen fixation capacity of rhizobia in soils - Part 2

How well do the soil rhizobia fix nitrogen with legumes

So far we have considered the number and diversity of rhizobia. Their function or capacity to fix nitrogen is just as important. Nitrogen fixation capacity is the result of the legume-rhizobia partnership, not just the rhizobia. Therefore it is possible that the same community of rhizobia may fix less or more nitrogen with different legume genotypes.

The terms effective and ineffective are commonly used to describe differences in nitrogen fixation capacity. Here, the term effective is used where the shoot weight of plants resulting from an inoculation treatment (rhizobia) is at least 75 per cent that of plants inoculated with a highly effective strain of rhizobia. Symbiotic capacity is deemed moderately effective when shoot weight is between 50 and 75 per cent and ineffective when below 50 per cent.

The effectiveness of soil rhizobia is commonly measured using a 'whole soil' inoculation method or by inoculating plants with individual strains of rhizobia isolated from nodules. Plants growing in nitrogen deficient potting media are inoculated with a suspension of soil to determine the effectiveness of the rhizobia in that soil. Plant growth provides a measure of the nitrogen fixation capacity of the soil rhizobia.

Data for symbiotic effectiveness of soil rhizobia is more limited than for population number, especially for the tropical legumes. Even so, it is apparent that while the symbiosis formed by the commonly grown legumes and soil rhizobia are seldom grossly ineffective, they are often less effective compared to the inoculant strain for the legume.

For example, the effectiveness of the symbiosis formed between sub clover and the rhizobia in 43 soils ranged from eight per cent to 99 per cent of that formed between sub clover and the commercial inoculant strain (WSM1325). Most commonly the communities of soil rhizobia were 51 to 60 per cent as effective as the inoculant strain. Thirty-two per cent were classed as ineffective.

Mean nitrogen fixation capacity of soil rhizobia with a range of different temperate legumes is shown in Table 1. The higher prevalence of ineffective symbiosis for burr medic compared to strand medic and lucerne (all *Medicago*) highlights the differences in symbiotic competence between legume species.

Among the annual clovers, symbioses tend to be similar or less effective (e.g. arrowleaf clover) compared to sub clover.

While differences in rhizobial persistence can be linked to frequency of legume cultivation and soil properties such as pH, reasons for variation in symbiotic effectiveness are not well understood. Variation in symbiotic effectiveness is therefore difficult to predict. Generally, stressful environments exerting greater selection pressure may increase the diversity of the rhizobia at the expense of nitrogen fixation capacity.

Dealing with soil rhizobia

Where large and persistent populations of rhizobia are present in the soil, a competitive barrier for the introduction of new strains of inoculant rhizobia is created. This is not a problem where the soil community is effective with the legume host. But where the soil rhizobia are not effective, high nodual occupancy by an effective inoculant strain is desirable to optimise nitrogen fixation potential. Rhizobia persist in many soils well above the threshold needed (100 rhizobia per gram) for prompt nodulation and often at numbers far greater than can be introduced through inoculation. However, rhizobia in the soil are diffusely distributed, while those applied to seed as inoculum are in close proximity to the root and able to rapidly multiply to the levels needed to achieve effective nodulation.

Studies investigating the success of applied inoculants show that if the rhizobia per seed are numerically equivalent to the number of rhizobia per gram of soil, then inoculant strain is able to form sufficient nodules to improve plant nitrogen fixation and growth.

This and similar studies form the basis of quality guidelines that specify minimum inoculation standards of 1000 cells per seed for sub clover and similarly sized pasture legumes.

As stated before it is common where a legume species has been grown that the number of soil rhizobia can exceed 1000 rhizobia per gram.

Table 1. Mean symbiotic capacity of temperate legumes with soil rhizobia relative to effective inoculant strains and distribution of the communities of soil rhizobia based on their classification as effective, moderately effective or ineffective.

Legume	Mean nitrogen fixation capacity (%)	Percentage distribution of soil rhizobia communities based on their symbiotic capacity		
		Effective ≥ 75%	Moderately effective 50 to 75%	Ineffective ≤ 50%
Field pea	78	68	23	11
Chickpea	60	25	40	35
Yellow serradella[A]	>75	-	-	-
Sub clover	58	19	49	32
Strand medic	62	36	34	30
Burr medic	36	15	21	64
Lucerne	84	89	11	0
Biserrula	>75	92	-	8

[A] Determined using individual strains isolated from soils

Source: Bowman *et al*. 1998; Brockwell 2001; McInnes 2002; Ballard *et al*. 2003; Charman and Ballard 2004; Ballard *et a*l. 2004; Elias 2009; Drew and Ballard 2010; Drew *et al.* 2011,2012.

Responses to inoculation would only be likely where the minimum standards for inoculant on seed are exceeded.

As Australian inoculants are mostly produced in sterile peat and meet minimum standards of one thousand million (1 x 109) cells per gram peat at manufacture, seed standards are easily surpassed when recommended rates of inoculation and methods of application are followed, and the seed is promptly sown.

While the benefits of effective strains introduced through inoculation will be important to pasture establishment, occupancy by the applied inoculant will be temporary and possibly insignificant where the pasture phase extends past a few years.

Research to manage suboptimal populations of rhizobia in soils continues. New inoculant formulations that provide competitive and stable strains of rhizobia, higher numbers of rhizobia or allow more strategic placement of the inoculant strain are being tested.

For annual pasture species that have a propensity to form ineffective symbioses with soil rhizobia, the development of varieties that can be effectively nodulated by a large proportion of soil rhizobia is being investigated to provide a long-term solution.

Concluding comments

After more than 100 years of legume cultivation, many Australian soils have developed substantial populations of rhizobia able to nodulate commonly grown agricultural legumes. However, suitable rhizobia may still be absent from the soil if the legume has not been grown previously, or where the soil is not conducive to long-term rhizobial survival. Soil acidity oftens affects persistence of the rhizobia. Medic, Lucerne and pea (including faba bean, lentil and vetch) symbioses are particularly sensitive to acid soils.

Where soils do support rhizobia, the communities are diverse and tend to become less effective at fixing nitrogen with time, when compared to commercial inoculant strains. The extent of ineffective symbioses formed can be modified by the host legume. Even so symbiosis between soil rhizobia and the host legume are commonly less than 50 per cent of the potential symbiosis between the inoculant strain and host legume. It is not possible to predict the nitrogen fixing capacity of the rhizobia at a paddock level.

The good news is that inoculant strains, when applied at a high number, can compete with background soil rhizobia.

This provides the opportunity to introduce effective strains in pulse crops and frequently renovated pasture systems.

Nodule occupancy by inoculant rhizobia declines with time in regenerating pastures. In these pastures there appear to be good prospects to develop ‘symbiotically promiscuous’ legumes that are better matched to the diverse communities of rhizobia that are now found in many soils.

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Editors Note: This article has been modified from Chapter 3 in Inoculating legumes - a practical guide. Reprinted with permission.

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Bureau issues Climate Outlook for December to February

The Bureau of Meteorology issued its monthly and seasonal climate outlooks for December 2015 to January 2016 on the 19th of November.

December temperatures are likely to be warmer than average for southern Australia, while rainfall is likely to be above average across southeast Queensland and northeast NSW, parts of the interior and southwestern Australia.

The summer outlook indicates below-average rainfall is likely across the northwest and Cape York Peninsula, and wetter across parts of the east. The daytime temperature outlook is patchy, with warmer days likely in parts of the west and north, while parts of the southeast are likely to be cooler.

Daytime temperatures are likely to be average to warmer-than-average for most of Australia. Meanwhile, overnight temperatures are likely to be warmer across most of the country except the southeast.

Current climate influences include a combination of a strong El Niño in the Pacific, a decaying positive Indian Ocean Dipole, and very warm Indian Ocean temperatures.

For more information, or to watch or share the video visit www.bom.gov.au/climate/ahead/

List of some of the rhizobial strains used in Australian inoculants

Inoculant Group	Rhizobial Strain	Legume common name	Legume botanical name
AL	RR128	Lucerne	*Medicago sativa*
		Strand medic	*Medicago littoralis*
		Melilotus	*Melilotus albus*
		Disc medic	*Medicago tornata*
AM	WSM1115	Barrel medic	*Medicago truncatula*
		Burr medic	*Medicago polymorpha*
		Snail medic	*Medicago scutellata*
		Sphere medic	*Medicago sphaerocarpus*
		Gama medic	*Medicago rugosa*
		Murex	*Medicago murex*
B	TA1	White clover	*Trifolium repens*
		Red clover	*Trifolium pratense*
		Strawberry clover	*Trifolium fragiferum*
		Alsike clover	*Trifolium hybridum*
		Talish clover	*Trifolium tumens*
		Berseem, Egyptian clover	*Trifolium alexandrinum*
		Cluster or ball clover	*Trifolium glomeratum*
		Suckling clover	*Trifolium dubium*
C	WSM1325	Subterranean clover	*Trifolium subterraneum*
		Balansa clover	*Trifolium michelianum*
		Bladder clover	*Trifolium spumosum*
		Crimson clover	*Trifolium incarnatum*
		Purple clover	*Trifolium purpureum*
		Arrowleaf clover	*Trifolium vesiculosum*
		Rose clover	*Trifolium hirtum*
		Gland clover	*Trifolium glanuliferum*
		Helmet clover	*Trifolium clypeatum*
		Persian or shaftal clover	*Trifolium resupinatum*
D	CC829	Lotus	*Lotus pedunculatus*
E	SU303 or WSM1455	Woolly pod vetch	*Vicia villosa*
M	CB756	Siratro	*Macroptilium atropurpureum*
		Butterfly Pea	*Clitoria ternatea*
S	WSM471 or WU425	Yellow and Pink Serradella	*Ornithopus compressus and O. sativus*
SPECIAL	CB82	Fine Stem	*Stylosanthes guianensis* var. *intermedia*
		Stylo	*Stylosanthes guianensis* var. *guianensis*
		Shrubby Stylo	*Stylosanthes viscosa*
	CB3126	Desmanthus	*Demanthus virgatus*
	WSM1592	Sulla	*Hedysarum coronarium*
	CC283b	Caucasian clover	*Trifolium ambiguum*
	CB3481	Caatinga Stylo	*Stylosanthes seabrana*
	SU343	Lotus	*Lotus corniculatus*
	WSM1497	Biserrula	*Biserrula pelecinus*
	CB1717	Burgundy bean	*Macroptilium bracteatum*

This table has been modified from pages 52–53 in 'Inoculating legumes - a practical guide'. For a complete list of rhizobial strains and legumes refer to the book. Copies of this book are available from Ground Cover Direct - 1800 110 044 www.grdc.com.au/bookshop

This dog has a nose for weeds

Eradication is the most cost-effective and efficient way to manage new weed incursions. But often finding the 'very last weed' is difficult, especially for 'hard-to-find' weeds like orange hawkweed.

Detector dogs can increase the ability to find even the smallest fragment of a target plant, making them a potentially powerful tool to help eradicate weeds.

Orange hawkweed (*Hieracium aurantiacum*) is a Class 1 Noxious Weed that has the potential to become a serious environmental and agricultural weed across SE Australia. Although a major threat to biodiversity, should this weed reach its potential distribution, losses to the Australian grazing industry alone could be over $48 million/year. Currently in NSW, it is only recorded in Kosciuszko National Park, where a team of over 200 volunteers are assisting Parks staff to eradicate the weed. But eradication is difficult because small, obscure plants often escape detection, thus detector dogs may be able to help.

Detector dogs were critical to the eradication of pest animals on Macquarie Island, and are successfully used to detect foxes, cane toads and endangered birds in natural areas. This project, funded by the NSW Weeds Action Program, is applying these scientifically proven detection techniques (i.e. the highly effective 'noses' of detector dogs) in an innovative manner to improve weed eradication. 'Botanist puppies', who are officially known as Weed Eradication Detector Dogs (WEDDs), may allow us to 'sniff out those very last weeds' and eradicate high-risk weeds, such as orange hawkweed, from NSW.

Check out www.environment.nsw.gov.au/pestweeds/OrangeHawkweed.htm to see Hillary Cherry, NPWS Weed Management Officer, under the guidance of Steve Austin (Canine Training and Behaviour Specialist) learning to train Sally the detector dog to find hawkweed.

The video captures one of the first instances in which Sally successfully 'indicated' on hawkweed, and as you can see she is a quick learner.

Sally the spaniel with Hillary Cherry, weeds officer from the NSW National Parks and Wildlife Service: (Photo sourced from ABC: Melanie Pearce). Orange hawkweed insert above.

Check out this link https://au.prime7.yahoo.com/n4/news/a/-/local/27454190/weed-sniffing-dog-not-what-you-think-video/ to see Missy and Sally in action at Kosciuszko National Park where both dogs were trialled in the field. Both were able to detect a live hawkweed plant (in situ) that Greg found for us. Missy then found another small plant nearby the first one, that was previously undetected. And both performed equally well the next day – despite the ground being covered in frost!

For more information contact Hillary Cherry, Weeds of National Significance Coordinator, Office of Environment and Heritage NSW

hillary.cherry@environment.nsw.gov.au

World-leading research steers to genetic improvement in cattle

The Australian beef industry will benefit with the completion of three years world-leading research on genetic traits to breed lower methane producing cattle.

Department of Primary Industries (DPI) Leader Beef Genetics, Dr Paul Arthur said the innovative research has produced the first and most comprehensive estimates of genetic parameters in the world for methane-producing traits in beef cattle.

"The genetic merit of methane emissions traits can now be described and will pave the way for the development of Estimated Breeding Values (EBVs) in our national genetic evaluation system BREEDPLAN®," Dr Arthur said.

"Cattle producers have tools to potentially identify bulls whose offspring will produce less methane - without impacting on their productivity or profitability.

"In Australia about 10 per cent of all greenhouse gas emissions and two thirds of agricultural emissions come from methane produced by livestock, mainly produced by animals' feed digestion. Reducing these emissions will be good for the environment. "It is expected that in 10 years of selection using DNA based genomic breeding values, the animals born will produce 4-5 per cent less methane than animals at present.

Dr Arthur said they found that animals that use feed more efficiently for growth, naturally produce lower levels of methane gas.
"This means, Australian beef cattle producers are able to breed cattle that are more feed efficient, which reduces the cost of production and reduces methane emissions," Dr Arthur said.
"Breeding these types of cattle will help to ensure an environmentally sustainable future for our industry."

The DPI cattle methane team conducted the research in partnership with the University of New England. Research was also conducted with the Angus herd held at the DPI Trangie Agricultural Institute. DPI Senior Beef Researcher at Trangie, Dr Kath Donoghue said that in just three years we have gained extensive knowledge into genetic improvement for methane traits. "It is hoped with further funding we can continue this exciting field of research to assist the beef industry," Dr Donoghue said. This comprehensive research work is a great example of organisations working together collaboratively, with the co-operation of various scientists, technicians and support staff over many years.

The cattle methane reduction project is supported by co-funding from the Australian Government Department of Agriculture, as part of its Filling the Research Gap Program and Meat & Livestock Australia.

The final report – Genetic technologies to reduce methane emissions from Australian beef cattle is available on the DPI website

REMINDER

New Zealand Study Tour in 2016

Expressions of interest are being sought from Grassland Society of NSW members to participate in a "pastures tour" of New Zealand's South Island next year, potentially in June. At a state committee level, coordinating such a tour with a couple of key New Zealand pasture field days is gaining momentum.

The committee is keen to explore what state wide interest there would be in such a trip, planned for approximately 4-5 days. Costs are yet to be determined, obviously group size and timings would play a significant part.

John Ive and Frank McRae, both members of our state committee, are keen to hear from anyone potentially interested. Their contact details are;

John Ive - talaheni@webone.com.au
Frank McRae - fmcrae@auswestseeds.com.au

Membership subscription due now for 2015/2016

Annual Grassland Society of NSW subscription of $60 for 2014/2015 was due July 1 2015.

Payment methods: Cheque, Credit Card (Mastercard or Visa) or electronic*

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* If paying by electronic banking, don't forget to email the Secretary (secretary@grasslandnsw.com.au) with your details

NSW GOVERNMENT | Department of Primary Industries

From the President

Hello 'From the President'.

What an interesting last week! Anywhere from 0 – 200 plus mm of rain depending on if you were "lucky" or not. For many 'grass growers' the week has been fantastic, and although I am yet to hear of any cropping downgrades, I am aware that grain receival sites have already brought the 'falling numbers' meters out. For those less cropping focused, this is a meter to detect weather damaged grain, and no doubt there will be some. We hope the balance of the harvest, for those involved in it, is as clean and as fast as possible from here on.

East of the cropping zone, and many graziers, even those with crop, are probably thanking the lord. Plenty of grazing wheat and oat paddocks are likely to benefit greatly from whatever fell, as will the all the pasture country. Even some of the far western pastoral zone got rain. Reports from Bourke had 60-70 mm over patches, with 30-40 mm more widespread, so it is great for those who have been waiting far too long.

Another year has passed, and again the MLA funded 'Grassland Society of NSW Pasture Updates' have been a great success. The most recent of these were at Mandurama and Collerina. Numbers at both were terrific, and the organisers need to be congratulated on providing such great content, that attendees saw great value in. On behalf of the Grassland Society of NSW Inc. I would like to thank MLA for their support of this initiative, and we hope, through our reporting and discussions, that a similar format can be supported in 2016. That said, the society is keen to build on the success of the 'Pasture Updates', so please keep an eye on the Grassland Society of NSW Inc. website for potential extension activities near you.

On behalf of the Grassland Society of NSW, I wish all our members, their families and friends a very safe and merry Christmas, and I hope to hear of a prosperous start in all regions of NSW in 2016. For those who have lost loved ones of recent times, this may be a difficult time for you. Take comfort as we will all be thinking of you. Stay well, think of others, and as always, don't be afraid to ask "How are you Going?"

All the best,
Regards,

David Harbison,
President.

Merry Christmas and a Happy New Year to all Grassland Society of NSW members and their families

Disclaimer

While every effort is made to publish accurate information the Grassland Society of NSW does not accept responsibility for statements made or opinion expressed in this newsletter.

Inclusion of an advertisement in this publication does not necessarily imply an endorsement of the company or product of the Grassland Society of NSW.

The Grassland Society of NSW Inc is a unique blend of people with a common interest in developing our most important resource - our Grasslands

The Grassland Society of NSW was formed in March 1985. The Society now has approximately 500 members and associates, 75% of whom are farmers and graziers. The balance of membership is made up of agricultural scientists, farm advisers, consultants, and or executives or representatives of organisations concerned with fertilisers, seeds, chemicals and machinery.

The aims of the Society are to advance the investigation of problems affecting grassland husbandry and to encourage the adoption into practice of results of research and practical experience. The Society holds an annual conference, publishes a quarterly newsletter, holds field days and is establishing regional branches throughout the state.

Membership is open to any person or company interested in grassland management and the aims of the Society. For membership details go to www.grasslandnsw.com.au
or contact the Secretary at secretary@grasslandnsw.com.au or at PO Box 471 Orange 2800

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If you are interested in reactivating an old branch or forming a new branch please contact the Secretary at secretary@grasslandnsw.com.au or by mail at PO Box 471 Orange NSW 2800

Grassland Society of NSW News

Next Newsletter: The next edition of the newsletter will be circulated in March 2016. If you wish to submit an article, short item, a letter to the Editor or a photo please send your contribution to the Editor - Carol Harris at carol.harris@dpi.nsw.gov.au or DPI NSW 444 Strathbogie Road Glen Innes 2370. The deadline for submissions for the next newsletter is 26th February 2016.

Electronic newsletter: Don't forget you can receive the Grassland Society of NSW newsletter electronically. Just email your details to Janelle (secretary@grasslandnsw.com.au) and you will be added to the list. Next newsletter you will receive an email notification with a link to the newsletter on the website.

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