GRASSLAND SOCIETY OF NSW INC.

Newsletter

Welcome to the second issue of the Grassland Society of NSW (GS NSW) newsletter for 2018. In this issue there is a report on the very successful GS NSW Pasture Update held at Grong Grong in March (page 2). This day focused on pasture establishment and early management of perennial pastures. As always keep an eye on the website and Facebook page for upcoming (GS NSW) Pasture Update events near you.

Other articles in this issue include; Understanding your feedtest (page 4), the Drought Feed Calculator (page 3) and the next installments in a series of articles on temperate pasture establishment - soil testing and soil issues that affect pastures (pages 5 and 8).

Don't forget it is nearly time to renew your membership subscription. Annual subscriptions of $60 for 2018/2019 are due 1 July 2018.

Payment can be made either by cheque or electronically. Don't forget you can also go to www.grasslandnsw.com.au and access the payment page via the green "JOIN NOW' button.

Payments are processed through PayPal, but you don't need a PayPal account - simply choose the option to "Pay with a credit or debit card" which is below the login area on the PayPal page. Don't forget to add your name to the comments box so we know you have paid.

Carol Harris,
Editor

The Grassland Society of NSW invite you to an afternoon event on 17 July 2018 to inspect grazing experiments at NSW DPI Orange Agricultural Institute and hear from Warwick Badgery, Dougal Pottie and Allen Benter (NSW DPI) on new technologies & how they can be used to assist grazing management decisions.

The event kicks off at 2.30 pm at the Training Centre Orange Agricultural Institute Forest Road Orange. Refreshments will be available after the paddock inspections. RSVP to secretary@grasslandnsw.com.au by 10 July.

For Grassland Society of NSW Members

Notice of Annual General Meeting of the Grassland Society of NSW Inc

Date: Tuesday 17 July 2018
Time: 5.15 pm
Venue: Training Centre, Orange Agricultural Institute, Forest Road Orange

Notice is hereby given that the Annual General Meeting of the Grassland Society of NSW Inc will be held on Tuesday 17 July 2018 at 5.15 pm

The business of the meeting will be:

- Receive and accept the Minutes of the Annual General Meeting held 24 July 2017.
- Receive and accept President's Report.
- Receive and accept Treasurer's Report.
- Election of Management Committee members.
- General Business.

Please then join us for dinner at the Parkview Hotel 281 Summer Street Orange at 7 pm. RSVP to the Secretary, Janelle Witschi, either by mobile 0408 612 235 or by email: secretary@grasslandnsw.com.au if you are attending by no later than Tuesday 10 July 2018 so we can confirm numbers for catering.

In this newsletter

Grong Grong (Berrembed Station) Pasture Update report

On March 22 producers and agronomists travelled from a radius of 150 km to the half-day Pasture Update at 'Berrembed Station', Grong Grong, 65 km west of Wagga Wagga. This day focused on establishment and early management of perennial pastures. The agenda was driven by interest among many mixed farmers in the region wanting to improve pasture quality and persistence as they expand the livestock component of their business.

Andrew Lloyd, Manager of Berrembed Station, hosted a tour of the 5,300 ha mixed farming operation to showcase the pasture improvement program. This covered many of the issues that the field day delegates are facing, particularly in regard to paddock preparation and successful establishment of perennial pastures.

Mr Lloyd outlined changes to the pasture improvement program currently being implemented to support a planned 25% increase in livestock numbers with a shift towards more perennial pasture and shorter crop rotations. Mr Lloyd said that the general aim is to crop for only 3 to 4 years before returning to pasture, allowing the operation to maintain flexibility and to be in a position to quickly adjust to changing markets.

Currently carrying the equivalent of 21,000 DSE, the Angus breeding herd relies heavily on native and naturalised pastures, with only 780 ha of sown pasture – predominantly SARDI Grazer lucerne (winter activity rating of 6). Sub clover is not included in pasture mixes because of bloat risk. The medium-term plans include a reduction in the cropping area to around 1800 ha annually, of which 30% will be undersown.

This set the scene for excellent discussion as the tour progressed through paddocks at various stages from pre-sowing weed control to grazing management of established pastures. Providing technical information and insight from their local experience were Frank McRae (AustWest Seeds), Richard Hayes (Senior Research Agronomist, from NSW Department of Primary Industries(NSW DPI)) Harry Hosegood (Heritage Seeds) and Helen Burns (Development Officer, NSW DPI).

The issues that resonated with the tour delegates were (i) effective weed control prior to establishment, (ii) the pros and cons of using cover crops to establish pasture, and (iii) the importance of rotational grazing for persistence of perennial species. The discussion loosely followed the eight key stages of the 'Perennial pasture establishment checklist' adapted from Temperate Perennial Pasture Establishment Guide (NSW DPI 2016). www.dpi.nsw.gov.au/tppeg .

Mr McRae stressed the importance of effective weed control, low weed seed levels and a clean seed bed before sowing. All pasture seedlings are weak competitors and with limited herbicide options for weed control in seedling pastures, the best strategy to avoid heavy weed burdens is to start with clean paddocks. Delegates were also warned of the risks of residual herbicides and the need to check herbicide labels. Of particular concern for local producers is risk of failed establishment of lucerne and clover due to persistence of residues of the commonly used in-crop herbicides, chlorpyralid (Lontrel™) and triasulfuron (Logran®).

The ongoing debate on the pros and cons of establishing perennial pasture under crop (undersowing) versus as a stand-alone pasture was given local context by Richard Hayes, who presented results from local research at Ariah Park that was part of the Future Farm Industries EverCrop experiments in the South West Slopes of NSW (link - https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2015/07/evercrop-improving-establishment-of-perennial-pastures).

One of the main reasons for including a cover crop is to achieve income from the harvested grain to off-set the cost of pasture establishment. However, the cover crop will compete with pasture seedlings for moisture, nutrients and light; it reduces the size (and root system) of the perennial pasture seedling, as well as seed production from the annual legume component. Furthermore, cover crops almost always lead to greater weed incursion in pastures, reducing pasture quality and increasing competition for water and resources to desirable species such as lucerne. Given the buoyant red meat and wool prices, the delegates were encouraged to consider the negative impact of the cover crop on pasture establishment and long-term productivity of the perennial pasture.

The ability of the pasture species to recover from the crop competition and establish successfully is very dependent on climatic conditions during spring and summer of the establishment year. Therefore, the use of a cover crop increases the risk of poor pasture establishment, particularly in seasons of low rainfall. Some guidelines Mr Hayes recommended to minimise the impact of cover crops on pasture establishment include:

Pasture Update attendees at Berrembed in Sardi grazer lucerne established under 20 kg/ha of La Trobe barley in 2016, which yielded 4.25 t/ha of grain. Photo: Helen Burns

* Do not sow perennial grass species or chicory under cover crops; establishment is affected, even at low cover crop sowing rates;
* Reduce crop sowing rates to one quarter of the normal rate. Trial results show that lower crop sowing rates had little impact on grain yield but had a potentially large benefit on pasture establishment, particularly in dry years;
* Keep pasture sowing rates up to help establish a dense pasture sward
* Sow early in the sowing window. Warm growing conditions benefit the less vigorous pasture seedlings; and
* Delay nitrogen applications to limit early vigour and growth of the cover crop.

Mr Hayes said that lucerne was the only pasture species that established successfully under cover crop across a range of seasons across the EverCrop experimental sites. Spring is usually the critical period for pasture seedlings competing with crop during grain fill. While lucerne is summer-active and able to respond to summer storms, the Mediterranean-type phalaris and cocksfoot varieties suited to the region enter a state of dormancy over summer and cannot recover after grain harvest and respond to summer rain.

Mr Lloyd said that the has been satisfied with lucerne establishment at Berrembed Station under cover crop sown at 25 kg/ha for wheat and 20 kg/ha of barley, with 3 kg/ha of lucerne seed (pre-coated). Lucerne sown in 2016 had no setbacks in a year of well-above average rainfall. Areas of lucerne sown in autumn 2017 under cover crop were struggling with lack of moisture, while a trial area of stand-alone lucerne, sown in spring 2017, was showing good promise despite the exceptionally dry summer period.

Supply of perennial grass seed is an issue in 2018 and producers were advised by representatives of seed companies that last minute orders were unlikely to be filled. They were advised that a longer term approach was needed to sure up seed supply through their agents.

Effective grazing management of perennial pastures in large paddocks, often more than 50 ha, was a challenge identified by delegates aiming to improve persistence of lucerne stands. The role of rotational grazing and the importance of the ‘rest period’ that allowed plants to rebuild root reserves needed to support periods of extended grazing was reinforced. This led to some interesting discussion on logistics: how many paddocks, the logistics of moving mobs of stock and the role of block farming.

Feedback from local agronomists who attended the day indicated that many producers operating mixed farming enterprises in the low to medium rainfall zone (average annual rainfall < 450 mm) are currently shifting the emphasis of their crop-dominant mixed farming operations from 70% crop and 30% livestock to 40 - 50% livestock. With estimates that approximately 80% of the ‘pasture’ is not sown and is ‘whatever comes up’, including naturalised clovers, annual grass and broadleaf weeds, there is huge potential to increase productivity from pastures in this region.

The Grassland Society appreciates the support of the 37 delegates who attended the Grong Grong Pasture Update that was held on March 20. The support of Nicole Robinson of Riverina Local Land Services is also appreciated. She worked closely with Andrew Lloyd and the staff at Berrembed Station, Helen Burns and Geoff Casburn, Development Officers from NSW Department of Primary industries (NSW DPI), and Frank McRae, Product Development Manager for AustWest Seeds to organise the event. The Grassland Society also thanked MLA for funding they receive to conduct 5 Pasture Updates across the state and keep the latest research and adaptation of science in front of producers.

When the going gets tough, the Drought Feed Calculator (DFC) gets downloaded.

During April the DFC was downloaded on 270 android and 290 apple devices, with an estimated total number of downloads equalling 12000 since its release in October 2014.

The popularity and use of the “Drought Feed Calculator” is expected to increase if conditions continue to deteriorate across NSW.

The DFC was produced by a team of development officers and researchers building upon great work done by DPI over the last three decades.

The DFC app has world wide appeal with significant numbers of downloads in India, USA, Brazil, Turkey, Mexico, South Africa, Pakistan, Egypt and Italy. The Drought Feed Calculator allows the user to develop a full feeding ration for sheep and cattle. It calculates the daily feed requirement of dry, pregnant, lactating and growing animals and the total amount of feed required for a mob of animals for a selected period. It calculates the cost per head as well as the mob. The DFC is designed for you to use in the paddock or at the silos.

There are 71 different feeds to select from, each with their own estimated energy, protein and dry matter values.

Values can be easily over written when feed test results are available.

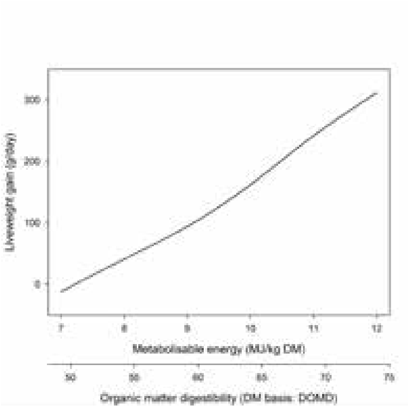
The user can easily assess the value of different feeds by simply comparing the results for up to three feeds as well a mixed ration.

The DFC was recently used to calculate least cost feed rations for livestock impacted by bushfire. The DFC can be downloaded free from the App Store or Google Play – just search ‘Drought Feed Calculator’.

Understanding your feedtest

John Piltz, NSW DPI Wagga Wagga

Feed quality determines potential growth rate and production from sheep and cattle. Feed is also the single biggest input in livestock production systems. Therefore knowing the quality your feed is important to optimise the balance between production goals and costs in a well managed livestock operation.



Predicted crossbred lamb growth rate for increasing diet ME content (source: Grazfeed). Additional gain of 217 g/day between ME of 8 and 12. Equivalent to 14 g/day per unit change in DOMD

Feed quality is an objective value on which to balance diets and provide supplements that ensure growth targets are met, and the basis for trading hay, grain, silage and other feeds.

There are several laboratories in NSW that commercially test feeds. Test results routinely provided include:

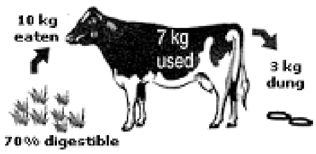
- Dry matter content (DM)
- Digestibility (DMD or DOMD)
- Metabolisable energy (ME)
- Crude protein (CP)
- Neutral detergent fibre (NDF)
- Acid detergent fibre (ADF)
- Water soluble carbohydrate (WSC)
- Organic matter (OM)
- Ash
- Ether extract (EE)
- Ammonia nitrogen (NH3-N)
- pH

Feed is made up of DM and water. The DM contains all the energy, protein, minerals and vitamins available for maintenance, growth, reproduction and lactation. Feed quality data is presented on a DM basis i.e. the amount of ME per kg of DM.

ME is measured as megajoules (MJ)/kg DM. ME is the energy that is available for maintenance, growth, reproduction and lactation. ME is the first limiting nutrient in most ruminant diets and the most important indicator of feed quality.

ME is difficult and expensive to measure directly because animals need to be housed in an enclosed metabolic chamber for a period of time. In commercial tests the ME is calculated from digestibility.

Digestibility is how much feed DM is digested by the animal and not excreted as faeces.



ME is best correlated with digestibility expressed as DOMD. DOMD is calculated using this equation:

$$\frac{\text{Feed DM eaten - faeces DM}}{\text{Feed DM eaten}} \times 100\ (\%)$$

Crude protein is a calculated value obtained by multiplying the quantity of nitrogen (N) by 6.25. CP is necessary for tissue maintenance and muscle growth. High ME feeds can support high levels of growth but require adequate levels of CP. Younger animals require higher CP levels while the maintenance CP requirement of older animals is much lower.

CP is not usually the first limiting nutrient, but some low CP feeds may need a protein meal supplement. Maize silage is an example of a low CP forage. Cottonseed meal is an example of a protein meal supplement.

The rumen microflora require N to grow. Rumen degradable protein (RDP) becomes available in the rumen during digestion. Undegraded protein (UDP) is digested further down the intestinal tract.

Excessive heating can reduce the availability of N in hay or silage. This can occur when hay is baled too wet. Acid detergent insoluble N or CP (ADIN or ADICP) is a measure of heat damage. ADIN (or ADICP) above 12% of the total N (or CP) indicates heat damage.

NDF, ADF and lignin are all measures of fibre content. NDF contains hemicellulose, cellulose and lignin. ADF contains cellulose and lignin.

Hemicellulose if mainly digestible, cellulose is partially digestible while lignin is indigestible. Fibre content is negatively correlated with digestibility. As plants mature fibre content increases which is why more mature plants are less digestible and therefore lower in energy.

DM is composed of OM and Ash. Ash is the residue remaining after the OM is burned off. Ash contains the minerals essential for livestock.

Ash content of pasture is typically 9-12%. High ash content can indicate soil contamination. High ash content reduces DOMD and ME as can be seen from the equation above.

WSC are soluble sugars and an easily digested energy source. WSC's are produced during photosynthesis which means they increase during the day with sunny conditions. Higher WSC levels are associated with more palatable forages. WSC ferment during silage making.

EE is the lipid (fats and oils) component of feed, at it is measured by extracting in petroleum ether. It has the highest ME value found in feeds (approximately 35 MJ/kg DM). Diets containing more than 3-5% EE are unsuitable for ruminants.

NH3-N and pH are tests specifically used for silages. During ensiling the

Ammonia N (% total silage N)	Silage fermentation quality
Less than 5	Excellent
5 to 10	Good
10 -15	Moderate
Greater than 15	Poor

protein in plants is broken down into smaller sized compounds. NH_3-N is the most degraded form of protein and an indicator of silage fermentation quality.
Silage palatability declines as fermentation quality becomes poorer.

Utilisation of the N fraction is also reduced in some cases. During fermentation WSC are converted to acids and pH drops. Efficient acid production and pH drop are essential for preservation. Therefore pH is also and indicator of silage quality for silages with less than 35% DM. As forages become drier the amount of acid produced is less and not such a good indicator.

Feed testing is an integral part of good animal nutritional management to achieve the best and most profitable results. The Feed Quality Service (FQS) located at the Wagga Wagga Agricultural Institute, Australia (https://www.dpi.nsw.gov.au/about-us/services/laboratory-services/feed-quality-service), offers a comprehensive commercial laboratory testing service for the analysis of animal feed including hay, silage and grain, mixed feeds and total mixed rations, pastures and forages. The FQS testing laboratory is accredited by the National Association of Testing Authorities (NATA).

Silage DM content (%)	Risk of poor fermentation if pH exceeds:-	
	Grasses	*Legumes **
15	4.10	4.20
20	4.20	4.30
25	4.35	4.50
30	4.50	4.70
35	4.65	4.8

** Includes grasses with low sugar content*

What you need to know about soil testing

Editors Note: This article and "Soil issues affecting pastures" on page 8 have been modified from the Temperate perennial pasture establishment guide - steps to ensure success published by the NSW Department of Primary Industries.

The Temperate perennial pasture establishment guide is available at www.dpi.nsw.gov.au/tppeg

Soil testing is a valuable tool used to determine the nutrient or fertility status of a soil and to identify potential constraints that may limit production. It enables you to select pasture species that match the soil characteristics. Considered in conjunction with pasture or cropping history, fertiliser history and economic considerations, soil testing also allows you to make informed fertiliser decisions.

Why should I have my soil tested?

The main reasons for soil testing prior to sowing new pasture are:

1. To identify potential soil and nutrient constraints that may limit pasture establishment and persistence; and

2. To optimise the selection of pasture species to be sown.

How do I take a soil sample?

The accuracy of a soil test is only as good as the sampling procedure! Soil samples are best taken using a soil testing tube which removes a 2.5 cm diameter soil core. These are often marked to give a fixed topsoil sampling depth (usually 10 cm). If the subsoil is being tested as well, remember to keep these samples separate from the topsoil samples. There are a number of methods used to sample soils for testing:

Transect method - The transect method uses a set line (e.g. 100–200 m in length) across a uniform soil type within a paddock. The start and finish points can be landmarks or GPS coordinates that can be easily found again.

Point sampling method - Point sampling involves sampling from a small area (not much bigger than a car) that is representative of a larger area, with similar soil type, depth, aspect, elevation, pasture history, etc. It is important that the person sampling is confident in being able to

select a point that is representative. GPS coordinates of the sample points are recorded.

The transect or point sampling methods allow you to resample specific locations and monitor fertility changes over time.

Random sample method - Traditionally soil samples have been taken from random points in a zig-zag pattern across the paddock. This method is no longer recommended as it is not repeatable, may not be representative of the whole paddock and is much less reliable in showing trends than the transect or point sampling methods.

Assessing problem areas

When sampling to assess problems in a paddock take samples from areas of both good and poor growth and have them analysed separately. Use the point sampling method in the affected area and use either the transect or point method to collect samples that are representative of the unaffected area.

Interpreting soil tests

The presentation of soil test results varies between soil testing services, depending on reporting preferences and the methods used by the testing laboratory. Discuss your soil test results with an agronomist.

Some notes on the common tests are outlined below.

pH

Soil acidity is measured on a pH scale from 0 (most acidic) to 14 (most alkaline), 7 is neutral. The scale is logarithmic, which means that, going down the scale from pH 7 (neutral), each unit is 10 times more acidic than the one before it. For example, a soil with a pH of 6 is ten times more acidic than soil with a pH of 7 (neutral) and a soil with a pH of 5 is one hundred times more acidic than a soil with a pH of 7.

It is important that you are clear which pH testing method is used for your soil analyses. The suffix Ca after the pH figure (i.e. pH_{Ca}) signifies that the pH was measured in a solution of calcium chloride ($CaCl_2$). This test is preferred by most soil scientists. When soil pH is measured in a solution of calcium chloride the pH_{Ca} is typically 0.5–0.8 units lower than if the pH was measured using the 1:5 soil: water suspension method. Results from tests using the water suspension method are usually expressed as pH_W. Note that most field pH testing kits use the water method.

Soil pH can be raised by applying lime to the soil. The optimum pH_{Ca} for many pasture and crop species is between 5.0 and 7.5.

Major soil nutrients

Phosphorus (P) - Phosphorus is a major nutrient essential for plant growth but is commonly deficient in Australian soils, with the exception of some basalt soils. Even paddocks with a long history of applied P may be deficient and benefit from P applications.

It is relatively immobile in the soil and is usually concentrated close to the surface. It is unlikely to be leached (except in very sandy soils) but can be lost with erosion.

Phosphorus can become unavailable to plants in acid soils when it is "tied up" with aluminium and iron in solution, so it is important to keep your soil pH_{Ca} at around 5 or above to maximise the benefit of applied P. Other factors that influence the ability of a soil to hold and/or fix P include: cation exchange capacity, organic matter content and iron levels.

There are three main tests for P in Australia: Bray, Colwell and Olsen. As they produce very different results, it is important to know which one is referred to in your report. The Bray test is not suitable for soils with a pH_{Ca} higher than 7.0. Bray test results are most accurate at low soil pH. The Colwell test is used extensively in NSW. Its critical value is determined by the Phosphorus Buffering Index (see below). The Olsen test gives similar critical P values to those of the Bray test. It is not often used in NSW.

Phosphorus Buffering index (PBI) - The Phosphorus Buffering Index (PBI) is a relatively new test that is used to measure the P sorbing ability of a soil. Used in conjunction with the Colwell P test value, it improves the ability to interpret soil P status and to identify critical P values for maximum potential pasture growth across a range of soil types.

Nitrogen (N) - Australian soils are naturally deficient in N. In a well managed, grass/legume pasture, effectively nodulated legumes supply N to the grass component. This results in an overall increase in growth and an improvement in pasture quality (digestibility and protein content). Nitrogen fixation by legumes varies, and is proportional to the amount of legume dry matter produced. There are some occasions when additional N may need to be applied; e.g. if the legume component of the pasture is poor; when sowing grass-based pastures, or when boosting pasture growth for fodder conservation. Nitrogen is highly mobile and easily leached. As occurs with sulfur (S), N levels fluctuate widely, depending on the season, rainfall, and pasture composition. Useful amounts of N (and S) can be released throughout the year by the natural process of mineralisation. Particularly during warm and moist conditions, microbial activity may convert organic N to plant-available inorganic N.

Potassium (K) **-** Potassium is not mobile in soils. It is usually not limiting in the pastures of most extensive

SOIL SAMPLING TIPS

Sample at least 3 months before sowing to give time to obtain results and order fertiliser and other soil amendments (e.g. lime, gypsum).

Sample at same time of year when monitoring trends to minimise seasonal variation.

Avoid sampling in very wet, cold periods.

Avoid sampling within 6 months of fertiliser applications. (N tests are the exception)

Sample from representative areas of the paddock. Avoid sampling from stock camps, swampy patches, feed out areas, manure patches, dams, under trees, gateways, tracks, etc.

0–10 cm is the most common standard depth for pasture soils. Record the sampling depth to ensure that the results can be interpreted with confidence.

If the paddock is made up of more than one soil type, sample and test each soil type separately.

Collect at least 30 cores per sample area. Remove excess undecomposed organic matter from the soil surface before taking each sample, but take care not to disturb the soil.

Label samples clearly and complete the field information sheet as fully as possible, as this will assist in the interpretation of results.

Do not let the samples get hot. Ideally, put samples in an esky during the collection process and refrigerate them until they are sent to the testing laboratory, as soon as possible after sampling.

Always use a soil testing laboratory that is NATA accredited and ASPAC certified. NATA (National Association of Testing Authorities) accreditation and ASPAC (Australasian Soil and Plant Analysis Council Inc.) certification ensures independent assurance of technical competence and provide confidence in the soil test results.

grazing systems, except in very sandy soils in high rainfall areas or where long-term hay or silage production has occurred. The critical Colwell K soil test values to achieve 95% predicted maximum pasture yield for sandy loam soils is 139 mg/kg and 161 mg/kg for clay loam soils.

Applying a fertiliser test strip across a paddock is one way of determining if a pasture is likely to respond to K.

Sulfur (S) - Sulfur availability is closely associated with soil type. It is mobile and can be leached from the root zone. Sulfur is particularly important for legume growth. It is also a vital component of all proteins and is essential for wool growth in sheep.

The basalt, granite and sandstone soils of the NSW Tablelands are often deficient in S. It is most commonly measured by the KCl_{40} test and the critical minimum benchmark is 8 mg/kg.

Calcium (Ca) and Magnesium (Mg) - Calcium is usually the most dominant cation in the soil and is rarely deficient in pastures. Likewise magnesium is rarely deficient, except in extremely sandy soils. The Ca:Mg ratio can be used as an indicator of soil aggregate stability. Research has shown that a wide range of ratios are acceptable. However, soils with Ca:Mg ratios less than 2:1 are more likely to be prone to dispersion, whilst those with ratios greater than 25:1 may have problems with Mg deficiency. Cases of Mg deficiency in pasture do not often persist as the concentration of Mg increases at depth in most soils and is accessed by plants as roots grow into the subsoil.

Other elements

Molybdenum (Mo) - Molybdenum is a trace element essential for legumes, as it is required by rhizobia bacteria for N fixation. Deficiencies are common in most Tableland pastures. Molybdenum should be applied to acidic soils once every 3 to 5 years. It may be applied using 'Mo Super', as a seed treatment, or as a foliar spray.

Sodium (Na) - High Na levels (greater than 6%) can indicate sodicity problems with: (i) dispersive soils (particularly when the soil Ca:Mg ratio is also less than 2:1), or (ii) salinity (see Electrical Conductivity below).

Aluminium (Al) - Although Al is abundant in soil, it is not a plant nutrient. In strongly acid soils (pH_{Ca} below about 4.7) 'exchangeable' Al is released into the soil solution. This form of Al is very toxic to most plants, even at low concentrations. Stunted, stubby root growth is the most common symptom of Al toxicity. Poor growth and vigour associated with Al toxicity is due to a combination of factors, including: (i) restricted root growth reduces the ability of affected plants to access nutrients, and (ii) low pH affects availability of nutrient (e.g. P, Mg, Mo). Sensitive species such as lucerne and seedling phalaris perform poorly when Al levels are greater than 5% – as a percentage of the cation exchange capacity (CEC).

Manganese (Mn) - Manganese is essential for chlorophyll production, photosynthesis, plant respiration, nitrate assimilation and for the production of enzymes. Deficiencies in pastures are rare and toxicity (or excess) is much more common. Legumes and other broadleaf plants are less tolerant of excessive levels of Mn than grasses. This is particularly so when Al levels are also high. Treatment with lime can reduce levels of available Mn.

Iron (Fe) **-** Plants require Fe to produce chlorophyll and to activate several enzymes, especially those involved in photosynthesis and respiration. Iron deficiency is not common in pastures and, if observed, is most likely to occur as a result of excessive lime applications and high pH. Excessive Fe can bind with P and reduce its availability.

Zinc (Zn) **-** Zinc has a role in the formation and activity of chlorophyll and in several plant enzymes. Deficiencies most commonly affect summer crops such as maize or sorghum growing in neutral or alkaline soil and those of basalt origin. Soils under pasture are not routinely tested for Zn.

Copper (Cu) and Boron (B) **-** Soils under pasture are not routinely tested for Cu or B. There have been isolated cases of deficiencies of these trace elements. Boron may be deficient in extremely sandy soils or where lime has been applied at high rates. Lucerne, canola and brassicas are sensitive to B deficiency, and seed production of clovers has been shown to be significantly reduced at deficient sites.

Animal health is usually the first indicator of Cu deficiency and may be caused by application of excessive rates of Mo. Seek veterinary advice.

Selenium (Se) **-** While not required for plant growth, Se is an important trace element for livestock health. Some NSW Tableland areas with a history of pasture improvement are notorious for Se deficiency, particularly on the lighter textured, less fertile soils. Light-textured, coastal soils are also prone to Se deficiency. Contact your local veterinarian for advice on how best to manage the problem.

Other soil tests

Cation exchange capacity (CEC)

Cation exchange capacity is a measure of the ability of the soil to hold and exchange nutrients (which are generally cations) for plant use. Cations, including Ca, Mg, K, Na and Al, are held in soil by clay and organic matter. Low CEC values often indicate sandy soils that have low fertility and contain very little organic matter. Conversely, high CEC soils may have more clay and organic matter, which 'hold' nutrients and, as a result, these soils are generally more fertile. Some soil test reports include hydrogen (H) on the list of cations. In Australia, this element should not be included in the total CEC when interpreting a soil test.

Organic carbon

Soil organic carbon (SOC) is a measure of organic matter in the soil. It includes undecomposed plant litter, soil organisms and humus. SOC holds water, stores important nutrients, stabilises soil structure and is a food for soil microbes. If SOC is declining over time, then consider using green manure crops, or practices such as reduced tillage, mulching, or strategic grazing and fertilising to promote pasture production. There are several tests available to measure SOC, all of which differ slightly in the carbon fraction they measure. To calculate percentage organic matter (%OM) multiply organic carbon by 1.7.

Electrical conductivity (EC)

Electrical conductivity is a measure of salts in the soil. Production of most species is likely to be affected when soil conductivity is below 0.15 dS/m (deci-siemens per metre), but the critical EC value varies depending on soil texture. For example, critical values can be higher in a soil with a heavy texture and therefore, at a given EC level the degree of plant reaction to salt stress is less in clay soils than in sandy soils.

Salinity problems are usually caused by salty irrigation water or saline ground water. Salt can also be a symptom of dryland salinity – a natural geological phenomenon. Plants vary in their reaction to salt stress, from 'sensitive' to 'tolerant' (see Chapter 6 – Pasture species selection).

Soil test reports

There are several important things to consider while reviewing your soil test results, including:

- Date of sampling – nutrient levels can vary throughout the year, particularly P. If you want to monitor change from year to year it is important that paddocks are sampled at a similar time each year.
- Depth of sampling is important when comparing past results; and
- Soil texture.

Laboratory tests are important but they will not identify soil compaction, structural decline, erosion or subsoil problems. These degradation issues are much harder to fix than a nutrient deficiency, and recognising the problem early can make a big difference to pasture establishment. When collecting your soil samples it is important to also take note of the following issues that may better inform your species selection and management approach:

- Condition of the soil surface
- Depth of the topsoil
- Soil structure; and
- Penetration of plant roots.

Tissue testing

If you suspect your soil has a trace element issue or wish to identify nutritional disorders observed in growing plants, a plant tissue test can help diagnose deficiencies or toxicities. Soil testing is not a reliable method to test for trace element deficiencies e.g. Mo, Zn, Mn and Cu.

Soil issues affecting pastures

Landscape, soil acidity, salinity, sodicity and nutrient decline all have major impacts on establishment, persistence and productivity of pastures. It is important to identify constraints well before sowing a pasture to inform management and investment decisions.

Landscape factors

Soil depth, texture and water holding capacity

Soil depth and soil texture (i.e. the relative proportion of sand, silt and clay) determine the amount of water a soil can store. Root growth and the amount of soil water plants are able to access is limited in shallow soils that overlay sub-surface rock layers and impediments such as hard pans. Restricted rooting depth is likely to affect the persistence of deep-rooted species such as lucerne.

Soil texture also influences the amount of water that is stored and available for plant growth. For example, when wet, a clay-rich soil is able to store more water than a loam (i.e. it has a high water holding capacity), but plants are less able to extract water from them as they dry. On the other hand, sandy soils have relatively low water holding capacity, but the water retained is readily available to plants.
Within any soil, it is a combination of the soil texture and plant rooting depth that determines the amount of water available to plants.

Aspect

Soil temperature, moisture and exposure to direct sunlight are all influenced by aspect. Consequently, aspect can have a strong impact on pasture production. For example, in summer a western aspect will be hotter and drier than a southern aspect due to exposure to northerly or westerly winds and the hot, afternoon sun. The western aspect is likely to have a shorter growing season due to moisture stress and is, therefore, unsuitable for long-season species such as ryegrass and late maturing sub clovers.

In winter, a north-eastern aspect will have a warmer soil temperature and therefore, potentially higher production than an adjacent south-western aspect. Soil moisture is not usually the most limiting factor on any aspect during winter.

Acid soils

Many soils of NSW are naturally acidic, with pH_{Ca} of less than 5.0, while others have become more acidic as a result of many years of agricultural production. Soil acidity has major impacts on pasture production. Acidity is relatively easily corrected if it is limited to the top 10 cm of the profile or within cultivation depth. On the other hand, subsoil acidity is very difficult and expensive to correct.

Effects of acid soils on pasture production

A soil pH_{Ca} in the range of 5.0 to 7.5 provides optimal growing conditions for most agricultural plants. The growth of species that are sensitive to acidity, such as lucerne, will be affected once pH falls below 5.0.

Several factors, and often a combination of these, may affect plants growing in acid soils, including:

* Al and Mn toxicity will affect susceptible plant species; levels of available Al and Mn decrease as soil pH increases;

* reduced availability of P, Mo, Ca and Mg;

* poor response to fertilisers;

* increasing competition from weeds such as Vulpia spp., sorrel (*Acetosella vulgaris*), dandelion (*Taraxacum officinale*), bent grass (*Agrostis capillaris*) and onion grass (*Romulea rosea*);

* low plant water use;

* thinning of sensitive sown species due to shallow or stunted root growth;

* reduced soil biological activity; and

* survival and persistence of rhizobia, and therefore the efficiency of nodulation and N fixation in legume species.

Causes of soil acidity

<u>*Leaching of nitrate nitrogen:*</u> Nitrate nitrogen is the main form of N taken up by a plant. It is very soluble and therefore easily leached. Soil pH will increase if nitrate nitrogen is leached out of the root zone before it is taken up by the plant, or before it is converted to ammonia (gas). The acid/alkali balance of the soil surrounding the roots remains in balance (and pH does not change) while the plants

continue to take up all the nitrate nitrogen. Deep-rooted temperate perennial plants reduce the risk of leaching, which is most prevalent in autumn/early winter.
The N fixed by legumes is the main source of N in many perennial grass-based pastures, and will result in net acidification if the N is not used and is subsequently leached below the root zone.

Use of nitrogenous fertilisers:
Acidity will only result from the use of nitrogenous fertilisers if the nitrate nitrogen produced from these fertilisers is leached before it is taken up by plants. The amount of acidification that results from using nitrogenous fertilisers depends on the fertiliser type, e.g. monoammonium phosphate (MAP) is significantly more acidifying than diammonium phosphate (DAP).

The use of superphosphate has an indirect effect on soil pH through stimulation of the growth of legumes

Removal of produce: Grain and animal products are slightly alkaline and their long-term removal from a paddock can contribute significantly to the acidification of soils. Some production systems are highly acidifying because of the quantity and type of product removed. For example, 70 kg of lime would be required to neutralise the acidification effects of producing 1 tonne of lucerne hay, whereas the rate of acidification is much slower in a wool production system – i.e. 14 kg of lime for 1 tonne of wool produced.

Increase in soil organic matter:
Although increasing organic matter has many benefits including improvement of soil structure; it can also increase soil acidity if the nitrogen in organic matter is mineralised and the nitrate nitrogen is then leached. Soil organic matter levels do not build up indefinitely and there is no further acidification once the organic matter stabilises at a new level.

The acidification caused by a build-up in organic matter can be reversed if the organic matter breaks down. However, if the topsoil containing the organic matter is eroded or removed, the net result will be acidification.

Reducing soil acidification

Soils acidify at different rates depending on soil type, climate and the amount of N and alkali lost due to leaching and/or product removal.

Strategies to reduce the rate of soil acidification:

* sow deep-rooted perennial species to utilise nitrogen before it is leached below the root zone;

* avoid using excessive rates of highly acidifying nitrogenous fertilisers, such as monoammonium phosphate (MAP) and sulfate of ammonia

*minimise soil disturbance to slow the breakdown of organic matter

* prevent erosion of the surface soil.

Managing soil acidity with liming products

Application of liming products, which contain carbonate, is the only way to raise the pH of acidic soils. Limestone and dolomite are the liming products most commonly used.

Limestone (calcium carbonate): Lime moves very slowly through the soil. Therefore, the most effective and rapid pH response occurs if superfine grade lime is evenly spread and incorporated to the depth of the acidity problem (or as deep as is practical).

If lime is topdressed the response time is considerably longer, depending on soil type and rainfall. For example, lime applied to the surface of sandy soils in areas with an average annual rainfall of more than 600 mm may move to 10 cm in 2 to 3 years. However, lime movement will be slower as the clay content of the soil increases and rainfall decreases.

The amount of lime required to raise soil pH will depend on the targeted soil pH, lime quality (fineness and neutralising value) and the cation exchange capacity (CEC) of the soil. Consult with your agronomist to determine a suitable rate for your paddocks.

In some situations the subsoil may also be acidic to depth, in which case responses to liming may be limited. If the aim is to increase subsoil pH, it is necessary to maintain the topsoil pH_{Ca} at 5.5. The 'lime effect' will then move slowly down the profile. Results from the NSW DPI long-term agronomic experiment on the South West Slopes of NSW (MASTER) showed that subsurface pH at 15–20 cm depth could increase by one unit over 20 years by maintaining pHCa in the top 10 cm at around 5.5.

Before undertaking a liming program it is a good idea to question the sensitivity and likely response of your preferred pasture species, both native and introduced, to a pH increase.

The economics and practicalities of a liming program need to be carefully considered on a case by case basis. Liming may not be a realistic option in hilly, steep, rocky landscapes. In these situations, management should aim to maintain and encourage the existing perennial species to reduce or slow the rate of acidification.

Dolomite (calcium/magnesium carbonate): Dolomite (also known as maglime) is a naturally occurring rock containing calcium carbonate and magnesium carbonate. It is a useful liming material for acid soils where supplies of magnesium are low, but tends to be more expensive and coarser than lime. In most circumstances, fine agricultural lime will be the most cost-effective option.

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Other liming products: From time to time various other liming products are available locally. Information on their liming quality, fineness and neutralising value should be obtained before deciding to use them.

Neutralising Value: Neutralising value is a measure of the reactivity of liming material and its relative ability to counteract soil acidity, which also depends on with the fineness of the product. Pure calcium carbonate (limestone), which has a neutralising value of 100, is used as the standard.

Soil salinity

Salinity has always been part of the Australian landscape. However, an increase in the incidence of saline areas has been attributed to the advent of agriculture, mainly as a result of land clearing and the removal of perennial vegetation.

Dryland salinity develops where upper slope (recharge) areas are cleared, resulting in increased soil water discharges on the lower slopes and concentration of salts at the soil surface. Soil acidity can contribute to soil salinity problems through inefficient water use by plants, which results in greater 'leakage' of soil water to groundwater.

Effects of soil salinity

Salinity has a major impact on the overall condition of a catchment

through reduced water quality and damage to infrastructure such as roads and buildings. Visual signs of soil salinity include:

* leaves of affected plants look darker than normal and often appear wilted; leaf margins are scorched;

* susceptible plants die – death of well established trees is an early symptom;

* pasture composition changes with the loss of clovers and invasion of water tolerant species such as rushes and then salt tolerant species such as sea barley grass (*Hordeum marinum*), couch grass (*Cynodon dactylon*), annual beard grass (*Polypogon monspeliensis*) and cumbungi (*Typha domingensis*);

* water in dams may change from muddy to clear with white salt crystals appearing above the water line; and

* areas of bare ground develop and when these dry they are covered with salt crystals. Animals tend to concentrate on these areas to lick the salt.

Reducing the impact of salinity

Salinity is best managed by first identifying the possible causes and then addressing the problem on a whole farm or catchment basis. Deep-rooted perennial pastures (e.g. lucerne and phalaris) and trees should

be planted on the recharge areas to minimise deep drainage and prevent salinity problems developing in the lower slope areas.

Saline areas should be fenced to control grazing stock and encourage re-vegetation. Moderately saline discharge areas can be sown to salt-tolerant species to encourage ground cover and increase productivity, e.g. tall wheat grass (*Thinopyrum ponticum*), puccinellia (*Puccinellia* ciliata), balansa, strawberry and gland clovers (*Trifolium michelianum, T. fragiferum and T. glanduliferum*) and old man saltbush (*Atriplex nummularia*).

This article "Soil issues affecting pastures" will continue in the next issue as well as an article on "Selecting pasture species"

AUGUST 5-7 PERTH, WA

LambEx 2018 celebrates all that is great about Australia's sheep and lamb industries, featuring a compelling program with outstanding speakers and an opportunity to network with all sectors of the lamb value chain.

Registration details - https://lambex.com.au/

From the President

Irrespective of who I talk to in NSW, the story is the same. Very dry, and a very ugly winter coming. By that I mean the hand feeding and managing stock numbers as conditions certainly get colder, and in many areas, drier still.

Fodder is now interstate, if you can find it, and grain prices for those feeding sheep or mixing their own, is getting dearer. As one grower told me recently, if there is a silver lining to the current situation, it is that all those less desirable jobs are getting done! Having a break from feeding is necessary, so even the worst jobs of the past don't seem so bad now. It is at times such as this, that each of us need to keep in contact with our friends, family and neighbours. Just catching up is good, and don't be afraid to ask, R U Ok?

While the markets have certainly eased, we are still fortunate that most classes of stock are still selling. I have heard of some folk who unfortunately have had stock get too poor to transport, and the end is not a desirable situation at all. For everyone's benefit, let's hope the rains come very soon. The balance of May looks unlikely, and then it will be winter. Bring on a wet winter asap!.

The 'Pasture Updates' have again been active since my past report. An Update near Narrandera, at Berrembed was held mid March, with a very good attendance. Many thanks to Helen Burns and her team for co-ordinating such. Other plans are in place, potentially the south coast in late July, and central west after that. Please keep an eye on the society web site for the dates and locations of the 2018 Pasture Updates.

All the best,

Regards,
David Harbison,
President.

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 Snippets

Next Newsletter: The next edition of the newsletter will be circulated in September 2018. 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 20 August 2018.

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.

Fan of Facebook - make sure you check out the Grassland Society of NSW Facebook page. You can either search for GrasslandNSW or access the Facebook page through our web site. Pasture Update details will be posted on the Facebook page as well as the website. Please feel free to Like Us, as well as post photos of pasture and/or related topics in your area.

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