PROGRAZE™

Profitable, sustainable grazing

SEGMENT 6
INCLUDING APPENDICES 3 & 4

PASTURES AND GRAZING

In this segment you will learn:

- Some of the basic principles of pasture growth.
- How grazing management can impact on pasture production.
- How grazing management, and other complementary management tools, can be used to manipulate the species composition of pastures.
- The grazing management requirements of specific pasture species.
- The relative productivity of the major pasture types for your region.

PASTURES AND GRAZING

FACTORS CONTROLLING PLANT GROWTH

The 3 essential factors for plant growth namely photosynthesis are:

- Sunlight
- Soil water
- Carbon dioxide

If any of these factors are missing, growth cannot occur.

The rate of plant growth is influenced by:

- Leaf area – how much green leaf there is to capture the sunlight.
- Fertility – nutrient deficiency or toxicity slows plant growth.
- Available soil water – the harder the plant has to work to extract moisture from the soil the slower the growth. Water logging also slows growth but by different methods.
- Temperature – all species have a range of temperatures in which they will grow e.g. for winter growing legume and grass species the minimum temperatures for growth are 5 and 8 degrees respectively with a maximum of 27 to 30 degrees. Summer growing species have higher minimum and maximums for growth. Growth will be slower when the temperatures are near either end of the range. This applies within a day and across the year. These ranges will vary slightly between species within the same group.

We have some control over the speed of plant growth. The leaf area during the year at a paddock level is controlled by our grazing and paddock resting decisions. Soil fertility is controlled by our decisions on nutrient input. Growing pastures and selling livestock products removes nutrient from the soil. If the nutrients removed are not replaced then soil fertility will drop.

We have no control over soil water and temperature but we can modify their impacts by species selection and where in the landscape we plant species. Too often pastures fail because the wrong species are sown in the wrong paddock. It is essential to only plant species that are adapted to the soil type, aspect and climate.

PLANT GROUPINGS

The major pasture plants (native and introduced) can be grouped into grasses or legumes, then into perennial or annual. Perennial species regrow each year from root reserves while annuals grow from a seed each year.

Another grouping is temperate or tropical. Temperate species tend to be winter/spring growing, so are able to grow at lower temperatures. Tropical species are late spring/summer growing, can tolerate higher temperature and are more water use efficient. These differences are due to a different internal make up. Temperate species and tropical legumes are classified as C3 and tropical grasses as C4 species, with the C relating to the biochemistry of the plants photosynthesis.

Section 2 talked about the differences in digestibility and animal performance from the C3 and C4 species.

C3 and C4 species can both play an important role on any property. The proportion of each will depend on your location within NSW. There is a mixture of C3 and C4 species in all areas of NSW, C4 are more common in the north and towards the coast and C3 are more common in the south. The important issue is to match the different strengths of C3 and C4 species to the properties objectives.

Knowing what species, including weeds, you have is important for seasonal decision making. Record your species under the following headings:

- is it perennial or annual,
- is it winter or summer growing.

Where these species occur on the farm is also important as it determines where you should be grazing, with what stock and when.

Why include weeds? Most pastures contain some weeds or less desirable species. It is important to note that some weeds impact more seriously on a pasture, e.g. serrated tussock and need to be controlled. Other species, e.g. barley grass is positive for winter growth but negative to stock when seeding. It

is the negative aspects, i.e. seed set, that need to be managed or avoided, not necessarily the control of the species. The density of the weeds determines what control measures need to be used.

Weeds are most successfully controlled using competition. Knowing what pasture species and weeds you have and when they grow allow you to plan grazing or other control methods to place competition pressure on the weed.

The majority of pastures are made up of many species so competition is occurring every day between species for light, water and nutrients. This competition is influenced by the growth habit of the different species i.e. short or tall growing. Longer rest periods favour the taller growing plants by shading the shorter ones. This is positive if the shorter species are weeds but negative if the shorter species are desirable and the shading causes their loss. Legumes provide the nitrogen for the grasses, need sunlight for seed set and are often short growing hence sensitive to shading by grasses.

Plants and production

The key to obtaining high animal production from pastures is by maintenance of productive pasture species. Production is determined by:

- The number of plants.
- How quickly they grow.

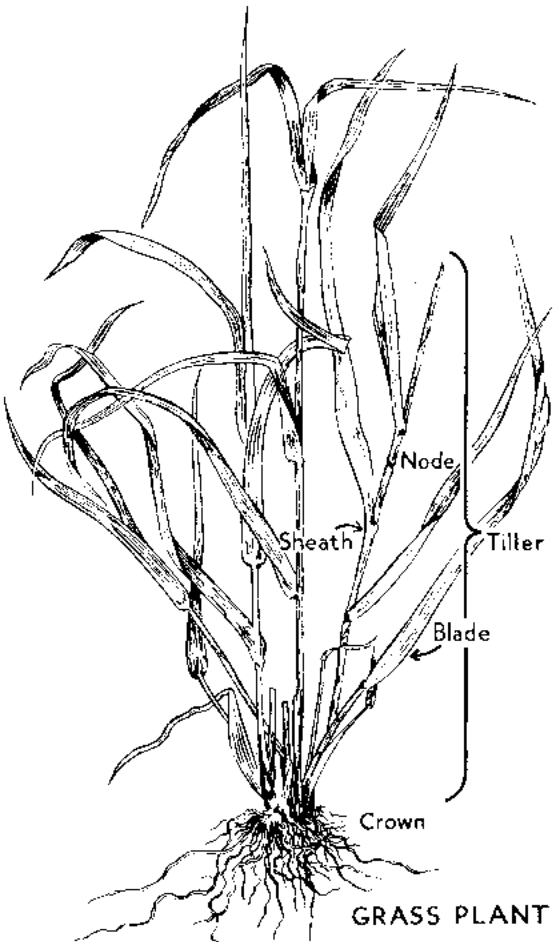
Growth of pasture occurs through an increase in the weight, and the number and size of leaves and stems. The rate of change of leaf and stem size and weight of an individual plant will be influenced by the competitive advantage of that plant.

In every pasture there is continual competition between plants (of the same species and of different species) for nutrients, moisture and sunlight. When one species is disadvantaged (for example, by selective grazing) another species may be advantaged. Similarly, as soils become acid, some species will tolerate and survive while the growth of others is reduced.

Grass growth

Grasses reproduce and become larger by production of tillers from the base of the plant causing the 'clumpy' appearance of most grasses (see Figure 6.1). Sunlight to the base of the plant is the stimulus for tiller production.

Figure 6.1. Key growth features of a grass plant.



Reprinted from *Pasture Legumes and Grasses* with permission from Westpac Banking Corporation.

Tillers are produced over growth periods but die when moisture becomes limiting or are shaded from sunlight by excess growth of older ungrazed tillers or competing species. Most species have a limit of 3 to 5 leaves per tiller. Once this maximum is achieved a leaf will die as a new ones grows

We can use the grazing action of animals to increase tillering and help thicken pastures. By keeping pastures in the range 3–15 cm sunlight reaches most of the plant material and allows maximum production of new tillers or competing species.

For reproduction, some grasses propagate vegetatively (e.g. kikuyu, rhodes grass) but most regenerate from seed. Opportunities have to occur for seeding and for regeneration of seedlings. This is essential for annuals, less so the perennials.

Perennial grass based pastures, well managed, use soil water to depth and help to reduce deep drainage. The deepest roots on perennial are survival roots. Their purpose is to access water in dry times or during dormancy to keep the plant alive. The roots that drive growth are in the top 40 cm.

Legume growth

The amount of legume (or clover) in a pasture is important because it increases the quality of the pasture mix. In the vegetative stage, legumes are highly digestible, and capable of supporting high levels of livestock production.

Where the digestibility of the grass and legume component is the same, the intake of the legume is likely to be higher than the grass, resulting in increased liveweight gain.

Legumes also benefit grass as they add nitrogen to the soil.

Too much clover in the diet of cattle can cause bloat. On the other hand, sheep grow well on high clover diets. As a recommendation, a balanced sheep/beef pasture will contain 15 to 30% of clover on a dry weight basis in spring.

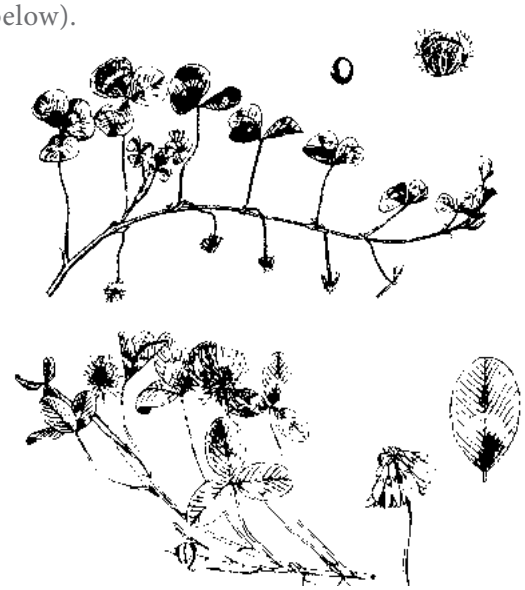
An efficient fertiliser management program will be important to achieving this outcome.

It is imperative then that management decisions take into account the legume component as it is a key factor driving the pasture/livestock system.

Legumes grow differently depending upon whether they are annual or perennial. For annuals such as subterranean clover, growth is from seed with numerous stems developing from the crown above a taproot. After rapid early growth in autumn, development slows over winter with seed production following flowering in spring. Grazing of taller grasses to open up the pasture over winter and spring allows sunlight to the clover leaves and encourages seed production.

A perennial clover such as white clover, consists of several shoots or stolons (see Figure 6.2). Stolons may have root systems and produce other leaves and runners (new stolons). Other legumes may form crowns and have a single tap root, producing a more clustered appearance rather than branching.

Figure 6.2. Subterranean (top) and white clover (below).



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An example is lucerne, which when well managed, is efficient in reducing deep drainage of soil water.

Reproduction in legumes is by varied means. Some are dependent on high soil seed reserves, such as subterranean clover and medics, others can reproduce by vegetative means (stolons) such as white clover. As with grasses, opportunities have to be provided for regeneration if persistence is important. This will vary for the species, and even varieties within species (e.g. Haifa white clover is more dependent on seed set for persistence whereas small leafed types are less so). Strategic spelling and grazing can have a dramatic effect on seed set of annuals (e.g. subterranean clover).

Growth curve of plant production

The different growth habits, tall or short, of species varies the way you assess how they will perform in the growth phases. Figure 6.3 shows simplified and representative growth curve of pastures typically tall grasses, consisting of three phases: Short growing species can persist in phase 1 without the listed negative factors.

Phase I. Pasture growth is slow because of low leaf area. Prolonged grazing in Phase I during the dry season can kills plants, can create bare areas and leads to runoff of water, erosion and weeds.

Phase II. Most rapid pasture growth occurs here. More sunlight is caught by the increased leaf area and converted to pasture growth. Pastures maintained in this condition are highly efficient users of soil water.

It is in this phase where pasture growth rates will be greatest, where livestock productivity is highest and where pastures can make their most positive impact on sustainability. Management should aim to maintain paddocks in this phase for as long as possible, it can only be done on a selection of paddocks resulting in other paddock being allowed move into phase 3.There will be times when management requires that pastures be in Phase 1 or 3.

Phase III. Plants are mature, of lower quality and may, through competition and shading, reduce establishment of new plants or limit seed set on shorter species. Pasture growth is therefore slowing and death of plant material is greater than the re-growth.

The height to which pastures should be grazed varies with pasture species, climate and soil factors. For example, a phalaris/sub clover pasture in good tableland conditions responds to maintaining pasture between 5 to 15 cm whereas a microleana/sub clover pasture is best kept in the 4 to 8 cm range. (See Appendix 3 for more details)

There will be occasions when grazing in Phase II is not desirable and grazing in Phases I and III are beneficial – for removing dead material or competing species (Phase I) and for regeneration of the species (Phase III).

On the tablelands and slopes the critical times to be concerned with the phases of pasture are:

- At the end of winter before spring growth.
- Between summer and autumn for annual pastures.

Usually, pastures are in Phase I at the end of winter with minimal leaf area. Re-growth will depend on leaf area, soil moisture and temperature. To make the best use of increasing temperatures in the spring, plan to have some pastures with a greater leaf area to maximise growth. Paddocks below 800 kg/ha at the start of spring will grow slower and longer into spring. This helps with management of spring when control of the pasture quantity is required to maintain pasture quality. Over winter the aim should be to manage pasture so that at the end of winter, they are around the Phase I/Phase II boundary.

The same principle applies to annual temperate pastures following the autumn break. A spelling period to allow pastures to accumulate leaf area and achieve 500–800 kg green DM/ha before grazing, gives greater growth over early winter and improved spring production.

SOIL FERTILITY

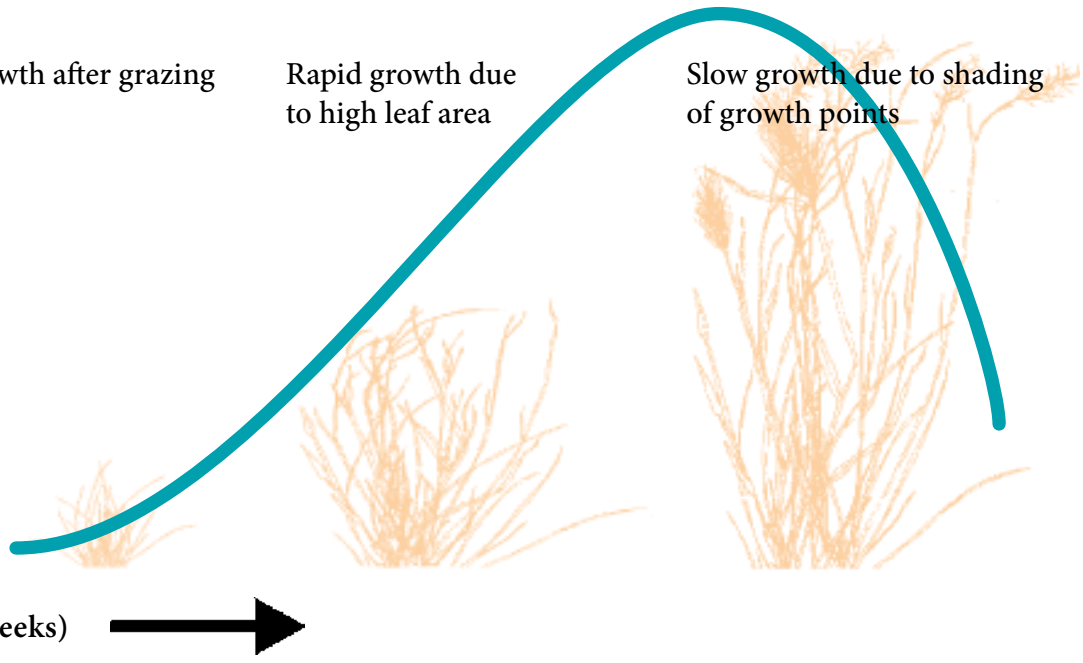
Of all the factors that producers have control over soil fertility is the one that has the greatest influence on pasture production and if this is combined with a stocking rate that make good utilisation of the pasture grown then farm profits/ha will increase. Benchmarking results for the last 30 years has shown the importance of stocking rate as a profit driver but stocking rate follows the improvement in pasture production. The positive impact of soil fertility works across introduced and native species and a variety of soil types.

Download the 5 easy step booklet from the MLA web site for more details on;

- Working out your critical fertility values, going above these values is a waste of money.
- How to taking a meaningful soil tests?
- How to calculate maintenance rates of fertiliser?
- Match your stocking rate to your soil fertility levels to drive profitability.

Figure 6.3. Simplified growth curve of pastures.

PHASE I	PHASE II	PHASE III
Characteristics		
Below about 800 kg green DM/ha of a moderately dense pasture	Between about 800–3000 kg green DM/ha of a moderately dense pasture	Above about 3000 kg green DM/ha of a moderately dense pasture
Positive aspects		
• Grazing enables control of unwanted species • Grazing enables reduction of litter prior to germination of desirable species • High digestibility	• High yield of high quality pasture • Grazing pressure will delay onset of flowering • Rapid pasture growth • Good livestock weight gain • High yields of feed • Good use of soil water • Good protection from run-off	• Replenishes energy reserves of perennial species • Allows seed set and replenishment of seed reserves in the soil for tall growing species • Low risk of run-off and erosion
Negative aspects		
• Slow pasture growth rate • Long term grazing threatens plant survival, tall species • Increased run-off and soil erosion risk • Low livestock weight gains	• May not allow desirable pasture species to seed down	• Low pasture quality Slow pasture growth rate • Suppression of companion species in pasture • Normally livestock lose weight • May inhibit germination of annuals the following season • Poorer use of soil water
Yield: Low Quality: High	Yield: Good to High Quality: Good to High	Yield: High Quality: Low
Slow growth after grazing	Rapid growth due to high leaf area	Slow growth due to shading of growth points



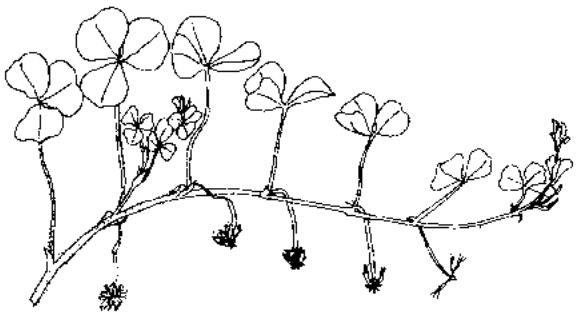
THE INTERACTION OF PASTURES AND LIVESTOCK

Pasture/livestock systems are very complex. Consequently, a large number of factors and interactions need to be considered to achieve the desired outcomes. For this reason, simple recipes for grazing management are not appropriate for optimal long-term pasture and livestock production. Knowledge of the principles and their application will enable greater progress.

Pasture plants of different species and varieties vary greatly in their response to grazing. Knowledge of how individual pasture plants respond to grazing is essential for top performance and pasture persistence. For example, lucerne has been extensively studied and a rotation with a 1 month rest is best for persistence and production. (See Appendix 3 including the north coast supplement for detail on individual species).

There are a number of features needed for successful pasture production. They are:

- Adequate ground cover of persistent adapted pasture species must be maintained. Besides being critical for farm carrying capacity, this reduces surface run off, erosion, improves soil health and the quality of run-off, and improves water infiltration reducing the potential for nutrients entering waterways and for weed control. Replacing washed off nutrient is very expensive.
- Good management at critical times (e.g. spring and autumn for many species) can favourably affect composition and persistence.
- Sown pastures need a well-adapted and persistent legume component. Without it, persistence and production of desirable grasses is likely to decline unless fertiliser nitrogen is added.



Pasture production and therefore carrying capacity, is mainly affected by species present, fertiliser, soil type, moisture, temperature, adequate leaf area and the grazing history. Producers can influence species choice, fertiliser inputs and the way stock graze pastures.

As perennial plants do not live forever, they need to be managed to keep them productive for as long as possible and provide opportunities for new plants to establish. To do this:

- Use the best adapted species and varieties for the climate, soil fertility and paddock.
- Have a range of pasture types on properties so that all pastures do not have to be managed in the same way at the same time. This provides practical flexibility.
- Ensure that soil nutrients are adequate; especially phosphorus, sulphur and molybdenum. The quickest way to improve pasture production is by getting the soil fertility to the right level to match the stocking pressure.
- During the establishment year, grazing management should aim to ensure that perennials establish good root systems and that annual legumes flower for seed production. Provided they cannot be pulled out and there is good soil moisture, new pastures can be grazed for short periods when greater than 15 cm tall. Do not leave stock in for extended periods allowing them to overgraze new plants. Grazing stimulates tillering and root development when growing conditions are good.
- Where perennial grasses are sown under less favourable conditions e.g. surface sowing, sowing late in the season, low fertility, dry conditions during establishment, and the root system is not developed; they will benefit more by not grazing in the first year.
- Desirable annuals should be encouraged to set as much seed as possible.
- In both annual and perennial pastures the proportion of clover in the pasture mix can be manipulated by pasture management strategies.

WHY USE GRAZING AS A MANAGEMENT STRATEGY?

Grazing management can have a significant role in achieving the following:

- Optimising pasture growth rate by keeping pastures in a growing state, which positively influences carrying capacity.
- Using feed efficiently and profitably to meet livestock production and market targets.
- Ensuring feed quality is satisfactory for stock.
- Enhancing persistence of desirable plant species.
- Maintaining adequate ground cover to reduce run off, prevent erosion, improve the quality of water entering waterways and resist weed invasion.
- In some instances, control insect infestations e.g. blue green aphid on lucerne.
- Strategic intervention by grazing management is often necessary because our pasture species are not ideally matched to:
- Climatic variability, soil type, weed competition, grazing habits of livestock, grazing pressure and soil fertility

Grazing management should be considered as routinely as any other management tool, such as fertiliser or herbicide and indeed grazing management is best used effectively in conjunction with one or more of these tools.

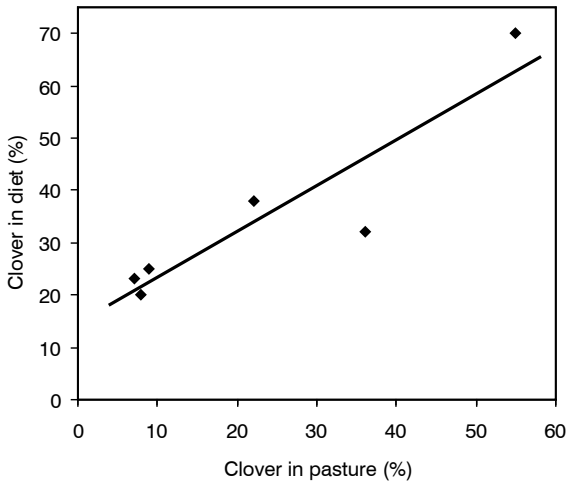
Impact of different livestock on pastures

Sheep and cattle have different feed preferences and different grazing behaviour. But both select leaf in preference to stem, and stem in preference to dead material.

When herbage mass is high, sheep will:

- Select green material.
- Tend to graze closer to the ground than cattle.
- Select leaf material and clover (see Figure 6.4).
- Have a greater impact on the botanical composition of the pasture than cattle.

Figure 6.4. Sheep preferentially selecting clover. Their diet may contain proportionally more clover than what is available.



From Milne et al, 1982 *Grass and Forage Science*, **37**: 209–18.

Cattle on the other hand:

- Also select green material but are less selective and are able to quickly reduce the mass of herbage, without particular selection of an individual plant.
- Can be used to clean up rank pastures because they are less selective than sheep and they will remove more dry feed, even though it is of lower quality.
- Grazing of sheep and cattle together on a pasture will often improve animal production and pasture stability.
- Selective grazing will occur according to variation in attractiveness of a plant to the animal.

Dry seasons – perennial grasses

Native grasses and the main introduced perennial grasses are relatively well adapted to our variable climate, some more than others (e.g. phalaris is better adapted than perennial ryegrass).

Recent research has indicated that survival in drought can be assisted by leaving a reasonable amount of pasture. This is also desirable as it reduces erosion risk and encourages water infiltration. Ideally leave a cover of 1000 kg DM/ha in prolonged dry conditions. To achieve this, concentrating stock into a few paddocks needs to be implemented in order to save the better paddocks for rapid recovery following the break of the drought. Native pastures will often recover better from intensive grazing during drought.

In the case of all perennial grasses, the effect of a moderate drought on their survival may be more severe than that of a major drought. Perennial species are at greatest risk if they grow in seasons when soil moisture is low and variable. Species that have good persistence (phalaris) tend to be dormant during this period and are protected. Species that continue to grow (summer active cocksfoot) during these periods are less likely to persist because they are providing all the quality feed for stock and so taking all the grazing pressure. To maintain these species leave 1000 kg/ha residue after each grazing.

The Stockplan program helps producers work through what drought strategies suit them best. There is no ideal drought plan. They range from feeding all to getting all stock off your place by sale or agistment and points in between. They have different strengths and weakness which need to be considered by each producer.

MANIPULATING SPECIES COMPOSITION

The botanical composition of a pasture affects the amount and quality of herbage on offer. This in turn affects animal production. Botanical composition can be modified in pasture using fertiliser, herbicides and strategic grazing and is more effective if used together in a planned improvement strategy. Note, when attempting to change the botanical composition of pastures containing native pasture species, The *Native Vegetation Act* (2003) may impact on some practices. Inquire through your local LLS office for further details.

By grazing management

Modification of botanical composition of a pasture by grazing can be achieved through:

- Heavy or light stocking densities.
- Continual grazing by either sheep or cattle.
- Changing the length and frequency of rests (for desirable species).
- Strategic grazing based on the stage of growth of the plant.
- Hard grazing over the flowering period to reduce seed production of undesirable species.
- Tactical cutting (fodder conservation or slashing).
- By allowing pastures to seed and regenerate.

In the establishment year of a pasture it is desirable that plants be allowed to set seed. However, with well established pastures, allowing perennial plants to seed annually is not critical.

The decision to allow established pastures to seed will be influenced by:

- Whether annual or perennial based (more critical with annuals than perennials).
- Density of pasture (low density pastures may benefit).
- Threat of weed competition.
- Current seasonal conditions and the increased stocking density required to manage other paddocks
- Previous and current stress on the pasture, e.g. disease, grazing pressure, nutrient deficiencies (more stress, the greater the need to rest).

Occasional spelling at the reproductive stage is important for the preservation of species. However, the spelling strategy can be used in conjunction with grazing to change botanical composition. The best example is the control of wiregrass by strategic grazing and its replacement by wallaby grass by spelling at critical periods such as seedling establishment, flowering and seed set of wallaby grass.

Spelling to allow regeneration of some pasture species from seed is desirable but not understood for many of our pasture species. Requirements for some species are known (e.g. autumn for annual legumes and Haifa white clover; spring and autumn for wallaby grass etc.).

By grazing management plus fertiliser and/or pesticides

- Legumes tend to be more responsive than grasses to phosphorus and sulphur, and so fertiliser can be used successfully to manipulate the legume content in conjunction with appropriate grazing management to encourage legume growth and discourage competition from companion species. By increasing rates of

phosphorus and sulphur on deficient soils in particular, the content of legumes can be increased relative to grasses. Conversely, on soils where soil nutrient levels are close to critical levels and where high legume content is present, a reduction in application rates can reduce clover content.

- A fertiliser program that reduces or eliminates soil nutrient deficiencies increases pasture production and so farm carrying capacity. This in turn results in more efficient water usage (kilograms of pasture dry matter per hectare per 100 mm of rainfall), especially if deep rooted perennials are a component of pastures. Fertiliser programs should not apply nutrient above the critical level for pasture production. Read '5 easy steps' see further reading.
- The addition of nitrogen can be used to stimulate growth and improve feed quality of responsive grass species where soil nitrogen levels are low. The use of fertiliser to manipulate composition assumes that soil moisture is adequate for good plant growth.
- Spray topping, in conjunction with subsequent grazing for annual grass control.
- Spray grazing using a combination of sub-lethal rates of phenoxy herbicides combined with increased stocking pressure to remove broadleaf weeds. The grazing pressure required must be above 30 DSE/ha and often can be 50 DSE/ha. In large paddocks this pressure is often not possible so the method should not be used.

By using pesticides alone

- Selective use of broadleaf herbicides to reduce content of broadleaf weeds e.g. using selective hormone herbicides.
- Selective use of grass-based herbicides.
- Tactical use of insecticides for control of red legged earth mite in spring, to reduce problems the following autumn (note: This tactic may not be suitable for blue oat mite – seek latest information).

By stock type

- Cattle vs Sheep. Different grazing habits and dietary preferences can affect pasture composition. No firm recommendations are available on desirable ratios of sheep to cattle, for various pasture situations.
- Goats. Grazing by goats can cause a change in botanical composition. Clover content can be increased by winter grazing with goats. As well, many weed species can be controlled by grazing with goats. Recommendations are available on the desirable mix of goats with other stock types.

LIVESTOCK HEALTH AND PASTURES

(See also Segment 7 for worm issues and Segment 8 for grazing management).

With increasing stocking rates and higher quality pastures, the incidence of animal health problems may increase.

Losses from animal health problems are usually small compared to increased production from pasture improvement. Bloat in cattle is one of the more important problems, in economic terms. Losses can be minimised by appropriate management.

Producers should be aware of the symptoms and preventative measures for the main conditions:

- Bloat with legumes – especially lucerne, white and sub clover.
- Nitrite/nitrate poisoning. Many grasses, broadleaf weeds and oats may be involved.
- Redgut when grazing lucerne, white clover.
- Internal parasites.(see Segment 7).
- Grass tetany.
- Phalaris poisoning.
- Ryegrass staggers.
- Clostridal diseases, including pulpy kidney.
- Photosensitisation – especially from the panic species, and fodder brassicas.
- Oxalate poisoning – especially pigeon grass, buffel grasses, kikuyu and setaria.
- Cyanide (prussic acid) – sorghum species.

Primefacts from NSW DPI are available on animal health issues, as well as the management of specific pasture species which include considerations for animal health. Consult your veterinarian when planning pasture improvement or if animal health problems should occur.

SUMMARY

The 3 essential factors for plant growth are sunlight, carbon dioxide and water.

The factors that control the rate of plant growth are temperature, soil fertility, leaf area and the available soil water.

Know your major plant species and where they are growing. This enables better grazing decision to be made within a year.

Legumes assist pasture quality and add nitrogen to the soil thus assisting grass growth. A balance between desirable species is needed to reach enterprise targets and management can assist in maintaining a suitable mix.

Pasture species differ in their grazing requirement for production and persistence. As a general rule, pastures maintained in Phase II – between 800 and 3000 kg green DM/ha provide the optimum combination of high quality and quantity of pasture as well as being beneficial for pasture sustainability. Growth in Phase I is slow. Pastures in phase III tend to be too low in quality to meet good livestock growth rates. Avoid prolonged under or over grazing of pasture, but there are occasions when pastures will benefit from being in Phase I or III.

Botanical composition can be modified by:

- Timing of grazing (especially on a seasonal basis).
- Grazing intensity and frequency.
- Grazing plus fertility and herbicide.
- Selective herbicides or insecticides.
- By using livestock behavioural differences.
- By allowing desirable pasture species to seed and regenerate.

When grazing pastures, especially intensively, knowledge of livestock health issues associated with the species is desirable.

Further reading and information

- *Prime Pastures Program*. NSW DPI (Booklet).
- *Managing high rainfall native pastures on a whole farm basi*s. NSW DPI, Goulburn, NSW. (Booklet).
- *Native grasses – an identification handbook for temperature Australia* (Book).
- *Regional pasture publications*, NSW DPI (Booklets).
- *Tip and Tools*. MLA, Sydney.
- *Weed control in lucerne and pastures*. NSW DPI (Booklet).
- *Five Easy Steps – to ensure you are making money from superphosphate*, MLA web site.
- www.dpi.nsw.gov.au