‘The grazier’s guide to pastures’ - Readers’ Note

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9. PASTURES FOR SPECIFIC SITUATIONS

Selecting the right pasture species and variety for individual paddocks is extremely important. The needs of the whole farm and its enterprises should be considered to determine the most suitable pasture with particular emphasis on filling the feed gaps. For example if feed is short in winter, then winter-active species should be considered to overcome this gap.

Effective rainfall and rainfall pattern, summer and winter temperatures and frequency of frosts will determine which species do best and these factors will vary from paddock to paddock depending on slope and aspect. Soil type and fertility will also determine what species perform best. A soil test of the paddock before sowing a new pasture is recommended to help you select the best species.

Drainage, depth and soil pH are the important soil considerations when selecting a species. Lucerne, for example, requires a deep, well-drained soil, which is less acidic. On the other hand most phalaris varieties are tolerant of waterlogging, but not of high soil acidity or low fertility.

Most introduced species such as ryegrass, tall fescue and phalaris as well as clovers and lucerne, require higher soil fertility for good production. Soils must be either naturally fertile or must have the essential nutrients supplied.

Due to the often large variation of soils over a paddock, it is worth considering fencing out different land classes and making separate paddocks. In this way pastures and management can be tailored to suit different areas.

Typical Pasture Mixes

**Long-term Pasture**

**High rainfall (750 mm+)**

<table>
<thead>
<tr>
<th>Species</th>
<th>Rate (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phalaris</td>
<td>2</td>
</tr>
<tr>
<td>Tall Fescue</td>
<td>4-5</td>
</tr>
<tr>
<td>Sub clover</td>
<td>4</td>
</tr>
<tr>
<td>White Clover</td>
<td>0.5-1</td>
</tr>
</tbody>
</table>

**Moderate Rainfall (600 mm+)**

<table>
<thead>
<tr>
<th>Species</th>
<th>Rate (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phalaris</td>
<td>2</td>
</tr>
<tr>
<td>Cocksfoot</td>
<td>1.5</td>
</tr>
<tr>
<td>Sub clover</td>
<td>4-5</td>
</tr>
<tr>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>Perennial ryegrass</td>
<td>0.5-1</td>
</tr>
</tbody>
</table>

**Low Rainfall (<600 mm)**

<table>
<thead>
<tr>
<th>Species</th>
<th>Rate (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phalaris</td>
<td>2</td>
</tr>
<tr>
<td>Cocksfoot</td>
<td>2</td>
</tr>
<tr>
<td>Sub clover</td>
<td>4</td>
</tr>
</tbody>
</table>

**Short-term Pasture (2-4 years)**

<table>
<thead>
<tr>
<th>Species</th>
<th>Rate (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perennial Ryegrass</td>
<td>6</td>
</tr>
<tr>
<td>Sub clover</td>
<td>4</td>
</tr>
<tr>
<td>White Clover</td>
<td>0.5</td>
</tr>
<tr>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>Red clover</td>
<td>1-2</td>
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</tbody>
</table>

**Lucerne Pure**

<table>
<thead>
<tr>
<th>Species</th>
<th>Rate (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dryland</td>
<td>4-6</td>
</tr>
<tr>
<td>Irrigated</td>
<td>8-12</td>
</tr>
</tbody>
</table>

**Acid Soils (pH <4.5 CaCl2)**

<table>
<thead>
<tr>
<th>Species</th>
<th>Rate (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocksfoot</td>
<td>2</td>
</tr>
<tr>
<td>Tall Fescue</td>
<td>4</td>
</tr>
<tr>
<td>Sub clover</td>
<td>5</td>
</tr>
<tr>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>Serradella</td>
<td>1-2</td>
</tr>
</tbody>
</table>

**Wet areas**

<table>
<thead>
<tr>
<th>Species</th>
<th>Rate (kg/ha)</th>
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</thead>
<tbody>
<tr>
<td>Phalaris</td>
<td>2-3</td>
</tr>
<tr>
<td>Fescue</td>
<td>4-6</td>
</tr>
<tr>
<td>Strawberry clover</td>
<td>1</td>
</tr>
<tr>
<td>White clover</td>
<td>0.5</td>
</tr>
<tr>
<td>Sub clover</td>
<td>2-3</td>
</tr>
<tr>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>Lotus</td>
<td>1-2</td>
</tr>
<tr>
<td>Paspalum</td>
<td>2-4</td>
</tr>
</tbody>
</table>

**Salty areas**

<table>
<thead>
<tr>
<th>Species</th>
<th>Rate (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall wheat grass</td>
<td>6-10</td>
</tr>
<tr>
<td>Puccinellia</td>
<td>2-4</td>
</tr>
<tr>
<td>Strawberry clover</td>
<td>2-3</td>
</tr>
<tr>
<td>White clover</td>
<td>0.5</td>
</tr>
<tr>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>Lotus</td>
<td>1-2</td>
</tr>
<tr>
<td>Paspalum</td>
<td>2-4</td>
</tr>
</tbody>
</table>

**Note**: The above mixes are to be used as a guide only. Sow higher rates where specific problems exist. Refer to your local insert for varieties and specific rates for your situation or alternatively contact your local NSW Agriculture agronomist.
**Points to Remember**

- Select pasture species and varieties carefully for your paddock and livestock enterprise.
- Climatic factors, aspect, slope, soil type and fertility will determine which species do best.
- Fencing similar land types will allow pastures and management to be tailored to suit the different areas.

*Phalaris is the best species to use in difficult sowing situations.*
10. PASTURE ESTABLISHMENT

Successful pasture establishment is vital for later productivity and stability of sown pastures. When all cash and non-cash costs are considered, it currently (in the year 2000) costs about $200/ha to establish a pasture (plus $80–$150/ha if lime is required), so successful establishment is essential to capitalise on your investment.

The Decision to Sow

Before any pasture is sown, consider these questions: Is it necessary to sow new pasture and if so what pasture type is best suited to your soil and topography? Can the existing pasture be improved/rejuvenated by tactical grazing and/or the use of selective herbicides, fertilisers etc? Can simple, less costly, non-destructive means such as broadcasting a legume and fertiliser increase production? Will the new pasture meet the livestock enterprise feed requirements? Will forage crops be a better alternative? Will your proposal comply with the Native Vegetation Conservation Act 1997?

The Planning Phase

If, after consideration, you decide to establish a new pasture, planning and attention to detail are essential to ensure that the money and time spent will produce the optimum result. To achieve successful establishment, there are three critical factors:

- absolute weed and pest control,
- adequate soil moisture, and
- accurate seed placement

Sowing time has been found to be far less important than these three factors. We suggest you follow the eight step **Prime Pasture Check List** to ensure successful establishment. This is summarised now to help you ensure the three critical factors are achieved.

1. **Assess and Plan Ahead:** commence 12–18 months before to ensure selection of the most suitable species for the paddock and type of production. Soil tests from both the surface (0–10 cm) and deeper (20–30 cm) are recommended.

2. **Year Before Weed/Pest Control:** this step is vital and must commence in the previous spring for autumn/ winter sowings. Spray fallowing is preferred to spray topping where windy spring weather can prevent spraying at the correct time to prevent annual seed set.

3. **Pre-Sowing Grazing or Cultivation:** integrates with step 2 to reduce trash and maximise weed germination before sowing.

4. **Absolute Weed and Pest Control:** the most important factor for success. Grass control herbicide options in new pastures are quite limited, so weed control in the year/s prior to establishment is essential.

5. **Adequate Soil Moisture:** moisture to a depth of 20 cm and at the surface ensures good germination and survival after sowing, even if dry conditions follow sowing. **Do not sow into a dry seedbed.**

6. **Accurate Seed Placement:** place seed in contact with moist soil in a furrow. Aim for 5% of seed and fertiliser to be visible at the surface, thus ensuring seed is not buried too deeply.

7. **Monitor Weeds And Pests:** inspect 10–14 days after germination and then weekly.

8. **First Grazing:** graze when grasses are 10–15 cm tall provided the soil is moist and plants are well anchored. Grazing should aim to leave at least 5 cm (1000 kg DM/ha) pasture height. Remember that cattle are less selective than sheep. If it is dry, delay first grazing till after the pasture sets seed.

Sowing Time

On the tablelands, sowing after the autumn ‘break’ is traditional. However, temperate perennial pastures have been successfully sown on the tablelands from February through to September. Sowing should not occur until after weeds have germinated and been killed. This often means sowing in June or later.

While winter sowings will germinate slowly and there is sometimes increased risk of waterlogging, the advantages from achieving good weed control and soil moisture are far more important than sowing date. The problem of heavy frosts in winter causing fatal frost-lift can be a consideration in some very cold areas such as the Monaro especially on heavy soils and in cultivated seedbeds. Direct drill sowing largely avoids this problem.

**Spring Sowing** in August/September tends to avoid these problems and also winter growing annual grass weed competition. In most of the region it has given good results and provides a good option for perennials. It is the preferred sowing time for lucerne.

Time of sowing is important for some species:

- Winter annuals such as subterranean clover must be sown in autumn–early winter as spring sowings are too late to allow seed set. They need to be broadcast sown the following autumn.
Frost sensitive or sub-tropical species such as paspalum, Consol lovegrass, etc. require soil temperatures above 18°C and must be sown in late spring or early summer.

**Seed Matters**

1. Seed Quality and Sowing Rate

Seed costs are relatively small compared to the total cost of establishment, so don’t be tempted to cut seed rates. *Always use certified seed* to ensure high germination and freedom from impurities (especially weeds).

Low seeding rates allow weeds to more readily invade and pasture density and production may never reach their potential. Increase seed rates in less favourable conditions e.g., broadcast sowings, rough seedbeds, acidic soils.

2. Inoculation of Legume Seed

Rhizobia are bacteria that allow legumes to fix and use atmospheric nitrogen for plant growth. Although rhizobia occur naturally in most soils, they may be less efficient than the strains available commercially as different legumes require specific inoculants to ensure effective nodulation. Inoculate with the correct strain of rhizobia. Lime coating of the seed is required in all soils with a pH (CaCl₂) below 5.5 to protect the inoculum bacteria from the acid soil and if seed contacts the fertiliser.

The trace element molybdenum is also required to enable the rhizobia to fix nitrogen and is thus important to ensure effective nodulation. It may be added to the lime used to limecoat the seed during inoculation or applied pre-mixed with the sowing fertiliser. Seed treatment is cost effective and ensures the molybdenum is where it is needed, close to the legume seed.

Survival of rhizobia outside soil is limited, so keep inoculated seed cool and out of sunlight and sow as soon as possible (preferably within two days) after treatment.

3. Other Seed Treatments

Treatment with a fungicide is recommended where ‘damping-off’ diseases such as pythium are anticipated, particularly with autumn/winter sowings. Fungicides can be applied during inoculation and will not injure rhizobia. Similarly, treatment of small surface sown seed (especially white clover and phalaris) to prevent ant theft will not harm rhizobia. Conversely, treatment of legume seed for earth mite control may be desirable, using registered insecticides, but these are highly toxic to rhizobia and must be applied 24 hours BEFORE inoculation. Seed must then be sown immediately after inoculation.

Your seed supplier using specialist equipment that should ensure a good product can carry out any or all of these seed treatments. Remember lime pelleted seed runs more slowly through the metering mechanisms of seed boxes, so calibrate the seeder using pelleted seed to ensure the correct sowing rate. Also, wait until the lime coating is dry before sowing, as damp seed will cause seed box blockages as will excess lime from poorly pelleted seed.

**Sowing Issues**

1. Seedbed Preparation

There are three ways to achieve a good seedbed.

- cultivation
- herbicides
- combinations of the above.

Heavy grazing alone will not produce a weed free seedbed and cannot be recommended as the sole means of seedbed preparation.

Heavy grazing is often used, especially in conjunction with herbicides. Spray topping or spray fallowing the previous spring is essential to reduce annual grass competition (from barley grass, vulpia etc.) no matter what method is used and should be followed up by grazing to reduce trash levels. Spray-grazing the previous winter is effective at reducing broadleaf weeds such as thistles, capeweed and Paterson’s curse.

2. Sowing Depth

Pasture seeds are small and easily buried too deep. However, if only placed on the surface, the seed may be taken by seed harvesting ants or dry out before the seedling’s root has entered the soil. For best germination, aim for good seed-to-soil contact with moist soil and coverage by loose soil of 1–2 cm.

3. Sowing Techniques

The sowing method used will be influenced by the erodibility of the soil, paddock topography, existing vegetation cover, and availability of appropriate machinery. There are several techniques that can be used.

**Direct Drilling**

This involves sowing seed into undisturbed soil following the use of a herbicide. It can be just as successful as sowing pasture into conventionally cultivated seedbeds. It is the method of choice in most situations, provided suitable sowing machinery is available (see notes later in this chapter). It provides greater flexibility in terms of:

- paddock use for grazing
- trafficability both before and after sowing
• more precise placement of seed
• reduced weed competition
• more precise control of sowing depth
• lower labour requirements

The use of narrow points combined with some simple, low cost modifications permit pastures to be successfully sown with most pasture drills and combines. There is also a range of specific pasture direct drill machinery.

**Conventional Sowing**
Aim to sow seed into a firm, friable and weed-free seedbed to provide seeds with good conditions for germination and growth. Cultivation has a role especially in heavy soils, where tussocky perennial grasses are present or the ground is very uneven or compacted due to pugging by stock and where erosion risk is minimal.

In many cases, a clean up crop before pasture establishment is useful. Oats, turnips, short-term and annual ryegrass are all suitable for this purpose and apart from providing valuable winter/spring feed, they can help break up heavy soils and reduce weed seed reserves.

There are two basic stages in preparing a conventional seedbed:
• Primary cultivation, preferably with tyned implements as they minimise inversion of the subsoil and break hard pans below the surface. However, where rocks would be brought to the surface, disc implements can be more appropriate. Be wary of one-way discs on shallow soils. Work across the slope, preferably on the contour to decrease the risk of run off and erosion.
• Secondary cultivations to break down clods, consolidate the seedbed and kill weeds. Make each working shallower than the previous one and depending on the soil type, use either an offset disc or heavy harrows. Beware of excessive cultivation, which can break down soil structure and lead to surface crusting. The number of workings can be reduced using a herbicide, instead of or with cultivation, for weed control.

**Minimum Tillage**
This technique involves limited cultivation with a tyned implement, usually in combination with one or more herbicide applications. These are used prior to the initial cultivation to improve the workability of the soil and speed up seedbed formation. Subsequent herbicide applications control germinating weeds.

**Broadcast Sowing**
This is only suitable for sowing certain legumes – no knockdown herbicide is used. Large areas of subterranean and white clover have been sown successfully throughout the tablelands using this method.

Broadcasting can be carried out by on-ground machinery such as fertiliser spreaders or by aircraft. Success depends on:
• cooler temperatures and good moisture to ensure germination and survival;
• minimal bulky standing top-growth but adequate plant litter (800–1000 kg DM/ha) to protect new seedlings;

Late April/May/June is normally the best time for broadcast sowing sub clover. Remember that once sub clover has reached the three leaf stage it is very tolerant of grazing which should occur to promote branching and hence maximise flowering and seed set.

*Aerially applying herbicide is the first step when using the aerial-spray-sow technique.*
Aerial Sowing
The aerial-spray-sow technique has been used to establish perennial pastures in the region for many years. The technique involves first applying herbicide by aircraft, and later the pasture seed and fertiliser. It is recommended where ground application methods are not possible and especially where land has been treated to remove, or is at risk from, weeds e.g. serrated tussock, St. John’s wort, thistles etc.

It is the least reliable sowing method for perennial grasses and a costly technique, which must be thoroughly planned. Consider the weed spectrum, the need for pre-treatment of annual grasses (spray topping), grazing over summer to reduce bulk, ant theft of seed, slug damage and seedling diseases in the presence of heavy litter.

The best time to aerially sow is May/June but wait until there has been sufficient rain to provide 15 cm of damp soil — this may mean sowing in July or waiting until next year.

For best results when aerial sowing (or broadcast sowing white clover) :-

- treat all seeds with a registered insecticide to prevent theft by ants
- if possible stock sown areas at a high density for up to a week immediately after sowing to trample seed into the soil
- generally, spell until the following autumn, because aerial sown seedlings are not well anchored in the soil and are easily pulled out. This will allow the sown species to seed in their first year.

Prior to undertaking aerial-spray-sowing, the requirements of the Native Vegetation Conservation Act 1997 must be assessed.

Aerial sowing has been successfully used to sow into cultivated seedbeds, where waterlogging prevented the use of surface sowing machinery.

Sowing Warm Season Species
The sowing of warm season species applies mainly to perennial grasses. These, however have a limited role in most of the region due to inadequate summer rainfall. Where favourable conditions do occur, the following establishment procedure is appropriate:

- Plan to sow when soil moisture and soil temperature is appropriate to the species (late spring-early summer).
- Where summer weeds occur, weed control in the year(s) prior to sowing will be necessary.
- Perennial legumes such as lucerne, strawberry clover, white clover and lotus can be included.
- Sow seed into loose cultivated soil on the surface or just below and lightly harrow. Tiny seeds e.g. Consol lovegrass, or fluffy seed e.g. digit grass, are difficult to handle but seeds can be coated to increase their size and improve ease of metering. Otherwise it can be mixed with fertiliser, where pasture seed boxes are incapable of handling the seed. Once mixed with fertiliser, seed must be sown immediately, otherwise germination will be inhibited. Where a granulated fertiliser is used, mixing 4 kg of microfine lime with every 50 kg of fertiliser will distribute seed more evenly, and prevent seed settling to bottom of the seed box.
- Direct drilling has generally proven unsuccessful. However, it can be successful with heavy-duty tynes and spear points, sowing dry on clay soils and creating major subsoil disturbance. Such machinery often incorporates a press wheel. Substantial summer rains are then required for germination and the deep ripping ensures good moisture penetration.

Sowing and Machinery
The aim of sowing is to place the pasture seeds in contact with moist soil and cover them with 0.5–1 cm of loose soil. It is very easy to sow seed too deeply, especially in cultivated seedbeds. Rolling before sowing can help where the seedbed is loose and fluffy and after sowing where moisture is marginal. However, beware of rolling post sowing on soils prone to crusting. Band seeders are preferred to achieve ideal seed placement in cultivated soil.

One advantage of direct drilling is that the seedbed is firm/fixed and so accurate seed placement is easier to achieve. While the machinery available for sowing are many and varied, drills can be either rigid frame machines or have a ground following ability on individual tynes. The latter include triple discs, single discs (and their conversions) and trailing tynes. They provide more precise sowing depth than rigid frame machines, such as most combines.

When sowing with a machine with a rigid frame some sowing points may scarcely scratch the surface while others, due to the uneven ground across the width of the seeder may be 3–4 cm deep. The aim in this case is for an average furrow depth of 2.5 cm but with the seed in each furrow only covered by 0.5–1 cm of loose soil.

Never use harrows or rollers when direct drilling otherwise seed will be buried. Single discs are generally not suitable for direct drilling unless converted, because they do not produce loose soil to cover the seed.

As a practical guide to correct direct drilling sowing depth aim for an average furrow depth equal to the first knuckle of your index finger. You should also be able to see 5–10% of the seed and fertiliser in the furrow but no more. Can’t see any? Too much coverage!
Contour following tyne mechanism

Pasture seed placement is most accurate with seeders having contour following tyres.

**Cropping and Pastures**

**Preparing For Pasture Sowing**

Winter cereals are the most widely used crops for preparing paddocks for pasture sowing. Sowing a crop in the year(s) prior to establishing a new pasture can provide good preparation. It should only be considered an option if soil fertility and topography are suitable. On suitable soils, spring sown crops such as brassicas offer a good option achieving good control of winter weeds, as well as acting as a biofumigant against many soil borne diseases of seedling pasture. If winter cereals are used prior to a pasture phase, they should be grazed out in spring or cut for hay/silage, before the annual grasses seed. This will also minimise the potential for competition from a self-sown crop.

**Cover Crops**

Cover crops are not recommended when sowing perennial pastures. Increased competition for nutrients, soil moisture and the effects of shading, all contribute to reduced establishment and weakened growth of newly sown pastures.

If cover crops must be used, the following guidelines will help improve pasture establishment:

- Sow the cover crop in alternate rows.
- Reduce crop sowing rates to less than 15 kg/ha for cereals, accepting a subsequent crop yield reduction trade-off. (For cereals a 10–20% yield reduction, depending on soil fertility.)
- When using cereals, choose a grain only variety which has less potential to smother rather than a forage/grazing type. If a grazing crop is to be used, consider slow maturing brassicas, such as turnip or rape, sown at 0.25 to 0.5 kg/ha.
- If the pasture becomes overgrown by the cover crop, a quick concentrated graze will reduce competition and allow pasture to recover. Ensure that pasture plants are well anchored so they are not pulled out by grazing animals, and that ‘bogging in’ will not occur.

**Points to Remember**

- No matter what sowing method is used there are 3 critical factors—weeds and pests; soil moisture, and sowing depth.
- Follow the 8-step Prime Pasture checklist to ensure success.
- Direct drilling is as effective as conventional cultivation but offers greater flexibility.

**Further Information**

Prime Pasture (Establishment) Field Guide. (60 pages).
Available direct from NSW Agriculture, PO Box 408, Queanbeyan 2620, Tel: (02) 6297 1861.
11. FERTILISERS FOR PASTURES

To achieve adequate pasture growth and production, most soils require fertilising to supply deficient nutrients.

**Sowing Fertilisers**

The seed supplies essential nutrients to enable seedling growth for several days after germination. However, seed borne nutrients are exhausted by about the tenth day and subsequent pasture growth is then influenced by the availability of nutrients in the soil.

**Soil tests** are a useful tool to assess soil nutrient status. Ideally sample soil at the same time of year to permit monitoring of change over time. For ease of sampling it is best done when the soil is moist in early spring or autumn. Avoid sampling in late spring when phosphorus, in particular, is mostly in the plant material that has grown. Always test prior to undertaking any new pasture development.

To maintain available soil nutrient levels for adequate pasture production, it is necessary to replace nutrients removed by livestock and harvested products. **Table 11.1** outlines the nutrients removed annually from a pasture by various enterprises/products.

**Major Nutrients**

Four main elements must be present in sufficient quantities: nitrogen, phosphorus, potassium and sulphur.

**Nitrogen (N)**

Most soils are naturally deficient in nitrogen which is a principal component of protein and thus necessary for plant growth. Ideally, it is provided to pasture plants by legumes, via the nitrogen fixing bacteria on their roots. There are some occasions when nitrogen may need to be applied; e.g. when direct drill sowing pastures and when boosting production from existing pasture for hay or silage.

**Phosphorus (P)**

Most soils in the region with the exception of basalt derived soils are low in phosphorus and economic responses to applied phosphorus will occur.

Phosphorus is required for early root development and its availability influences plant growth potential and overall health. Adequate levels also stimulate flower and seed production. Even soils with a long history of applied phosphorus will benefit from its application at sowing.

A soil phosphorus level of 30 mg/kg (Colwell P test) will maintain good pasture production. To maintain this level, an annual application of 0.5 to 1.0 kg of phosphorus per dse (dry sheep equivalent) is required, depending on the enterprise being run and the soil phosphorus status. **Table 11.2** provides a guide to recommended rates.

<table>
<thead>
<tr>
<th>Production Type</th>
<th>Nitrogen (N)</th>
<th>Phosphorus (P)</th>
<th>Potassium (K)</th>
<th>Sulphur (S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 t/ha pasture or lucerne hay</td>
<td>125</td>
<td>15</td>
<td>100</td>
<td>13</td>
</tr>
<tr>
<td>500 kg/ha of lamb or beef meat</td>
<td>15</td>
<td>4</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>50 kg/ha of wool</td>
<td>6</td>
<td>0.25</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4 t/ha grain</td>
<td>80</td>
<td>18</td>
<td>20</td>
<td>6</td>
</tr>
</tbody>
</table>

**Potassium (K)**

Potassium is usually not limiting in pastures in most grazing systems except where long-term hay or silage production has occurred or where very heavy rates of lime are applied to light soils. Potassium helps legumes fix nitrogen and helps plants resist stress due to drought, disease and cold. Poor clover growth and particularly brown spots along the leaf margins can indicate a potassium deficiency.

**Sulphur (S)**

Sulphur availability is also linked to soil type with the basalt and granitic soils of the tablelands often sulphur deficient. Sulphur is particularly important for legumes. It is used by plants for protein formation and subsequently for wool growth.

Sulphur is found in two forms: either sulphate (e.g. gypsum) which is readily available to plants, or
Elemental sulphur which is insoluble and slow to become available to plants. Single superphosphate contains approximately equal levels of both sulphur and phosphorus and so with regular supering, sulphur deficiencies are overcome. On high phosphorus basalt soils, gypsum is used to rectify low sulphur levels.

**Other Elements**

**Calcium (Ca) and Magnesium (Mg)**
Calcium is usually the most dominant cation in the soil and is rarely deficient for pasture growth. Likewise magnesium is an exchangeable cation and while it is rarely deficient, except in very sandy coastal soils, low levels can cause grass tetany in livestock.

**Molybdenum (Mo)**
Molybdenum is a trace element essential for the bacteria that fix nitrogen in the legume nodules and deficiencies are common in most tableland pastures. Mo must be applied to acidic soils once every 3-4 years.

Molybdenum may be applied using Mo Super, or when sowing, it can be added to the lime used to lime pellet the legumes. Mo is more evenly distributed this way (on the seed) and is, therefore, more effective and recommended when sowing pastures.

Fifty grams (50 g) of elemental molybdenum is required per hectare on Mo deficient soils. Use either 75 g molybdenum trioxide (66% Mo) or 92 g ammonium molybdate (54% Mo). The Mo can be mixed either with the inoculant/glue solution or, dry with the liming material.

**Sodium molybdate**
Sodium molybdate dissolves readily in cold water and can be sprayed directly on the pasture. It is 39% Mo so to apply 50 g Mo/ha, mix 130 g in whatever amount of water your boom spray delivers per hectare.

**Copper (Cu) and Boron (B)** are trace elements that may be deficient in isolated cases. Copper may become deficient for animal health if excessive applications of molybdenum are applied. Boron is essential for good seed production of sub clover. In some cases these elements may become toxic e.g. boron may become toxic after high rates of lime have been applied.

Selenium (Se)
While not required for plant health, selenium is an important trace element for livestock health. Some tableland areas with a history of pasture improvement are notorious for selenium deficiency, particularly on the lighter, less fertile soils. Rural Lands Protection Board veterinarians are familiar with the local situation and can advise how best to overcome any problem.

**Compound Fertilisers**
A compound fertiliser (one containing nitrogen, phosphorus and sulphur or other elements) is the preferred fertiliser for pasture establishment as it provides establishing seedlings with essential nutrients for active growth.

For this reason, compound fertilisers are best used at sowing, with superphosphate most often used for subsequent pasture maintenance. Table 11.3 compares the nutrients supplied by some commonly used fertilisers.

**Table 11.3. Common fertiliser products**

<table>
<thead>
<tr>
<th>Product</th>
<th>N%</th>
<th>P%</th>
<th>S%</th>
<th>Ca%</th>
<th>K%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starterfos (MAP)</td>
<td>10</td>
<td>22</td>
<td>2.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Granulock 15</td>
<td>15</td>
<td>12</td>
<td>11.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legume Special</td>
<td>5.7</td>
<td>16</td>
<td>5.6</td>
<td>4.5</td>
<td>10</td>
</tr>
<tr>
<td>DAP</td>
<td>18</td>
<td>20</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Super</td>
<td>8.6</td>
<td>11.0</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasture Starter</td>
<td>6.5</td>
<td>13.6</td>
<td>8.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasture Gold</td>
<td>13.8</td>
<td>4.4</td>
<td>12.7</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>SF 45</td>
<td>5.5</td>
<td>7.0</td>
<td>35</td>
<td>12.7</td>
<td>50</td>
</tr>
<tr>
<td>Muriate of Potash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitram</td>
<td>34</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urea</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fertiliser Maintenance Applications**
Many factors influence the persistence and vigour of a pasture, but along with grazing management maintaining adequate levels of plant nutrients is the most important.

The present economic situation has most graziers looking at cutting costs and reducing or ceasing fertiliser applications to pastures is commonly considered. What happens if fertiliser isn’t applied for a while?

The rate of pasture production decline depends on the paddock’s fertiliser history. The better the recent history and the higher the soil phosphorous level, the slower the decline in pasture production. Research has shown that in lower fertility situations pasture production can decline by 30% if you skip one year, 50% if you skip two years and 75% if you skip three years. Much of this production loss is reduced clover growth and so pasture quality declines too. As pastures lose vigour, weeds increase causing further pasture decline.

**Priorities for Fertiliser Use**
In most situations the current economics don’t favour resumption of large scale ‘whole farm’ supering programs. Apply strategic applications of fertiliser to maximise pasture response and get the best value for...
your fertiliser dollar. The following list is a guide to priorities for fertiliser application:

- Recently established pastures – they cost a lot to establish and will need top-dressing to allow them to develop and remain persistent. Most sown species will not persist unless adequately fertilised.
- Special purpose pastures – those used for fattening, weaning, lambing, hay or large numbers of stock e.g. close to shearing sheds.
- Older sown pastures with a low soil test value (see Table 11.2).
- Other pastures (including natives) with a low to moderate soil test, provided they contain legume.

Low priority areas for fertiliser application include:

- Paddocks with a long super history and high phosphorous levels
- Pastures dominated by weeds such as Paterson’s curse, variegated thistle and vulpia
- Native pastures containing no legume

**Liming Soil**

Lime is not strictly a fertiliser but is used to supply calcium to counter soil acidity. In the same way that super is used to balance removal of P and S, lime can be used to balance the acidifying effect of taking plant products from the paddock. Table 11.4 indicates the amount of lime needed to neutralise the acidification caused by removal of certain products.

**Table 11.4 The amount of lime needed to neutralise acidification caused by produce removal**

<table>
<thead>
<tr>
<th>Produce removed</th>
<th>Lime requirement (kg/t of produce)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perennial Pasture hay</td>
<td></td>
</tr>
<tr>
<td>(Phalaris, cocksfoot)</td>
<td>30</td>
</tr>
<tr>
<td>Lucerne hay</td>
<td>60-70</td>
</tr>
<tr>
<td>Cereal grain</td>
<td>5-10</td>
</tr>
<tr>
<td>Meat</td>
<td>17</td>
</tr>
<tr>
<td>Wool</td>
<td>14</td>
</tr>
</tbody>
</table>

**When Should Phosphorus Be Applied?**

A common fallacy concerning pasture topdressing in this region is that phosphorus fertiliser must be applied in autumn. This is not the case.

Research on subterranean clover pastures on the tablelands showed no differences in autumn clover growth where super was applied between the previous November and February. However, applications after February gave reduced clover production.

The problem with mid autumn and winter application is that it is often not there when the clover germinates and while soil temperatures and growth potential are relatively high. Also a greater proportion of fertiliser will be ‘fixed’ by the soil. ‘Fixation’ is where the phosphorus is converted by the soil into chemical states that are less accessible by plants. Fixation is greatest on acid soils and when soils are cold and wet.

Applying fertiliser at the end of the financial year may be attractive for tax purposes but any advantage secured will be illusory if much of the phosphorus gets lost through fixation. The growth response of the pastures in autumn and winter is optimised by late spring or summer spreading.

**Points to Remember**

- For effective pasture establishment and growth, fertiliser will be required.
- Use soil tests to determine fertility status.
- Replace nutrients that are removed by the grazing system.

**Further Information**

12. GRAZING MANAGEMENT

Grazing management can be a very powerful and cost effective tool to obtain the most from a pasture. It should be considered routinely like other management tools such as fertiliser or herbicide, and is often best used in conjunction with them.

Good grazing management means you control what the stock eat and can thus:

- Optimise pasture growth and maximise feed quality
- Meet profitable livestock production and market targets
- Increase pasture utilisation and avoid selective, patch grazing
- Maintain adequate ground cover to prevent erosion and resist weed invasion
- Manipulate species balance to maintain an adequate level of legume.

**Botanical Composition**

This affects the amount and quality of herbage on offer and this in turn reflects animal production. Botanical composition of a pasture can be changed by grazing regimes and in particular:

- Stocking density and paddock size. The bigger the paddock and lower the stock density the more the stock are in control of what is eaten.
- Type of stock. Different grazing habits and dietary preferences of sheep or cattle can affect pasture composition - sheep graze very close to the ground and can be highly selective, while cattle are less selective and better able to graze tall growth.
- Class of stock. Dry stock, particularly wethers and to a lesser extent yearling heifers, can be forced to eat less palatable species or lower quality feed without penalty compared to young or lactating stock.
- Length and frequency of rests (if any). Most perennials benefit from a rest period after defoliation. The extreme example is lucerne which will die out if continuously grazed.
- Stage of plant growth when grazed. Strategic grazing such as crash grazing over flowering will reduce seed production of undesirable species as will tactical cutting for fodder conservation or even slashing.
- Resting at critical times (e.g. until sub clover reaches the 3 leaf stage after the autumn break) can improve composition and persistence.
- Allowing thin perennial pastures to seed down. This is particularly useful for large or fluffy seeded species such as ryegrass, fescue, cocksfoot and danthonia. It is less effective for phalaris because seed harvesting ants will remove large quantities of dry phalaris seed.

High density grazing for relatively short periods by large mobs of sheep and cattle increase pasture utilisation and reduce selective grazing.
Grazing management of newly sown pastures is addressed in chapter 10 ‘Pasture Establishment.’

**Seasonal Management of Established Sown Pastures**

As many pasture species are sensitive to seasonal changes, management on a seasonal basis allows the producer to focus on the likely issues to address at a particular time. The following notes outline appropriate grazing strategies throughout the year.

**Autumn**

After the autumn ‘break’, both annual and perennial plants are regenerating from seed, stolons, crowns or tillers. Try to avoid heavy grazing at this time. In key paddocks such as those used for lambing, delay grazing sub clover until the 3–5 leaf stage to maximise winter production.

**Winter**

Over winter the challenge is to manage pastures to increase growth e.g. to maximise leaf area. Cold temperatures limit pasture growth during winter so use long rotations. Spelling of key paddocks such as those to be used for lambing or calving, is often required.

**Spring**

Control of pastures is critical in spring in order to maintain a good clover and perennial grass balance. However, it is the most difficult time to do this due to the bulk of feed produced. Ideally and where practical, keep early spring growth at about 5 or 15 cm high (1200 or 2500 kg DM/ha) for sheep or cattle respectively. This allows pasture to remain leafy and be of higher quality for longer. If there are not enough stock to control pasture growth just concentrate on some paddocks. Cutting hay, mowing or making slage in one or more paddocks is always an option while other paddocks may need to be allowed to run to head. Don’t allow the same paddocks to run to head in consecutive years or sub clover seeding will be reduced. Sub clover produces the maximum number of flowers when grazed short (500–800 kg DM/ha) in early spring.

**Summer**

Pasture growth is limited by moisture stress. For winter active species, heat over 30°C also limits growth. Avoid hard summer grazing and exposure of perennial plant crowns particularly when plants are moisture stressed. Such overgrazing may kill some species. Graze perennial grass-annual legume pastures to about 1500 kg DM/ha (5–10 cm in height) in late summer/early autumn to remove top growth and facilitate light penetration, germination and re-establishment of legumes. This strategy will also reduce allelopathic effects (where dry residues of some grasses release chemicals which adversely affect nearby plants). Allelopathic effects are worst if there has been no summer rain. Leached material from the dry, undecomposed feed inhibits the germination of new plants following the autumn break. Phalaris and vulpia inhibit growth and kill sub clover seedlings in this way.

**Rotational Grazing**

Some pasture species require particular grazing management for survival. For example lucerne requires rotational grazing in order to maintain plant numbers. As a broad guide, lucerne is best managed in a three to four paddock rotation whereby it is grazed for 10–14 days and spelled for six weeks. Chicory, a summer growing herb, also requires rotational grazing during its active growth period.

**Managing Native Pastures**

Our knowledge about how to best manage native grass based pastures is incomplete. Remember the more productive native pasture species respond to increased fertility and particularly to legume nitrogen. However, there are two things to avoid — legume dominance especially in spring and development of excessive amounts of bare ground by overgrazing in summer. These situations are best assessed by regularly monitoring your paddocks.

**Monitoring**

Pasture composition is dynamic, fluctuating within and between years according to a whole range of factors including seasonal conditions and grazing/fertiliser management. Sound pasture management will aim to maintain ground cover and pasture stability. It is essential to avoid instability over time through the loss of the perennial grass component. Pasture composition usually varies both within and between paddocks so multiple inspection sites are required and once chosen, the same sites should be monitored each time. There are two critical times of the year to assess your native pastures for pasture stability (late winter and late summer). These can be used as a benchmark against future monitoring.

**Late Winter**

At this time of the year, ground cover should be close to 100% (droughts excepted) and all annual species clearly visible (e.g. annual legumes, grasses and broadleaved weeds). Annuals should be no more than 30–50% of the total pasture, while ensuring legumes are adequate (minimum 15–20% of the pasture).
Late Summer

The perennial grass component and the proportion of bare ground is easiest to estimate just prior to the autumn break. If the proportion of bare ground is steadily increasing from year to year this usually indicates loss of the perennial grass component. Monitoring is essential so that you can determine whether the changes occurring are beneficial or undesirable. For further information, see *Prime Pastures Management Guide, 1996*, pp31-38.

NSW Agriculture offers a PROGRAZE course, for sheep and beef cattle producers, to develop skills in pasture and animal assessment and assist them in identifying ways to use these skills to improve their grazing management decisions. Contact your local NSW Agriculture office for details.

Points to Remember

- Grazing management is a cost-effective tool to obtain the most from a pasture.
- Good grazing management allows you to control what livestock eat and influence feed quality, pasture utilisation, ground cover and botanical composition.
- Objectives of various strategies will vary with seasons and species present.

Further Information

PROGRAZE Manual
