GRASSLAND SOCIETY OF NSW INC.

Newsletter

In this newsletter

From the President

At the time of writing, the state is currently experiencing one of the wettest Novembers on record causing widespread crop losses and flooding in many regions. The economic loss will continue to be counted for many months to come. Importantly, the livestock industries continue to remain buoyant and the optimism amongst producers remains strong leading into summer. The predicted correction in meat prices has not occurred due to the ability of producers to maintain stock on-farm. The volume of pasture growth experienced over the spring has been one of the best in living memory and with the outlook of an La Nina until autumn next year, producers are enjoying the ease of conducting business for a change.

The Grassland Society state committee have continued to meet at regular intervals, albeit through virtual means to ensure the functionality of the organisation.

The committee membership has grown in recent months and we warmly welcome new members through the newsletter and local branch activities into the new year.

Branch activities have been halted in 2021 due to Covid and the committee have ideas in place to encourage face to face interaction in 2022. Project work continues as the report in the newsletter discusses the Perennial Pasture Acid Soils project under the astute leadership of Helen Burns.

The biannual conference was held virtually in July and given the constraints of Covid, was an enormous success under the guidance of the convenor Helena Warren. Members should have received their conference proceeding by now and the state committee encourage feedback on ways of improving the event in future years. We thank Helena for convening the conference where speakers were aligned, and the sessions were executed in a professional manner. The cost of providing a conference is not possible without the continued support of our sponsors. For many years, the sponsors have been an integral component of the conference and the Grassland Society will continue to promote them wherever possible.

The society also with to thank the outgoing president David Harbison for his term where he showed sustained enthusiasm and believed in the values of the Grassland Society to benefit producers. The current executive thank David for the many hours of voluntary time he committed to improving the outcome for members and promoting the society at all levels.

As the incoming president, I wish all members a safe Christmas period and hopefully the chance to re-connect with family members. Let’s put 2021 behind us and look forward to a productive 2022.

Pete Wilson
President

Alternative fertiliser pasture study findings

Fiona Leech
South East Local Land Services, Yass

Alternative fertiliser products are commonly promoted for use on pastures as a means to improve pasture productivity and support a more 'healthy' soil microbial environment. However, minimal field research has been conducted to validate such claims. A six year study (2009 – 2014) was conducted on phosphorus (P) deficient soils at three sites near Yass, NSW, to investigate the effect of top-dressing typical native perennial grass-based pastures with a range of alternative fertilisers and with single superphosphate.

The alternative fertiliser products trialled included manures, composts, crushed rock, rock phosphate-derived products, concentrated ash and microbial products. Annual measurements were made of soil chemical properties, pasture yield and botanical composition during winter and/or spring as well as the relative effectiveness of products per unit of pasture grown. Soil microbial community structure under each fertiliser treatment was also analysed in the sixth year of the study.

Fertiliser products with substantial quantities of P resulted in significantly higher pasture production and clover content in pastures compared to the unfertilised control treatment. The solubility of the P present in the products also played a key role in the pasture response. Products consisting of a high proportion of plant available P resulted in a quick pasture growth response compared to products containing very slow release forms of P, which showed a delayed pasture growth response. The cost-effectiveness of the products in relation to pasture growth varied considerably and was a function of rate and frequency of application as well as amount and solubility of P applied. Despite large differences in pasture growth across the various fertiliser treatments, there was no significant effect of the alternative fertiliser treatments on microbial community structure compared with either the superphosphate or unfertilised control treatments. The observed variation in bacterial, fungal and archaeal community structures across all fertiliser treatments was best explained by soil pH or aluminium concentration, which was influenced differentially by the fertiliser products. Fungal community structure was also correlated to pasture productivity parameters, that included pasture yield, clover percent and soil available P.

These findings demonstrate a highly resilient soil microbial community that was influenced minimally by use of the alternative fertiliser products. Soil microbial community analysis as a predictor of the productivity of a pasture system is currently not an informative and defined tool to aid on-farm decision making, and the overall findings of this study support this. It is worth noting, however, that for a small number of soil fungal groups a relationship was found to pasture productivity parameters, indicating that in the future it might be possible to identify specific indicator organisms that can be linked to higher or lower levels of pasture production. Understanding relationships between soil microorganisms and pasture production will none-the-less continue to be a significant challenge, given the complexity of the microbe-soil-plant interface.

The key conclusion of the work undertaken is, farmers should continue to use economic rationales associated with pasture productivity response to guide their decision making around the choice of fertilisers to apply. In doing so, they can be re-assured that they are not having a detrimental effect on the microbial communities that are present in the topsoil.

This research study was hosted and supported by Binalong Landcare, subgroup of Harden-Murrumburrah Landcare with trials conducted on properties owned by Bruce and Noelene Hazell 'Kia-Ora' Bookham, Gary and Hansie Armour 'Te Kooti' Bookham and Old Bundemar Pty Ltd (former managers Geoff and Fiona Henderson) 'Glenroy'. Funding was received from NSW DPI, former NSW Department of Environment and Heritage, former Murrumbidgee Catchment Management Authority, the Australian Government's National Landcare Program, Woolworths, NSW Local Land Services, Meat & Livestock Australia (E.PDS.1503 Final Report), Sibelco Australia, and Sheep Connect NSW.

Details of the research (Comparative effect of alternative fertilisers on pasture production, soil properties and soil microbial community structure) were recently published in CSIRO journal, Crop and Pasture Science, Volume 70 (12) 2019. Authors were ex NSW DPI Agronomist and now Yass based Local Land Services Senior Agricultural Adviser Fiona Leech, Dr. Alan Richardson CSIRO Agriculture & Food, Dr. Michael Kertesz University of Sydney, Beverley Orchard, formerly NSW DPI, Dr. Samiran Banerjee North Dakota State University, and Phillip Graham, formerly NSW DPI.

If you would like a copy of the journal publication please contact Fiona Leech, South East Local Land Services, Yass (Email: fiona.leech@lls.nsw.gov.au; Mobile 0427201805).

Editors Note

Hello, everyone the last couple of years have been a bit topsy-turvy for me (as it has for everyone) and unfortunately I have been unable to bring you the newsletter over that time. Thank you for your patience over this time. From the recent membership survey we know how much you value the newsletter so we have some exciting plans for 2022.

As always I would welcome your contributions (articles, letters, photos) to the newsletter. Please email to me at carol.harris@dpi.nsw.gov.au

Don't forget to renew your Grassland Society of NSW member subscription. Go to www.grasslandnsw.com.au and access the payment page via the green "JOIN NOW" button on the right hand side of the home page.

I hope everyone gets a chance to have a bit of rest and relax with family and friends over Christmas and the New Year period.

Cheers Carol

New approaches to managing soil acidity: Field sites established - what, where and why?

Helen Burns[A] and Jason Condon[B]

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Revision of past research, a positive economic climate and intensification of livestock systems prompted the Grassland Society of NSW to invest in a two-year National Landcare Program (NLP) project with NSW Department of Primary Industries (NSW DPI) and Holbrook Landcare Network, exploring ways to improve management and productivity of acidic soils. The project has financial support from the Australian Government and was outlined in an earlier Newsletter (Vol 34, 3 Sept 2019). Soil surveys show that pH in the 5–15 cm subsurface layer is declining, even in paddocks with a history of liming activity (Burns and Norton 2018). Soil acidification processes affect all agricultural systems that export product and current liming programs are not addressing acidity below the 0–5 cm surface soil.

Entrenched acid soil management practices need updating, these include:

1. Soil samples collected at standard depths of 0–10 cm that guide management programs and lime rates often overestimate soil pH due to pH stratification. Sampling intervals of 5 cm to a depth of 20 cm are necessary to detect acidic subsurface layers.

2. Management and research efforts tend to focus on severely acidic soils while acidification of highly productive soils with marginal acidity (e.g. 0–10 cm pH_{Ca} > 5.0) is not addressed.

3. Traditional acid soil management practices that apply lime at rates just sufficient to remove aluminium toxicity (≈pH_{Ca} 5) do not prevent subsurface acidification.

Soil pH targets and trigger points need adjustment

Research points to opportunities to modify acid soil management programs to increase the effectiveness of lime investment to ameliorate subsurface acidity. For example, maintaining pH_{Ca} *above* 5.5 in the surface 10 cm, will gradually increase pH in subsurface layers below 10 cm. This higher pH target is supported by several long-term experiments, including the MASTER site near Wagga Wagga (Li *et al*. 2019). At this site, soil pH in the 10–20 cm and 20–30 cm depths was increased by 0.80 and 0.36 pH units, respectively, by maintaining soil pH_{Ca} in the 0–10 cm depth above 5.5. This was achieved with an initial 'capital' lime rate of 3.7 t/ha (incorporated), then three 'maintenance' lime applications (0.7–1.8 t/ha, topdressed), totalling 8.6 t/ha of lime over 18 years.

To confirm the effectiveness of higher pH targets and re-liming triggers on ameliorating soil acidity, large-scale field sites were established near Morven (NSW Southern Slopes), Lyndhurst and Toogong (NSW Central Slopes) as part of the NLP project. They were designed to monitor long-term changes in soil chemical properties and:

1. investigate the optimal rate of lime and application methods (i.e. surface applied or incorporated) to prevent subsurface acidification and enhance downward movement of the lime effect;

2. identify the residual value of applied lime and the acidification rate of current farming systems.

The 2.0 ha sites demonstrate a range of acid soil management options across soil types typical of the medium to high rainfall zones of NSW (Table 1). The sites at Morven and Lyndhurst were under long-term pasture and had no lime history. The soils are severely acidic (i.e. pH_{Ca} < 4.5) to a depth of at least 30 cm.

In contrast, the soil pH profile of the Toogong site represents moderately acidic soils that support highly productive mixed farming systems of the Central and Southern Slopes regions. The site has a history of lime application and the traditional paddock soil tests returned pHCa of 5.0 from 0–10 cm samples. It was not considered a high priority for liming.

However, sampling in 5 cm increments indicated stratified soil pH and an acidic subsurface layer developing at 5-15 cm: the 0–5 cm pH_{Ca} was 5.1, decreasing to 4.8–4.9 in the 5–15 cm layers and increasing to 5.2 at 15–20 cm and 6.0 in below 20 cm.

Based on a survey of farmers and advisors, the triggers that prompt lime application, often immediately before sowing acid-sensitive species, are a combination of factors, including soil pH_{Ca} of less than 4.5 to 4.8 for 0–10 cm samples and presence of aluminium (often > 5% Alex). Using these criteria, the severely acidic paddocks at Morven and Lyndhurst, would be prioritised for liming.

Why bother with a lime trial on the moderately acidic soils at Toogong? It is unlikely that there will be a measurable productivity response to lime application at this site, in the short-term. However, it is an ideal site to test the effectiveness of early intervention aimed at preventing subsurface acidification and a subtle decline in productivity over the long term.
It is important that such highly productive paddocks, which have high acidification rates, are not excluded

Table 1. A summary of test results for soil pH, exchangeable aluminum (Alex%) and effective cation exchange capacity (ECEC) from samples collected at 5 cm intervals at the Morven, Lyndhurst and Toogong field sites.

Soil Depth (cm)	Morven Southern Slopes ECEC: 2.9		Lyndhurst Central Tablelands ECEC: 2.3		Toogong Central Slopes ECEC: 10	
	pH_{Ca}	Al_{ex}%	pH_{Ca}	Al_{ex}%	pH_{Ca}	Al_{ex}%
0–5	4.5	10	4.1	31	5.2	< 1
5–10	4.2	27	4.1	47	4.8	1.8
10–15	4.3	27	4.2	50	4.9	1.3
15–20	4.4	20	4.3	48	5.3	1.1

Note: Soil pH_{Ca} values used throughout refer to soil pH measured in asolution of calcium chloride, which are approximately 0.8 pH unit lower than pH measured in water (pH_w).

Table 2. Lime rates and application method at Morven, Lyndhurst and Toogong field sites.

Treatment	Incorporated (Yes/No)	Description/rationale	**Site 1: Lyndhurst** Incorporation: Horsch® Tiger	**Site 2: Morven** Incorporation: disc harrows	**Site 3: Toogong** Incorporation: disc harrows
			Rate of lime applied (t/ha)		
1	No	Nil lime, not incorporated (NI)	0	0	0
2	No	Target 0–10 cm pH_{Ca}>5.5 Trigger for re-liming when pHCa decreases to 5.5	5.9	4.0	2.8
3	Yes				
4	No	Target 0–10 cm pH_{Ca}~5.2 Trigger for re-liming when pH_{Ca} decreases ~ 5.0	4.7	3.0	1.0
5	Yes				
6	No	Maintain target in 0-5 cm at pH_{Ca} >5.5 Trigger for reliming: 0–5 cm pH_{Ca} decreases to 5.5	2.9	2.0	1.4
7	Inc	Once-in-a-generation	7.0*	6.0*	3.8

* Despite high rates of lime applied at Lyndhurst and Morven there were no visual symptoms of induced nutrient deficiency

from liming programs. If liming is delayed until subsurface pH drop to critical values that cause plant clinical symptoms of soil acidity (e.g. stunted, stubby root systems): (i) production is already compromised; (ii) ameliorating subsurface layers becomes increasingly expensive; and (iii) it will take time and expense to ameliorate acidic subsurface layers.

An early intervention strategy is particularly important for non-arable country and zero-tillage systems where cultivation is not an option.

Field sites test range of management options

Treatments at the field sites were selected by steering committees of local farmers, advisors and NSW DPI to monitor the effect of different rates of lime, with or without incorporation, on change in soil chemical properties to a depth of 30 cm. Plant response data is not being collected, due to funding limitations.

The rate of lime applied is specific for each site, depending on the starting pH and effective cation exchange capacity (ECEC) of each site and the target pH. Table 2 summarises the rationale for each treatment, including lime rates to achieve pH_{Ca} > 5.5 or the traditional target of about 5.2.

Treatment 6 tests whether the efficiency of surface-applied lime can be improved by regular topdressed applications of lower rates of lime, compared with traditional practices (i.e. treatment 4) or pH_{Ca} target >5.5 pH (treatment 2). This is particularly important for situations where topdressing is the only option. When lime is not incorporated the surface soil pH is elevated, reducing the solubility of the topdressed lime, and leaving a proportion of the applied lime unreacted on the soil surface. This unreacted lime represents an opportunity cost, has very limited impact on improving soil pH and is at risk of being lost via erosion.

The ‘once-in-a-generation’ lime rate (treatment 7) tests the boundaries for farmers prepared to commit to an effective one-off deep incorporation:

• Will high lime rates induce nutrient deficiencies?

• Will effective mixing of lime to increase pH_{Ca} >5.5 to the depth of incorporation increase the rate of movement of the lime effect down the soil profile and prevent subsurface acidification?

Method and results to date

Lime of high neutralising value (>95%) and fineness (99% passing through 250 µm sieve) was applied to the Morven site in October 2019, and in February 2020 at Lyndhurst and Toogong, either surface applied and only incorporated by sowing, or incorporated with either a Horsch® Tiger to an estimated depth of 20 cm at Lyndhurst or with disc harrows to 10 cm depth at the other sites.

All sites were sown with farmer equipment to crop in 2020, and pasture was sown at Lyndhurst and Toogong in 2021. The delay between lime application and sowing pasture allowed time for the lime to react and increase pH.

Figure 1 shows that incorporation with a Horsch Tiger cultivator™ at Lyndhurst mixed 4.7 t/ha of lime to a depth of about 15 cm (treatment 5), 4.7 t/ha of surface-applied lime (treatment 4) remains concentrated on the soil surface.

Test results from soil samples collected at 2.5 cm depth intervals in December 2020 and January 2021 provide an early indication of the relative effectiveness of the treatments. Preliminary results indicate that across all sites and treatments, targeting pH_{Ca} >5.5 results in greater depth of alkali movement, as in treatments 2, 3 and 7. When lime was incorporated, the magnitude of pH and Alex% change was increased to the depth of incorporation, or deeper. When lime was not incorporated the depth of lime effect increased with the rate of lime application, but even then, change in pH and Alex% was only significant in the 0–5 cm surface layer in sampling, to date.

The full set of results comparing the influence of lime rate and incorporation on soil pH and Alex% to a depth of 20 cm at all sites approximately 12 months after establishment of lime treatments can be accessed online, see Condon and Burns (2021) in reference list below. Note that a considerable proportion of the applied lime has not reacted in that time (Conyers et al. 2020), so we expect that pH will continue to increase until most of the lime has dissolved. Eventually, ongoing acidification will outstrip the neutralising processes being driven by alkali released from the lime. When this occurs, the soil will reacidify and pH will decrease. We are actively seeking funding to enable long-term monitoring of these sites.

Summary

Initial results indicate that:

- maintaining pH_{Ca} >5.5 in the 0–10 cm layers influences acidity in layers below 10 cm.
- incorporation will accelerate the lime reaction and increase the depth of the lime effect.

References

Burns HM and Norton MK (2018) Subsurface acidity threatens central and southern New South Wales cropping areas. Proceedings of the National Soils Conference, Canberra, ACT, Australia, November 2018, (eds N Hulugalle, T Biswas, R Greene and P Bacon), pp. 352–353, Soil Science Australia.

Condon J and Burns H (2021) Future proofing agricultural production through effective management of acidic soils. In: Southern NSW Research Results 2021, NSW Department of Primary industries. pp. 116-125. Available at: https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/southern-nsw-research-results

Conyers MK, Scott BJ, Whitten MG 2020. The reaction rate and residual value of particle size fractions of limestone in southern New South Wales. Crop & Pasture Science, vol. 71(4), pp. 368–378. Available at: https://doi.org/10.1071/CP20045.

Li GD, Conyers MK, Helyar KR, Lisle CJ, Poile GJ, Cullis BR (2019) Long-term surface application of lime ameliorates subsurface soil acidity in the mixed farming zone of south-eastern Australia, Geoderma 338, 236-246.

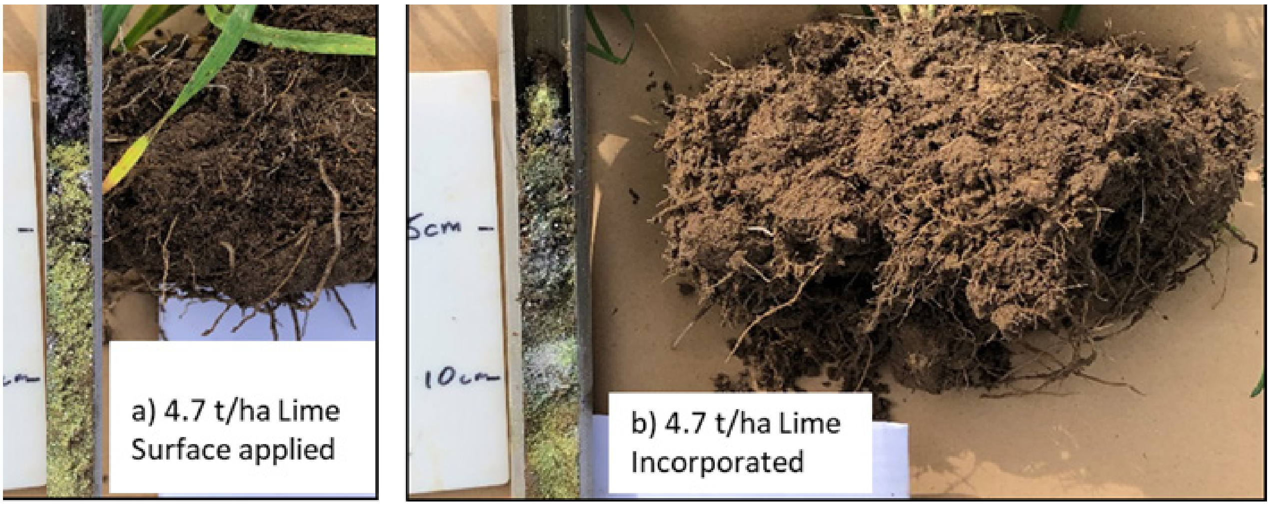
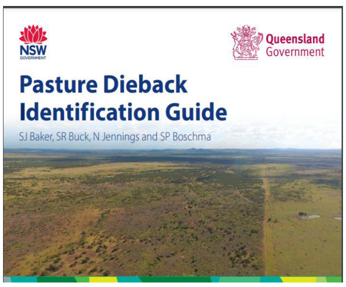


Figure 1. Lime incorporation improved root development and depth of pH change at the Lyndhurst site. The purple pH colour in the surface 2 cm of the soil cores a) 4.7 t/ha of the lime - surface applied shows that lime remains concentrated at the surface with pHCa of 6.3, decreasing to pHCa 4.9 at 5 cm and 4.3 at 10 cm. In b) the soil core indicates that aggressive incorporation of 4.7 t/ha increase pH to depth of abot 15 cm.

Pasture dieback identification guide released

Pasture dieback is a condition that kills summer growing grasses. These grasses are also known as C4, sub-tropical or tropical grasses. Pasture dieback begins in small patches which can grow to affect large areas, significantly reducing pasture productivity.



This guide describes some common pasture disorders and diseases with symptoms similar to pasture dieback, however, not all pasture disorders are discussed.

https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/1333692/16876-PastureDiebackGuide2021.pdf

Help NSW DPI identify where pasture dieback is by reporting. If you suspect symptoms of pasture dieback please:

- Contact the Exotic Plant Pest hotline on 1800 084 881
- Email biosecurity@dpi.nsw.gov.au with a clear photo and your contact details or,
- Complete the online reporting form https://biosecurity.transactcentral.com/Biosecurity/servlet/SmartForm.html?formCode=report-a-biosecurity

For more information including factsheets and webinars check out https://www.dpi.nsw.gov.au/agriculture/pastures-and-rangelands/establishment-mgmt/pests-and-diseases/pasture-dieback

Is there a critical phalaris (*Phalaris aquatica*) density to determine when to resow a pasture?

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[2]Department of Agriculture and Fisheries, Emerald, Queensland

Phalaris (*Phalaris aquatica*) and subterranean clover (*Trifolium subterreanuem*) are the primary sown pasture species in the high rainfall zone of southern Australia due to the persistence and production of phalaris. However, annual grasses are commonly the dominant species group throughout pastures in southern New South Wales. Following from the current drought conditions it is likely that the dominance of annual grasses could increase. Pasture establishment costs are high and there are no current benchmarks that can be used to determine the point at which a degraded perennial pasture requires re-establishment. A single small plot experiment was conducted to ascertain if a critical phalaris basal frequency for pasture production could be determined.

The experiment was located on at Bringenbrong (-36.15 S, 148.05 E; GSR (Apr-Nov 2016) 849 mm; elevation 286 m) in the South-West Slopes of NSW in 2016. The soil was characterised as a yellow Sodosol with a pH ($CaCl_2$) of 4.3 and an aluminium percentage of 14%. The experiment was conducted in an established phalaris pasture cv. Grazier with a high basal frequency between 40–50%. Basal frequency was measured by placing a steel mesh over the plot which had squares that were 10 x 10 cm in size. Basal frequency was determined by counting the number of squares that had a phalaris base in them. Basal frequency is a simple and fast tool to assess phalaris density. Four basal frequency treatments were applied, 40–50%, 30–39%, 20–29% and 10–19% (assigned the letters A, B, C & D, respectively). Plant tufts were removed by a mattock to achieve the required density for each plot. For each basal frequency treatment, there was a plus and minus nitrogen (N) treatment to determine if N would influence the critical basal frequency. The N fertiliser treatments were applied as urea (46% N) immediately before rainfall on April 19, June 17 and August 1 with 46 kg N/ha applied each date. After basal frequency treatment application on April 15, the site received a uniform application of single superphosphate (9% P, 11% S) at the rate of 25 kg P/ha. Subterranean clover (cv. Rosabrook) seed was sown on April 19 at a rate of 20 kg/ha (300 seeds/m^2) in the space between phalaris by hand which had been lightly disturbed. Due to the lack of rain in April, the experimental area was irrigated with 20 mm of water by watering can on April 19 to simulate a rainfall event and encourage autumn growth. Dry matter was measured by harvesting the total plot to a height of 2.5 cm on five occasions at a six-week intervals on: June 14, July 29, September 9, October 24 and December 6. The herbage was then sorted into four components: phalaris, clover, annual grasses and other broad leaf species. These components were then dried at 60^{o}C for 48 hours and weighed.

Species in the phalaris pasture during the season included winter grass (Poa annua), annual ryegrass (*Lolium rigidum*), capeweed (*Arctotheca calendula*), sorrel (*Rumex acetosella*) and wireweed (*Polygonum aviculare*).There were no significant differences of clover establishment between plots with a mean of only 58 plants/m^2 established.

Nitrogen treatment (Figure 1) greatly increased pasture production (37%) primarily with increases in phalaris (79%) and annual grasses (39%). The production of clover decreased in response to nitrogen application (45%) presumably through competition for light with the grasses. The effect of nitrogen on this pasture was not surprising but the addition of a nitrogen treatment was primarily to determine if there was an interaction between critical phalaris basal frequency and nitrogen fertility. Importantly this means that responses to basal frequency are independent of nitrogen fertility.

At three sampling times phalaris dry matter for the lowest basal frequency was less than higher basal frequencies (Figure 2). In comparison, total pasture production for the season was not affected by phalaris density. Phalaris basal frequency treatments were only associated with increased total pasture production at the June 14 sampling when treatments A and B were greater than treatment D. This occurred when the pasture composition was dominated by phalaris at an average of 99% of dry matter. For all other sampling periods, basal frequency had no effect on total pasture production. Total pasture production was determined by nitrogen application and the proportion of phalaris in the sward decreased as basal frequency decreased.

Clearly a reduction in phalaris basal frequency below 20% reduced phalaris production but does not necessarily reduce total pasture production. If there is a critical density for phalaris in which

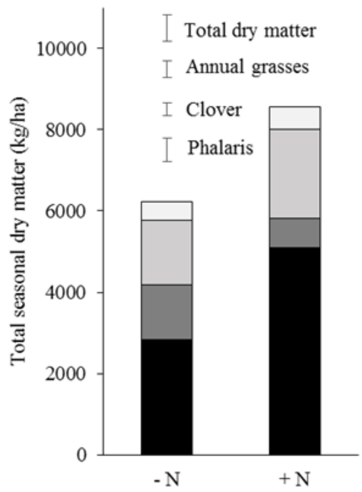

Figure 1. The effect of nitrogen application on total seasonal dry matter for different components (phalaris – black, clover – dark grey, annual grasses – light grey, broadleaf weeds – white) within the pasture for the season. Significant differences were found for phalaris ($p < 0.001$), clover ($p < 0.001$), annual grasses ($p < 0.005$) and the total dry matter ($p < 0.001$). Broad leaf weeds were not different between nitrogen treatments. Bars are LSD values at p = 0.05 level.

it should be re-sown it is likely to be less than 10% which was not tested in this experiment. Therefore, low density phalaris paddocks can still be productive.

A reduction in phalaris basal frequency in an established pasture will change the botanical composition with potential increases in either clover or annual grass production. Whether or not a pasture with low phalaris frequency is still productive will depend on the annual species that are present. In this study the annual grasses were primarily annual ryegrass and winter grass which at the vegetative stage are high in quality. If the annual species was vulpia (*Vulpia stipoides*) then there would be a reduction in quality. In contrast, the

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quality of a phalaris pasture with a lower basal frequency could be improved if the annual grasses were replaced with subterranean clover. This is because clover is able to maintain a higher herbage quality than grasses during late spring and summer. There would however be a trade-off due to higher clover content in that autumn production is likely to be reduced. This would occur during the critical period of feed deficit on farm. Growers are encouraged to assess the companion species of the phalaris pasture. If it is dominated by annual grasses then quality could be improved by direct sowing clover into the pasture. It should be emphasized that sowing clover seed is much more effective then broadcasting seed on the surface.

If phalaris basal frequency is < 20% then grazing management may provide a solution for increasing basal frequency. Strategic rotational grazing with rest periods during autumn and winter will increase the basal frequency of phalaris. Increasing basal frequency over 20% will result in increased pasture growth early in the season. Growers should utilise grazing management techniques to ensure that basal frequency remain greater than 20%.

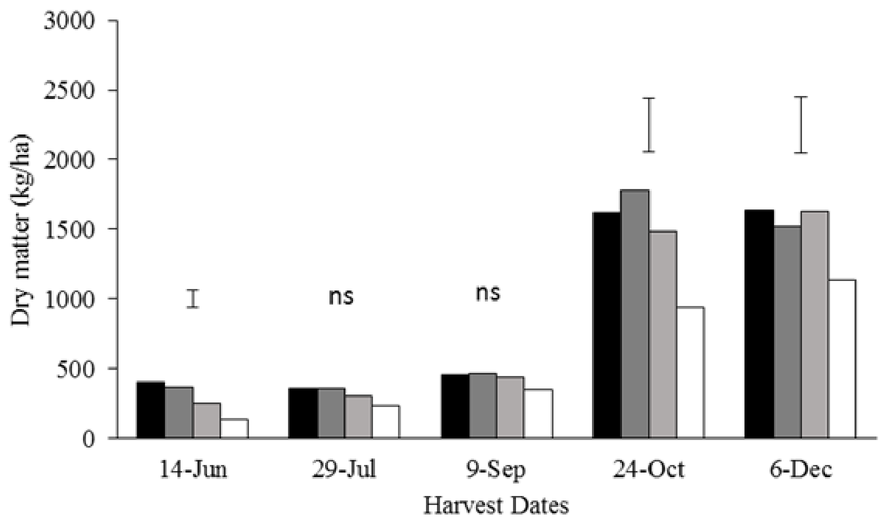

Figure 2. The effect of basal frequency (A – black, B – dark grey, C – light grey, D – white) on phalaris dry matter for five sampling dates. Significant differences found on 14 Jun ($p < 0.001$), 24 Oct ($p < 0.001$) and 6 Dec ($p < 0.061$). Bars are LSD values at $p = 0.05$ level.

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.

Grazing strategies for resilience of ryegrass (*Lolium perenne*) dominant pastures in hill country

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Abstract. Perennial ryegrass (*Lolium perenne* L.) is a widely sown pasture species in temperate regions. Under heat and moisture-deficit stress, its production is suppressed and tiller mortality increases, particularly when plants are simultaneously exposed to other stresses such as intense defoliation. We investigated the effects of extended grazing exclusion periods in spring and summer on herbage and soils of rotationally grazed, perennial ryegrass-dominant pastures at a summer-wet site and a summer-dry site in sheep and beef hill country in New Zealand. Treatments comprised 'grazed' (conventional rotational grazing), 'early opening' (grazing exclusion from mid-spring to midsummer to allow perennial ryegrass to flower), and 'deferred grazing' (grazing exclusion from mid-spring to late summer to allow perennial ryegrass to flower and set seed). At both sites, deferred grazing increased perennial ryegrass tiller density and total vegetation cover, and reduced the abundance of broadleaf species and *Pseudopithomyces chartarum* spores for up to 15 months after exclusion compared with the grazed control. Herbage production was reduced during the deferred period but there was a growth surge thereafter so that herbage production over the study period was similar in the deferred and grazed treatments. Pasture nutritive values were lower in the deferred than the grazed treatment during the exclusion period but were similar in all treatments by the end of the following winter. In the autumn after deferring, seedlings contributed ~50% of the perennial ryegrass tillers present at the summer-dry site but only ~10% at the summer-wet site, where regrowth tillering of existing plants contributed a high proportion of the perennial ryegrass tillers present. Overall, early opening had few effects on the pasture, whereas deferred grazing had numerous positive effects on the pasture but only short-term effects on soil quality.

Crop and Pasture Science
https://doi.org/10.1071/CP21123

Forage brassicas have potential for wider use in drier, mixed crop–livestock farming systems across Australia

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Abstract. Forage brassicas are currently widely used in temperate–humid livestock systems; however, they offer potential to diversify crop rotation and forage options in the drier, mixed crop–livestock zone of Australia. A literature review highlighted that in these hotter and more arid environments, forage brassicas are more likely to fit as autumn sown forage crop where they offer an energy-rich, highly digestible feed source that could be used during periods of low production and nutritive value of other forage sources. However, brassicas can also accumulate several anti-nutritional compounds that require gradual introduction to livestock diets, thereby reducing potential health risks and optimising animal performance. Preliminary experimental and commercial evaluations in subtropical Australia found high production of some forage brassica genotypes (>5 t DM/ha with growth rates of 50–60 kg DM/ha.day), comparable or superior to widely used forage cereal or forage legume options. Several forage brassicas showed moderate to high resistance to the root-lesion nematode, *Pratylenchus thornei*, and hence are likely to provide breakcrop benefits compared with susceptible species (e.g. wheat). Together, this evidence suggests that forage brassicas have significant potential for wider use in crop–livestock farming systems in Australia. However, research is needed to identify genotypic adaptation and to match different forage brassica genotypes to production environments or system niches, especially some of the new genotypes that are now available. There is also a need to develop regionally-relevant recommendations of agronomic and grazing management that optimise forage and animal production, and mitigate potential animal health risks.

Crop & Pasture Science,
https://doi.org/10.1071/CP20271

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Lime on established perennial pasture keeps on giving: Case Study

Hicks Beef, Holbrook, NSW

Key Points

- Productivity from raising soil phosphorus and strategic grazing initially increased, then plateaued
- Introducing a program of lime application onto established perennial pasture boosted carrying capacity by 30%
- Regular soil testing monitors change in soil pH and prompts re-liming
- The long-term objective is to maintain pH_{Ca} of the top 0–10 cm layer above 5.5 to increase soil pH in subsurface layers and encourage deeper root growth.

Tom Hicks (left) with Nick McGrath, project officer from Holbrook Landcare Network, says that he has been surprised at how quickly phalaris/subclover pastures have responded to a program of topdressed lime.

Enterprises: Australian Beef Composites and Red Angus seedstock herd plus commercial beef cattle production

Owners: Tom, Kate, Andrew and Anne Hicks

Introduction

Financial analysis of livestock production response to acid soil amelioration from 1980 to the early 2000s, investigated by NSW Department of Primary Industries (NSW DPI), questioned the economic benefit of liming perennial pasture. Lime application at that time had a long payback period. 'It did not pay' for livestock producers facing relatively high lime prices, low land and livestock commodity prices and very high interest rates.

Twenty years on and significantly higher land and stock prices have livestock producers rethinking the role for effective management of soil acidity.

Background

Tom Hicks, his wife, Kate and parents, Andrew and Anne, operate a commercial beef cattle and seed stock herd of 1500 females on an aggregation of 3,600 ha on the hillslopes south-east of Holbrook. With an average annual rainfall of 650 to 700 mm, phalaris and sub clover pasture is the mainstay for the operation.

Soils range from red loams to severely acidic grey soils and lighter granite soils on the hills. The most acidic soils have pH_{Ca} of less than 4.5 to depth and exchangeable aluminium levels in the surface 10 cm of up to 24%.
Acid soil management practices have been sporadic, with lime only applied to the most acidic paddocks at the standard rate of 2.5 t/ha, immediately before sowing pasture.

The Hicks' strategy for business growth was through buying land and increasing pasture productivity by sowing perennial pasture, building soil phosphorus (P) levels and fencing newly purchased blocks to improve grazing management.

Tom says, "Increasing soil P was the priority as it gave us quick payback."

Fertiliser was one of the inputs cut during the Millennium Drought.
The impact on soil P reserves was highlighted via a soil testing program instigated by Holbrook Landcare Network from 2010.

"Soil tests showed that we were mining soil P, so our post-drought production recovery efforts included a fertiliser and soil testing program to increase soil P from around 10 to 14 ppm (Colwell) to critical P values of 30 and subdividing the new blocks we'd bought," Tom said.

Benchmarking, land value and livestock prices prompt rethink on acid soils

The Hicks' involvement in a benchmarking program indicated that despite reaching optimal soil P targets on their improved pasture, productivity was below that of comparable businesses.

Carrying capacity across their operation had plateaued at 22,000 dry sheep equivalents (DSE). This was below that of top businesses, with similar livestock operations in the benchmarking group.

Tom said that the standout difference between their business and the best performers was the use of lime to manage soil acidity.

Fast forward to 2017. Encouraged by their agronomist, Sandy Middleton and consultant, John Frances, the Hicks began an acid soil management program, applying lime to degraded pasture before resowing.

"Increased land prices in the last decade means that we need to improve our return on investment by increasing productivity on the land we already have," Tom said.

The plan was to topdress lime in spring at rates to increase pH_{Ca} in the top 10 cm to above 5.5 and wait 18 months for the lime to dissolve and increase pH before sowing pasture.

"We prefer to direct drill pasture and cultivation to incorporate lime is not an option on most of our country," said Tom.

"We expected it would take time for the topdressed lime to work, so were surprised to see a response from sub clover after the autumn break

Tom Hicks noticed that lime topdressed onto pastures with a good subclover density produces growth response in clover first, which then drives recovery of phalaris plants.

and couldn't justify spraying out and resowing pasture," he said.

Benefits from todressed lime

Improved health and vigour of the clover was followed by more vigorous growth from phalaris in the second year. Despite a density of only one to two phalaris plants per square metre, the healthier plants spread, now making about 40% of ground cover on those early limed pastures.

In just five years, the combination of P nutrition, grazing management and acid soil management has increased carrying capacity 30% to 32,000 DSE.

These observations compare with 25% more stock and 28% increase in liveweight recorded at the long-term lime experiment (MASTER site) conducted by NSW DPI near Wagga Wagga from 1992 to 2006. Researchers attributed those productivity gains to increased pasture growth, especially in winter and spring, and higher quality feed on the limed pastures.

Tom said that one of the lessons from their experiences has been that increasing soil P is not enough in their acidic soils.

"It's a combination of phosphorus and lime – we wouldn't be getting results from one, without the other," he said.

The dry springs of 2018 and 2019 convinced Tom that they were on the right track. The lime paddocks hung on in the dry period and kicked again after November rain.

"The limed paddocks carried us through the dry," he said.

Tom has also noticed improvements in the health of the pasture, including a gradual change in pasture composition.

"We didn't have to control broadleaf weeds in 2021 and it was the first year we didn't see a response from phalaris to topdressed urea," he said.

These are signs of a vigorous pasture, able to compete with weeds, likely driven by increased nitrogen fixation from the healthier sub clover component boosting growth of phalaris. This is backed by NSW DPI research conducted near Gerogery in the early 2000s, which reported 14% increase in sub clover production two years after lime application and a 38% boost in sub clover nitrogen fixation.

"Our aim is to systematically lime all improved pastures and boost productivity from around 8 DSE on unlimed areas to the 14 DSE we're getting after liming", said Tom.

If the business is to capitalise on the anticipated increase in productivity, Tom said that they will need additional stock and must manage an increased workload. The options are to address soil acidity across the entire improved pasture area and increase scale or put a ceiling on stock numbers and limit the liming program to selected paddocks.

Lime rates, pH targets and monitoring soils for long-term, sustainability

According to Tom, one of the differences in their current approach to managing soil acidity, compared with the guidelines used by his father, has been liming to a pH_{Ca} target above 5.5 in the top 10 cm.

This target is based on 18 years of soil monitoring at the MASTER acid soil site, which showed that it is necessary to maintain pH_{Ca} above 5.5 for the lime effect to move down and gradually increase pH in acidic subsurface layers.

"That means we're going hard to catch up, applying rates from 2 t/ha to 4 t/ha, depending on soil tests," Tom said.

Lime is topdressed onto pastures with reasonable clover and phalaris density, while degraded pastures are resown. Lime may be incorporated to speed up lime reaction and improve pH in the subsurface as quickly as possible, if risk of erosion is low.

Budgeting to spread 1,000 t of lime per year is a significant expense, but Tom sees that unlike annual applications needed to maintain P levels, lime is a long-term investment.

"It keeps working and is gradually improving the health of the soil - the limed paddocks are obvious, glowing green this year," he said.

Soil testing a fixture on the calendar

According to Tom, the discipline of an annual soil testing program is important to guide fertiliser and acid soil management programs, retesting paddocks to monitor P and pH and to check that their approach is working.

"Soil testing tells us the rate of lime the different soils need to keep the pH_{Ca} above 5.5," he says.

The future

Tom said that he is following the local research to be sure that their approach is ameliorating pH down the profile as quickly as possible. For example, at a field site established by NSW DPI and HLN on acidic soil nearby at Morven, changes in soil pH down the profile under different lime rate and application treatments is being monitored.

Improved root growth in wheat plants (right) following incorporation of 3 t/ha of lime at the Morven field site compared with Nil lime application (left).

"Seeing the effect of increasing pH on root growth at Morven was an eye opener," he said, following a field day at the site.

Tom compared the extra root growth in wheat at the Morven site to what they have experienced in their pastures. He is confident that increasing pH in the subsurface layers will improve rooting depth of pasture plants.

Tom believes that increased rooting depth is key to pasture persistence and productivity, for example via improved access to moisture in dry periods, as they experienced in 2018 and 2019. He is also interested in research on the benefits of increased pasture health on the capacity of permanent pasture systems to sequester soil carbon, which is an objective for the Hicks Beef operation.

Further reading

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This case study is part of a project funded by the Holbrook Landcare Network, Grassland Society of NSW and NSW Department of Primary Industries, with financial support from the Australian Government National Landcare Program.

NIGHT BEFORE CHRISTMAS IN AUSSIE LAND

Twas the night before Christmas; there wasn't a sound.
Not a possum was stirring; no-one was around.
We'd left on the table some tucker and beer,
Hoping that Santa Claus soon would be here;

We children were snuggled up safe in our beds,
While dreams of pavlova danced 'round in our heads; And Mum in her nightie, and Dad in his shorts, Had just settled down to watch TV sports.

When outside the house a mad ruckus arose; Loud squeaking and banging woke us from our doze.
We ran to the screen door, peeked cautiously out, Snuck onto the deck, then let out a shout.

Guess what had woken us up from our snooze, But a rusty old Ute pulled by eight mighty 'roos.
The cheerful man driving was giggling with glee,And we both knew at once who this plump bloke must be.

Now, I'm telling the truth it's all dinki-di, Those eight kangaroos fairly soared through the sky. Santa leaned out the window to pull at the reins, And encouraged the 'roos, by calling their names.

'Now, Kylie! Now, Kirsty! Now, Shazza and Shane!
On Kipper! On, Skipper! On, Bazza and Wayne! Park up on that water tank. Grab a quick drink,
I'll scoot down the gum tree. Be back in a wink!'

So up to the tank those eight kangaroos flew,
With the Ute full of toys, and Santa Claus too.
He slid down the gum tree and jumped to the ground,
Then in through the window he sprang with a bound.

He had bright sunburned cheeks and a milky white beard.
A jolly old joker was how he appeared.
He wore red stubby shorts and old thongs on his feet,
And a hat of deep crimson as shade from the heat.

His eyes - bright as opals - Oh! How they twinkled!
And, like a goanna, his skin was quite wrinkled!
His shirt was stretched over a round bulging belly
Which shook when he moved, like a plate full of jelly.

A fat stack of prezzies he flung from his back,
And he looked like a swaggie unfastening his pack. He spoke not a word, but bent down on one knee, To position our goodies beneath the yule tree.

Surfboard and footy-ball shapes for us two. And for Dad, tongs to use on the new barbeque. A mysterious package he left for our Mum,Then he turned and he winked and he held up his thumb;

He strolled out on deck and his 'roos came on cue;
Flung his sack in the back and prepared to shoot through. He bellowed out loud as they swooped past the gates-

'MERRY CHRISTMAS to all, and goodonya,MATES!'

Unknown Author

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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.

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