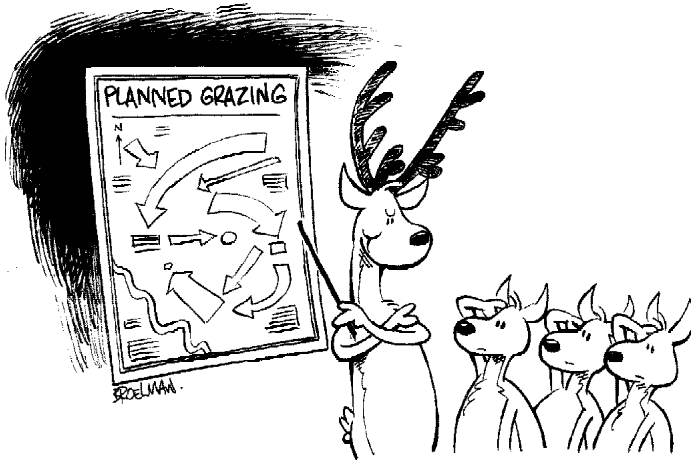


PASTURE ASSESSMENT AND MANAGEMENT



PASTURE ASSESSMENT AND MANAGEMENT

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This manual does not attempt to deliver the SGS PROGRAZE training course of pasture and animal assessment. However, it reinforces and promotes the 'common language' developed in the PROGRAZE manual and it is intended as a stand-alone reference for the underlying principles of the PROGRAZE manual.

PROGRAZE was originally conceived by NSW Agriculture to train producers in pasture and animal assessment and how to utilise these skills in decision making on grazing management.

Alan Bell and Cameron Allan originally compiled the PROGRAZE manual, on which this chapter is based, with direct assistance of Advisory staff and scientists from NSW Agriculture. Within each State, the manual has been adjusted for local issues by livestock and pasture specialists from each State's Department of Agriculture. Chris Tuckwell has edited the PROGRAZE manual for application to the deer industry.

PROGRAZE Training Courses

This section provides an introduction to pasture assessment skills. The Deer Industry Association of Australia (DIAA) encourages all deer farmers to participate in training courses offered by SGS PROGRAZE to further develop their skills and knowledge.

SGS PROGRAZE training courses aim to train producers and others in pasture and animal assessment and how to utilise learned skills in decisions of appropriately matching pastures to animal requirements. Course coordinators in each state who can be contacted about participation in PROGRAZE courses are:

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Grazing Management of Deer

Like all sectors of agriculture the deer industry is under increasing pressure to lift efficiency while at the same time maintain or, in many cases, improve the environment and resources employed for production.

For deer producers the key issues are the efficient conversion of pasture to animal products, which are capable of competing effectively on domestic and international markets. This conversion must originate in a production system capable of maintaining pasture stability and productivity.

To achieve this many variables must be considered in grazing management, with each pathway interlinked (see Diagram 11).

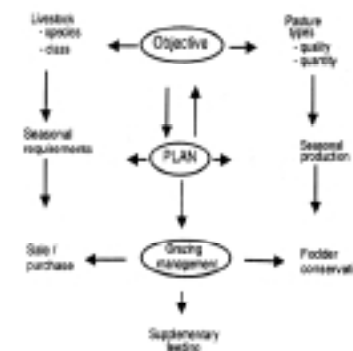


Diagram 11: Pathways of grazing management decision making
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To ensure that the potential for stock to efficiently maximise production is not compromised, farmers must understand differences in seasonal feed requirements and differences related to production status.

Stock feed requirements must be considered in advance of need so supplies of anticipated requirements can be met.

Pasture Assessment

The major emphasis of PROGRAZE training courses is to develop their pasture assessment skills. Such skills provide the basis on which to build sound pasture and grazing management. It is important that people managing livestock develop an ability to visually assess and estimate the amount and quality of pasture present in a paddock.

The DIAA recommends all deer farmers consider participating in a PROGRAZE pasture assessment course.

Why Assess Pastures

Animal managers should be able to assess pastures so they can:

- Match animal requirements and pasture production
- Achieve more precise supplementary feeding
- Accurately assess feed requirements and plan feeding programs
- More effectively manipulate pasture production and composition

Visual Assessment of Pastures

Visual assessment of pasture by stock managers trained in assessment allows them to:

1. Estimate the quantity of pasture available.

This is referred to as herbage mass and it is measured in kilograms of dry matter per hectare (kg DM/ha). It is important that pasture assessment recognises the proportion of green and dead material in the pasture mix. The influence of herbage mass on animal production is discussed in the next section.

2. Predict the quality of pasture available.

The most useful measure of pasture quality is digestibility. Pasture digestibility is expressed as a percentage and is an estimate of the proportion of pasture or feed which, once consumed, can be utilised

by an animal. It may refer to the total pasture but often a more useful measure is the digestibility of pasture components including green, dead, grass and legume components.

The influences of digestibility and legume content of pasture on livestock production are also discussed in the next section.

Measuring Herbage Mass

People who participate in PROGRAZE training courses are taught to visually estimate the quantity and quality of feed available in a paddock.

A common method used to train people to accurately estimate herbage mass is known as the median quadrat technique. In principal people objectively measure available pasture and learn how to relate a known pasture mass to its visual appearance in a paddock to, “calibrate the eye”. People who participate in the PROGRAZE pasture assessment course will be trained in the median quadrat pasture assessment technique.

While the median quadrat technique is preferentially taught at PROGRAZE courses, the single quadrat technique explained below has the advantage of being simple and can be used by untrained people to assist the estimation of pasture mass.

The single quadrat method involves making a square quadrat with an internal measurement of 500 mm x 500 mm (0.25m²). The technique requires the selection of a small relatively even area of pasture that is representative of the paddock, say 2m x 2m, that is identified by a peg placed at each corner. Within this area, an area the size of the quadrat that is representative of the whole is selected.

The quadrat is placed over the selected area and all pasture within the quadrat is cut at ground level. The sample is dried using the method described in Appendix 1 and the dry sample is weighed (to the nearest gram). The weight in grams multiplied by 40 provides an estimate of kilograms of dry matter per hectare (kg DM/ha - a quadrat of the size described above is 1/40,000 of a hectare). The estimate of dry matter in the quadrat is related to the pegged area and the estimate of the pegged area related to the whole paddock to estimate the paddock dry matter.

PROGRAZE courses emphasise the development of participants’ visual assessment skills via the measurement of relatively small pasture areas. These skills are used to assess paddocks, the assessments of which form the basis of grazing management decisions.

As these skills are developed, common circumstances where errors occur are:

Where clover makes up a significant proportion of the pasture there is a tendency, as pasture height increases, to over estimate herbage mass. This is due to clover being very showy and lacking density beneath the leaf canopy. Pasture density needs to receive the same emphasis as height when making assessments. Be careful under estimating very dense pasture.

There is also a tendency to over estimate herbage mass when pasture is in the early vegetative stage, leafy and actively growing. Remember, herbage mass is based on the amount of dry matter available and pastures in this condition can be in the range of 10-20% dry matter. That is, 80-90% water.

Conversely, where a pasture contains mainly mature dead material there is a tendency to underestimate herbage mass. You might say: Well what the heck, this is poor quality pasture anyway. Such pastures, when little or no green feed is available make an important contribution to livestock production even if they require some supplementation. These pastures may be 80-90% dry matter. Non-palatable species, such as thistles, should be ignored when assessing herbage mass.

Measuring Pasture Digestibility

Digestibility is mainly influenced by the pasture's stage of maturity. Information in the next section of the manual will assist in developing digestibility estimates for pastures.

It may be that you would find it useful to have a digestibility profile on your pastures. The collection technique is important and is described at the end of this chapter.

Assessing Botanical Composition

The proportion of species in a pasture can give a quick estimate of pasture quality. As the proportion of less desirable species increases, so pasture quality declines. Monitoring provides an ongoing understanding of changes in composition. Corrective measures can be applied before the decline is too great, and costly re-sowing is required.

The simple "pointed stick" technique is used to monitor the species present in a pasture. The stick is randomly thrown across the paddock and the plants that are nearest the ends of the stick are recorded. The best time to assess botanical composition of pastures varies. Generally in winter rainfall areas the best time is in early winter after the autumn break. Plants have then established full ground cover. In other areas a different time may be more appropriate.

Pasture Species Identification

PROGRAZE courses also develop pasture species recognition skills.

When collecting specimens for identification remember it may require a flower or seed head to be successfully identified. For information on identifying your pasture plants contact local Department of Agriculture offices.

Herbage Mass, Pasture Digestibility and Animal Intake

Herbage mass and digestibility interact to determine the amount of pasture consumed by livestock. Assuming the animals are healthy, the level of pasture intake will determine animal production. There are critical levels of digestibility as there are with herbage mass. One can offset the other when high levels of production are not required. Through pasture assessment and understanding this interaction, animals' requirements and pasture availability can be better matched.

A major aim of a grazing enterprise is to produce animals that provide commodities that meet market specifications. Using skills developed in PROGRAZE along with strategies such as production targeting, graziers will be in a better position to determine if they are on track to get animals to a particular target.

Once a market is identified, livestock production requirements can be determined (eg. growth rate required). Similarly, stock can be better allocated to paddocks to keep them on target. PROGRAZE courses will train participants in production targeting.

Where pasture is limited, supplements may be required to fill the shortfall. The amount of supplement needed by animals depends on the quality of the supplement (can be determined by feed tests) and the production status of the animals (pregnancy, lactation, growth, etc.). A knowledge of pasture and supplement quality will allow you to more accurately satisfy animal feed requirements.

Summary

- Pasture assessment is used to determine the capability of the pasture for animal production
 - It is a visual scoring method based on cutting, weighing and drying of pasture
 - It involves recognising pasture quantity and quality
- Quantity
 - Herbage mass, the amount of pasture available in kg DM/ha
 - The amount of green and dead material
 - Herbage mass = total green + dead material

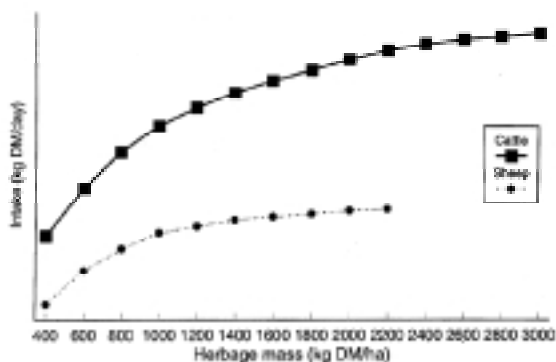
- Quality
 - The digestibility of a pasture
 - The percentage of legume on a dry weight basis
 - The species composition in a pasture

Livestock Production From Pasture

The quality and quantity of animal product derived from pasture fed livestock is directly related to the quality and quantity of the pastures they graze. The nutrient requirements of animals are most cost effectively met by grazing pasture.

The critical factor determining the production level of livestock grazing pasture is the amount of that pasture the animals are able to consume, otherwise known as intake.

Intake is influenced primarily by the quantity of pasture available as well as its quality. Skills in estimating pasture quality and quantity provide the basis for improved grazing and pasture management decision making. Diagram 19 provides a guide to intake of sheep and cattle. Deer intake curves are likely to be similar to these curves.



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Diagram 12: Influence of herbage mass on the intake of sheep and cattle

Pasture Quantity

Pasture quantity, which is usually described as herbage mass, is expressed in kilograms of pasture dry matter per hectare (kg DM/ha). Herbage mass refers to the total amount of pasture present, assuming a cut was taken at ground

level and includes both green and dead material. At times the term green herbage mass is used. This is a prediction of the green pasture present only, a critical factor where high levels of livestock production are required.

Herbage mass is expressed in terms of dry matter because water content of pasture can vary depending on the time of day and with different stages of growth. For example, a young leafy, rapidly growing pasture may contain 85% water (or 15% dry matter) while flowering grasses may be 50% water and therefore 50% dry matter. Dead pasture on a hot summer day may be over 90% dry matter. While being vital, water itself has no nutritional value. When relating herbage mass to what the animal can eat and utilise, the water component is ignored.

The Importance of Herbage Mass to Livestock Production

If herbage mass drops below a certain level grazing animals are unable to consume sufficient pasture to maintain their weight. When herbage mass is low, animals must spend more time grazing to meet their nutritional requirements since each bite of pasture harvests a smaller amount.

Similarly there is a point at which intake will not increase even if more pasture is made available because the animals have reached their maximum gut fill.

When a paddock contains a greater herbage mass than required for the particular livestock class grazing it, the opportunity occurs for manipulating the stocking density to improve the utilisation of pasture.

So far, herbage mass has been discussed in relation to livestock production but also, it influences pasture productivity, i.e., pasture growth rates and botanical composition.

Pasture Quality

Numerous quality characteristics of pasture can influence intake by livestock. From a practical point of view pasture digestibility and the proportion of legume are probably the most useful measures even though they do not always fully explain the variation which can be observed in intake.

Pasture Digestibility

Digestibility, expressed as a percentage, provides a prediction of the proportion of the pasture consumed that is actually used by the animal. For example, if the digestibility of a pasture is said to be 75%, the animal for its own nutritional requirements will use approximately 75% of that consumed on a dry matter basis, while 25% will eventually pass as faeces.

Digestibility influences the time feed spends in the animal's stomach. A pasture high in digestibility will move quickly through the animal allowing it to consume more. More pasture consumed equates to higher production.

On a pasture of low digestibility (even though there may be plenty of it) stock are made to consume sufficient pasture to meet their nutritional requirements because they can only eat to 'stomach' capacity.

Digestibility is a useful measure of quality because:

- It is directly and positively related to the energy content of the pasture. Animals need energy for body functions. Energy in feed is assessed as megajoules of metabolisable energy per kg of dry matter. See Table 28 for energy contents of common feeds

Digestibility %	Energy Content of Feed (MJ/ME per kg DM)*
40	4.8
50	5.7
60	8.2
70	9.9
80	11.6

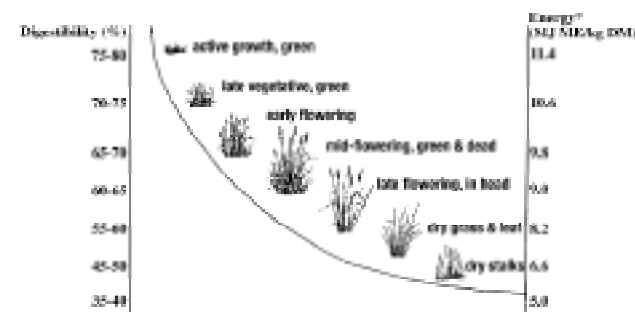
* Megajoules of Metabolisable Energy per kilogram of dry matter

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Table 28: Guide estimates of energy content of feed relative to digestibility value

- Digestibility is positively related to protein content. When digestibility is high, protein content also will be high. However, there is variation between pasture species in protein content. For example, clovers are generally higher in protein than grasses
- Digestibility directly relates to the speed of digestion and therefore the movement of feed through the animal. In general, pastures with higher levels of digestibility will be digested more rapidly allowing for greater intake and so greater animal production

Pasture digestibility differs between pasture species and varieties, parts of a plant and by the stage of growth of the plant. Lets now deal briefly with each of these aspects.



*These values are only typical estimates corresponding to the range in digestibility values.

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Diagram 13: Pasture digestibility declines as pasture matures

Species

Legumes usually have a higher digestibility than grasses. Maintaining legumes in the pasture mix will improve the overall quality and livestock production potential of the pasture. In addition, at the same digestibility the intake of legumes can be expected to be greater than the intake of grasses. Perennial grasses may be more digestible for a longer period than annuals as annuals die off after seed production.

Parts of the Plant

Leaf material is more highly digestible than stem. Pasture management that maintains pasture with a high proportion of leaf will provide a pasture of higher digestibility and so improved livestock performance. As well, by maintaining leaf area on a plant, its ability to recover following grazing is quicker.

Stage of Growth

The stage of growth of pasture plants has a major influence on digestibility. Diagram 13 provides a guide to the decline in digestibility that occurs as pastures mature. Young, actively growing plants, said to be in the vegetative stage, will have the highest digestibility. Digestibility decreases as plants mature, particularly as they enter their reproductive phase and prepare to flower. Following flowering the plant enters senescence and digestibility declines rapidly. This situation is characterised by declining green herbage and a rapid increase in the proportion of dead. In this type of pasture, digestibility (55-60%) has reached a point where the pasture will barely maintain the weight of stock even if herbage mass is not limiting intake.

In dead pastures, and where significant amount of leaf remains, particularly cloverleaf, digestibility should be in the range of 50-55%. In circumstances where the dead leaf has largely disappeared from the pasture, intake will be insufficient to maintain animals and an increased weight loss will occur (digestibility of 40-50%).

The digestibility of cereal straws is likely to be in the range of 35-40%. Rain on dry standing feed will cause a drop in digestibility, and so the feed value of the dry pasture.

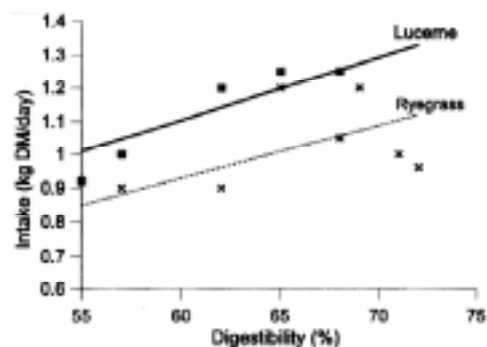
Grazing management should aim to keep pastures in the growth phase for as long as possible, delaying the onset of flowering and an associated decrease in digestibility.

Proportion of Legume

Legumes are critical components of pastures, being the major source of nitrogen for pasture grasses. Legumes are also important to livestock production.

Legumes at the same stage of growth will often be of higher digestibility than grasses. So, on digestibility alone, intakes can be expected to be higher on pastures containing greater proportions of legume. In addition, research has demonstrated that, in general, intake of legume will be greater than grasses even when their digestibility is measured as the same.

Protein levels of legumes are usually superior to grasses especially as they approach maturity.



(© PROGRAZE manual)

Diagram 14: Intake of legumes may be higher than grasses of the same digestibility

Interaction of Herbage Mass and Pasture Digestibility

It is important to realise that herbage mass and digestibility interact. At low herbage mass but where digestibility is high, intake is limited because of small bite size. While stock will extend grazing time in these situations, they are limited to about a total of 13 hours per day.

Livestock production, in the situation of low herbage mass and high digestibility is not necessarily improved by reducing the stock numbers in a paddock (lowering stocking density, or providing a larger paddock with a similar quality and quantity of pasture).

The only way a reduction in stocking density may improve livestock production is that the availability of pasture (herbage mass) may increase. However, this is dependent on pasture growth rates being greater than intake of livestock.

Where herbage mass is high but digestibility is low, intake is limited by the slow movement of feed through the animal as described earlier in this section.

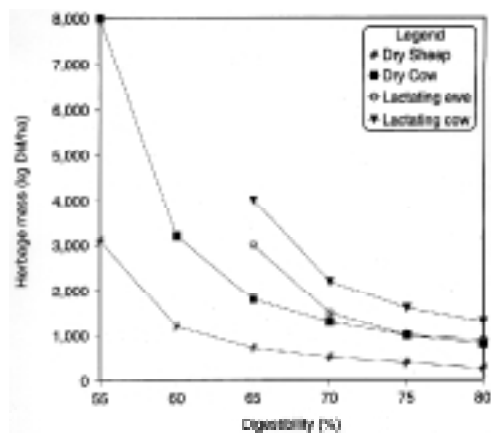
The interaction between herbage mass and digestibility allows trade-offs between the two to achieve the same production outcome in livestock. The potential for trade-off is greatest in animals with low nutritional requirements, i.e. maintaining dry stock, but there are less opportunities in high demand animals as indicated in Diagram 14.

The four classes of livestock shown in Diagram 15 are each achieving the same production level along their line; that is, the dry sheep requires a herbage mass of 3000 kg DM/ha at 55% digestibility to maintain weight. When at 70% digestibility, only 500 kg DM/ha is required.

Note that if average pasture digestibility falls below 55% digestibility stock are likely to lose weight irrespective of the quantity of feed available.

In the case of lactating cows, 4000 kg DM/ha at 65% digestibility achieves the same production level in those particular cows as 1500 kg DM/ha does at 75% digestibility.

Where near maximum production is required there is little opportunity for trade-offs. Digestibility of the green component needs to be above 70% and the amount of green for sheep around 1500 kg green DM/ha or more. For cattle the figure is doubled. Although exact data for deer is unavailable, requirements are likely to be between that for sheep and cattle and are dependent on live weight.



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Diagram 15: The trade-off between digestibility and herbage mass

Selective Grazing

Sheep, cattle and deer are described as selective grazers, that is, they show a preference for particular plant species within a pasture and for particular parts of the plant. This preference is reflected in what they consume. Deer are more selective than sheep that are more selective than cattle. Such grazing behaviour can be used to manage pastures but, left unchecked under continuous grazing, can lead to a decline in particular pasture species especially where a pasture is under stress due to drought, acid soils or low fertility.

Selective grazing will also occur due to variation in the attractiveness or palatability of pasture to the animal. As the botanical composition changes and species, such as vulpia, barley grass or phalaris become more dominant at maturity, a greater grazing pressure will be placed on the remaining or more preferred species. The result is that the over grazed (preferred) species will be removed. A changing composition can be a response to grazing management so grazing management must be modified so that desirable species are not threatened.

Pasture Benchmarks

The pasture benchmarks indicating how much green herbage mass is required to satisfy the nutritional requirements of sheep and cattle at various stages of their reproductive cycle, and for growth have been developed. Research has determined the association between pasture intake of sheep and cattle and pasture characteristics such as herbage mass, digestibility and legume content.

Benchmarks for deer are being determined and guides are presented in the nutrition section of this book.

Summary

- Herbage mass = total of green and dead pasture
- Pasture quality is influenced by digestibility and the proportion of legume
- Animal production will be determined by pasture intake
- Intake is determined by herbage mass (the amount of pasture) and the digestibility of the pasture (the amount of feed actually used by the animal)
- Pasture digestibility decreases with plant maturity
- Pasture digestibility is positively related to energy and protein content of the pasture
- Digestibility of a pasture will be influenced by pasture species, stage of growth and percent legume
- Pasture benchmarks are the minimum herbage mass of green pasture that a particular livestock class (dry, pregnant, lactating, growing) can graze and meet their production requirements
- Herbage mass and digestibility interact to influence intake

Pastures And Grazing

Grazing Management Strategies

The outcome of the livestock enterprise depends on the reliability of the pasture to provide feed, of suitable quantity and quality, to meet the required livestock production targets at an acceptable cost.

Many management tools are available to help achieve this. Selection of the best mix of pasture varieties and herbicides are widely used to:

- Increase the quality and quantity
- Time of availability of feed
- Reduce weed problems
- Increase ground cover
- Improve persistence and so on

In recent years research has highlighted the role of grazing management in achieving some of these objectives, usually in association with one or more of the tools above. Grazing management can be a very powerful cost-effective tool. It should be considered as routinely as any of these other tools. As further research results become available new strategies are likely to be developed and old strategies refined.

Grazing management has a distinct advantage over other management tools. Seed and re-sowing is costly and often risky. Fertiliser and herbicides are expensive inputs, yet strategic grazing can cost almost nothing and potentially provide enormous benefits.

Knowledge of pasture species, and their requirements for production and persistence, enables the manager to get the best value out of these pasture systems. This is in terms of production, persistence, the environment and the bottom line - short and long-term profit.

The overall objectives of the enterprise and the whole farm unit need to be taken into account when considering whether to use strategic grazing.

Action is often needed because our pasture species are not ideally matched to:

- Climatic variability
- Soil types
- Weed competition
- Grazing habits of livestock
- Grazing pressure
- Soil fertility and so on

Any one factor can assume dominance and the effects may not be in the best interest of the pasture, livestock enterprise, the environment or overall profitability and sustainability.

As insufficient details are available, they give only general guidelines for many species, environments, and grazing systems. Research is improving the degree of detail over time. However, because of the variables involved, “recipes” are unlikely except for pasture systems with low variability of production - such as irrigated annual ryegrass.

There are many features necessary in our pastures whatever the grazing system used. Grazing management can have a role in achieving them. They are:

- Maintain good ground cover of persistent adapted pasture species. Besides being critical for livestock production, this reduces erosion and weed invasion
- Spring and Autumn are critical periods for many pasture species and mixtures. Mismanagement at these times may affect composition and persistence
- Sown pastures need a good adapted persistent legume component. Without it, production persistence and production of desirable species is likely to decline

The Principles

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

From a grazing perspective, pasture production is directly influenced by the intensity and frequency of its immediate past grazing. This affects how quickly and how much the pasture can re-grow.

Pasture Plants

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

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.

We can use the grazing action of animals to increase tillering and help thicken pastures. By keeping pastures short (3-12 cm) sunlight reaches most of the plant material and allows maximum production of new tillers or competing species.

Clover Growth

Clovers grow differently depending upon whether they are annual or perennial.

For an annual sub-clover, growth is from seed and numerous stems develop 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. Stolons may have root systems and produce other leaves and runners (new stolons). Other clovers may form crowns and have a single taproot, producing a more clustered appearance rather than branching.

Growth Curve of Plants

Diagram 24 shows a simplified and representative growth curve of pastures, consisting of three phases:

Phase I.

Pasture growth is slow because of insufficient leaf area. Prolonged grazing in Phase I kills plants, creates bare areas and leads to run-off of water, erosion and weeds.

Phase II.

Most rapid growth occurs here. Sunlight is caught by the increased leaf area and converted more efficiently to pasture growth.

Phase III.

Plants are mature, of lower quality and may, through competition and shading, reduce establishment of new plants. Pasture growth is therefore slowing and death of plant material is greater than the re-growth.

The best height to graze pasture to for these growth phases varies with pasture type, climate and soil factors. For example, a phalaris/sub clover pasture in good tableland conditions responds to maintaining pasture generally between 3 and 12 cm

Avoid under or overgrazing of established pastures. Keeping pastures in the active growth phase (Phase II):

- Provides high pasture yield
- Provides good animal nutrition
- Avoids waste
- Enables quick recovery after grazing
- Affords protection from soil erosion (i.e., avoid continuous grazing in Phase I or III)

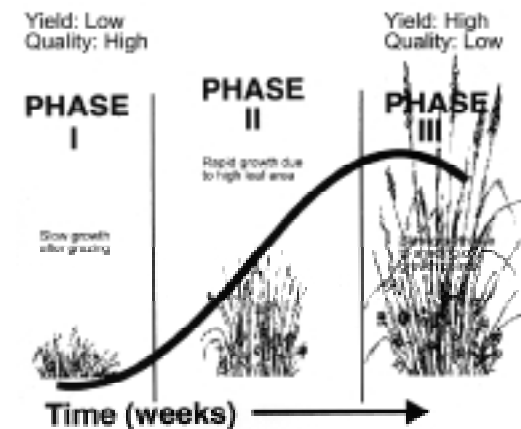
There will be occasions when grazing in Phase I and III can be beneficial for removing dead material or competing species (Phase I) and for regeneration of the species (Phase III).

In most grazing situations the important times to be concerned with the phases of pasture are:

- At the change of season
- At the end of winter before spring growth
- With annual pastures, between summer and autumn

Traditionally, pastures are usually in Phase I at the end of winter and are very short 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 before moisture becomes limited. This means that 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, giving greater growth over early winter and improved spring production. Summer rainfall in the north may assist in the early establishment of annual pastures.



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Diagram 16: Simplified growth curve of plants

Features of Pasture between Phase I and II

In terms of herbage mass, pasture (with more than 90% ground cover) with around 800 kg green DM/ha and about 3 cm in height will be entering Phase II.

Features of Pasture between Phase II and III

In terms of herbage mass, pasture (with more than 10% bare area) will be in Phase III when offering more than 2500 kg green DM/ha.

In terms of height, pasture will be entering Phase III when reaching about 12 cm in height. Some yellowing at the base of tillers occurs as plants decay.

Actively growing pasture (Phase II) provides the best quality and quantity of pasture for livestock, as well as providing benefit for pasture sustainability.

Phase II pasture will be:

- Between 800 and 2500 kg green DM/ha.
- Between 3 and 12 cm in height.

Another benefit of keeping pasture grazed in Phase II is that grazing pressure on the plant will delay the onset of flowering. Quality will be maintained because of grazing. This is particularly the case with perennial grasses.

Growth must be controlled as this impacts in the current year (by keeping pasture quality high) and the following year, as no dead stalky material will be restrict pasture growth. This has real benefit in terms of finishing yearling deer. An extra few days (a week or two) on high quality pasture may make the difference between achieving a target live weight or not.

Locking up paddocks over spring for use by weaners may produce feed of lower quality than a short (3-12 cm) grazed pasture.

Manipulating Species Composition

The botanical composition of a pasture affects the amount and quality of herbage on offer. This in turn reflects animal production. Botanical composition can be modified in pasture using fertiliser, herbicides and strategic grazing. Such strategies are sometimes used alone but are often more effective if used together in a planned improvement strategy.

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

- Heavy or light stocking rate

- Continual grazing of either sheep or cattle
- Length and frequency of rests (for desirable species)
- Strategic grazing based on the stage of growth of the plant
- Grazing strategies in conjunction with a fertiliser or herbicide (eg., spray topping, spray grazing and subsequent grazing for annual grass control)
- Hard grazing over the flowering period can reduce seed production
- Tactical use of insecticides (mite control)

Grazing strategies to renew or maintain desirable species in a pasture will probably be quite different to those used while the pasture was degrading.

Other Methods

Using other tools on the farm can assist the biological action of plant competition. Other strategies of use are:

Herbicides

- **Selective use of broadleaf herbicides.** Reduce content of broadleaf weeds using selective hormone herbicides
- **Selective use of grass based herbicides.** Eg. removal of vulpia by use of simazine
- **Selective use of grass-based herbicides** to reduce viability of seed of annual grasses using paraquat or glyphosate (spray top technique)

Herbicides Plus Grazing Pressure (spray graze technique)

Removing broadleaf components (usually weeds) by a combination of sub-lethal rates of phenoxy herbicides combined with increased stocking pressure.

Heavy Spring Grazing Pressure

Where subdivision is adequate, stock grazing pressure can be used to reduce annual grasses from setting seed (eg., annual ryegrass) and reduce the quantity of annual grasses in the pasture the following year. Hay/silage operations can also be used to achieve this.

Stock Type

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.

Grazing by goats can cause a change in botanical composition. Clover content can be increased by winter grazing of goats. As well, grazing with goats can

control many weed species. Recommendations are available on the desirable mix of goats with other stock types.

Fertilisers

Pasture development on nutrient deficient country tends to follow a trend with legumes being more responsive to phosphorus, sulphur and molybdenum than grasses and grasses being more responsive to nitrogen.

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

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.

The Importance of Legumes in Pasture

The amount of legume (or clover) in a pasture is important because they increase quality of the pasture mix. In the vegetative form legumes are very digestible, and so animal production will be high.

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

White clover and sub-clover are two important legumes for animal production, with complementary growth to other pasture species to allow animal production over a longer period.

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 a minimum of 30% of clover on a dry weight basis.

Allowing Pastures to Seed

Pasture seeding may modify the botanical composition of a pasture. 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
- Density of pasture; low density pastures may benefit
- Stage of growth, threat of weed competition, soil fertility
- Current seasonal conditions
- Previous and current stress on the pasture, eg., disease, grazing pressure, nutrient deficiencies
- Availability of feed
- Profit from grazing

Occasional spelling at the reproduction stage is important for the preservation of pasture species and periodic spelling of pasture benefits the soil by allowing pasture to decay.

The Applications

The Importance of Grazing Management

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 an appropriate grazing strategy has been developed to provide persistent, productive lucerne areas.

The objectives of grazing management are to:

- Optimise pasture growth rate
- Use feed efficiently and profitably
- Ensure quality is satisfactory for stock
- Ensure persistence of desirable plant species
- Ensure that ground cover is adequate to prevent erosion and resist weed invasion
- Maintain stable pastures

Pasture systems are very complex. Consequently, a large number of factors and interactions need to be considered to achieve the above objectives. For this reason, simple recipes for grazing management are not possible for long-term optimal animal and pasture production.

Fortunately, management that assists the wellbeing of the pasture usually benefits grazing stock. This consists of:

- Reading the pasture
- Assessing the situation (livestock and pasture requirements)
- Applying appropriate strategies where they will be beneficial and profitable (for pasture and animals)

Grazing management should not be used as a strategy isolated from other management inputs. For example, grazing management is of little value if poorly adapted species have been sown or plant nutrients are deficient.

Selective Grazing

Given suitable moisture and temperature when pasture is heavily grazed, new growth or recovery is initially slow. Then, as new leaves are produced, they are able to trap more sunlight and the rate of growth increases. The lower a pasture is grazed the longer will be that initial delay. The critical factor for regrowth is maintaining adequate leaf area allowing plants to trap sunlight.

Sheep and cattle have different feed preferences and different grazing behaviour. But for both sheep and cattle leaf is selected 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
- Select leaf material, and clover
- Have a greater impact on the botanical composition of the pasture than cattle

Cattle will:

- Also select green material
- Be less selective and are able to quickly reduce the mass of herbage, without particular selection of an individual plant
- Condition a pasture; that is, they remove taller shading grass and encourage clover growth
- 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

Deer generally:

- Select green material
- Preferentially graze the tips of growing plants. They eat from the top down
- Are said to select the most nutritious tips of the pasture
- Can waste pasture in rapidly growing swards.

Inter-grazing of sheep, cattle and deer on a pasture will often improve animal production and pasture stability although risks of Malignant Catarrhal Fever (MCF) and Lungworm should be considered (see the chapter on Health).

Selective grazing will occur according to variation in attractiveness of a plant to the animal. Undesirable species such as maturing silver grass (*vulpia*) or

barley grass are avoided with greater grazing pressure placed on more preferred species. The result is that these undesirable species will become more dominant and the over-grazed, preferred species will be removed.

When assessing pasture, do not simply look at total herbage mass, keep an eye on the different species. Look at the clovers and see if they are being grazed heavily when grasses are not. Check that some grass species are not being grazed a lot more than others.

Over time, in a mixed species pasture continuous grazing that allows selection of a particular species will change the botanical composition of that pasture. The invasion of weeds and undesirable species is a response to, among other factors, grazing management. This needs to be modified so that desirable species are not threatened.

Stocking Rate

The aim of a grazing enterprise is to profit by:

- Optimum production from each animal
- Optimum animal production from each hectare of land

Increasing stocking rate to increase animal production per hectare can lead to lower production per head. As stocking rate increases there is greater competition between animals for pasture, greater spoilage by dung, urine and trampling.

Consequently, up to an ideal stocking rate animal production per hectare will rise as stocking rate increases, even though there is a decline in per head production. However, past the optimum stocking rate, production per hectare as well as per head will decline. Fodder budgeting (Segment 8) allows you to match pasture supply and production, thereby calculating stocking density or the number of grazing days in a particular paddock.

The grazer needs to achieve a compromise between per head and per hectare production. Pasture benchmarks can be used as a basis for varying stocking rate while ensuring the nutrient intake of livestock is maintained.

Grazing management decisions aim to match feeding requirements with pasture production. That is, match sheep or cattle with the lowest demand (eg., dry stock) with lower pasture quality and growing stock on pasture with the highest quality on offer. Essentially, two options are available for grazing management; continuous grazing or some form of rotational grazing. There are mixed results from research where continuous grazing is compared to rotational grazing that is based on a fixed rotational interval.

Overall, an annual strategy combining the benefits of both continuous grazing and flexible rotational grazing can be used to achieve pasture and animal targets. Such a strategy will attempt to better use flushes of pasture but will not penalise pasture during periods of slow growth. Further grazing options will be explored in Segment 7.

General Guidelines

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

- Ensure the species and varieties sown are the best adapted for climate, stock type, soil fertility, paddock and grazing system
- 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
- 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
- Where perennial grasses are sown under less favourable conditions, and the root system is not developed, for instance:
 - In surface sowing
 - Sowing late in a season
 - Low fertility; when a short dry season occurs they will benefit more by not stocking at all in the first year
- Desirable annuals should be encouraged to set as much seed as possible (see annual legumes)

Seasonal Management of Pastures

Remember: Aim to keep pasture in Phase II. Grazing of pasture too early jeopardises plant establishment and growth. Grazing too late jeopardises pasture quality.

In both annual and perennial pastures the proportion of clover in the pasture mix can be manipulated by pasture management strategies.

Autumn

Autumn is a period on the slopes and tablelands when both annual and perennial pastures are regenerating from seed, stolons, crowns or tillers.

- Dry summer feed needs to be minimised to reduce shading of seedlings and new tillers from perennial grasses
- Plants are generally small and, when moisture becomes available, perennial grasses have an advantage over annuals because of their initial larger size. However, some annual grasses may be a problem if seed density is very high. The dense seed advantage of annual grasses may be assisted if perennial grasses are over-grazed during this period
- Heavy grazing in autumn may reduce plant regeneration because of damage to new seedlings, crowns or stolons
- Decreasing ground cover may also put seedlings at risk if they germinated following early rain with no significant follow-up.

Grazing over autumn should promote growth of desirable species that will provide more total herbage mass during winter.

- In annual pastures, this may mean a period of deferred grazing to allow establishment (see Section 5). This deferment of grazing is more important when the autumn break is late as lower winter temperatures mean growth is reduced
- With perennial grasses early autumn growth, particularly from phalaris, can shade developing clovers. Moderate grazing (to 10 cm) at this stage will assist clover development
- In northern NSW research has shown that white clover will benefit from a rest after summer grazing.

Winter

Over winter the challenge is to manage pasture to increase growth, especially of clover.

- Moisture stress is generally not a problem over winter, but temperatures will restrict growth
- Winter feed will limit stock carrying. The problem continues as stock graze and re-graze pasture, so recovery of plants is further reduced
- Ideally grazing should be based on long rotations over winter
- Long rotations increase the size of plants and therefore growth rate
- Spelling of perennial pastures over winter favours perennial over annual species. But this may mean that the amount of clover is reduced

- Sheep grazing may further restrict clover growth as clovers are being preferentially selected over grasses
- In annual pastures, spelling over winter from grazing increases clover content in a mixed pasture
- Quick hard grazing at the end of a winter spelling may reduce the seed set of barley grass.

Spring

Control of pastures is critical and most difficult in spring. Decaying plant material will reduce growth in the current season and restrict germination/tillering in the following autumn if it is not prevented in spring or removed over the summer.

- To maintain growing clovers, grasses must be restricted in height. If too many paddocks require attention and insufficient animals are available, cut hay, mow or make silage
- Rapid early growth of tall grasses will shade clovers and reduce subsequent flowering
- In the north with white clover pastures, hard grazing before flowering will assist stolon development, but grazing late will limit production of seed. Similarly with grasses, grazing late will restrict seed production
- In sub clover dominant pasture, frequent grazing assists flowering and seed production as well as removing taller grasses.

Keep spring growth to around 10-30 cm. This will allow pasture to remain vegetative and be of higher quality. Consequently tall, rank pasture is avoided in late spring.

- Be careful, with spring grazing of new phalaris cultivars such as Sirosa. Heavy grazing may kill some plants if grazed during stem elongation
- With some native pastures/white clover pastures, control of the rank grass growth is not as critical as white clover is still able to survive. Poa tussock pastures are the exception
- In some situations grazing to reduce excessive spring sub clover growth may be necessary to prevent shading and death of native grasses such as Red grass and Wallaby grass.

Summer

Strategies over summer differ dramatically from summer rainfall in the north to the winter dominated rainfall of the south.

- Survival of improved southern pastures can be threatened by hard summer grazing when plants are under moisture stress
- Grazing of pasture in the north will be required to maintain clover content. Do not overgraze growth points
- Moderate summer grazing will encourage white clover development
- Hard grazing by sheep on sub clover may reduce the density of clover seed and reduce numbers of plants the following year
- Dry feed should be removed
- Maintain greater than 70% ground cover of pasture to prevent soil erosion
- In perennial grass/annual legume pastures, graze hard (to 8 cm) in late summer/early autumn to remove top growth to allow germination and establishment of legumes.

Assessing Botanical Composition

The quality of the pasture and an understanding of how the species in your pasture are changing may be monitored by assessing botanical composition using the “pointed stick” method. This is best done in early winter when ground cover has been established but the pasture is not tall.

Use a 1 cm thick dowel about 30 cm long with pointed ends - or a nail can be partially driven into each end of the stick.

To measure the pasture, throw the stick ahead of you at random as you walk across the paddock. When you reach the stick, identify the pasture component touched or directly below the end of each nail head. Record these on a sheet similar to Table 4.

Repeat the process 50-100 times throughout the paddock. Fifty observations of a double-ended stick will give you 100 observations (hits). The total hits for each pasture component divided by the total number of hits, indicates the percentage of each species in the pasture.

Summary

Pastures are best kept in Phase II – between 800 and 2,500 kg green DM/ha. Phase I pastures have minimal leaf area and so there will be delayed response when growth conditions are present (temperature and moisture). Pasture can get to Phase III when seeding is required to increase density of species.

Phase II pastures provide the best quality and quantity of pasture for livestock as well as being beneficial for pasture sustainability. *Avoid continual under or over grazing of pasture.*

Botanical composition can be modified by:

- Timing of grazing
- Grazing intensity and frequency
- Grazing + herbicide
- Selective herbicides
- Continual grazing by one stock species
- Fertiliser

Legumes assist pasture quality and add nitrogen to the soil thus assisting grass growth. Seeding in the establishment year may assist poorly established pastures, to increase their density.

Grazing management:

- Maximises pasture growth, use feed efficiently, satisfy livestock requirements and persistence of desirable species
- Maximises cattle and sheep to select green leaf material in preference to dead stalk
- Uses livestock grazing preferences and behaviour to manage pastures
- Uses selective grazing by livestock over extended periods to remove desirable species from a pasture
- Increases stocking rate increasing livestock production per hectare, but above a critical level production per head it declines

Before grazing pasture in the establishment year ensure soil moisture is not limiting and that plants are well anchored with good root system.

Pastures require a different grazing strategy over each season. If allowing regeneration in autumn, defer grazing. In spring, high density grazing will keep pastures vegetative, etc.

Avoid prolonged grazing in Phase I or III of a pasture.

Grazing Management Options

Preceding sections have provided information on the theoretical and practical aspects of livestock production from pasture and aspects influencing pasture production (in particular the effect of grazing).

This section attempts to combine the management issues of livestock and pasture. In doing so we must recognise there will be times when the needs of both conflict. Management aims to minimise these conflicts while achieving the 'best' long-term results.

Grazing management is complex and it is not possible to cover all aspects in this section. However, many of the issues will be examined although individual management needs should be developed further.

Planning

The key to grazing management is effective planning. Planning is likely to exist at a number of levels. There is what could be called a strategic plan which might be carried out each year and provide a framework for the years operation. Included in such a plan could be:

- A review of the stocking rate and how numbers are expected to change each month through the year. These stocking rates can then be compared to prediction of pasture production
- Identification of paddocks most appropriate for fawning, weaning or finishing and planning preparation for these activities
- Identification of paddocks for special attention. This may be to increase legume content; reduce weeds or an undesirable grass infestation; decide priorities for fertiliser application or pasture improvement.

Then there is what might be called a medium term plan. Ideally this is considered about four times each year when the annual strategic plan is reviewed and progress assessed.

Changes may be made to the plan due to differing circumstances, seasonal conditions and the extent to which livestock and pasture targets are being achieved. At each assessment a plan is drawn up for the next 3 months based on objectives of the strategic plan.

Finally, day-to-day (tactical) decisions have to be made. When making these decisions the longer term plans need to be kept in mind and consideration given to the future productivity of stock and pasture.

Some strategies are likely to be main core activities and be included in the overall plan. Others may be used only in certain circumstances (hay or silage making are examples) when pasture growth far exceeds livestock requirements.

In developing grazing plans knowledge of the requirements of your pastures and livestock are critical. Grazing plans need to be flexible to allow for the inevitable variations of weather, stock prices, etc. Implementation of grazing plans relies on sound pasture and livestock assessment skills.

Grazing Systems

The manipulation of stocking rate and stocking density are two critical factors influencing the short and long-term success of grazing enterprises.

Stock density should vary depending on the grazing strategy. Densities to achieve a specific target may range from a relatively low level of up to 5 times the average stocking rate, to a high which may be 25 or more times. Varying stocking density to achieve different targets are described in the next section.

The extent to which higher stocking densities can be achieved is determined by mob or herd size and the degree of subdivision of paddocks. When high stocking densities are required temporary electric fencing is often used.

The following are some common grazing system terms.

Continuous Grazing

As the name implies the pasture is rarely, if ever, spelled from grazing.

- Allows animals to graze selectively and reduce or remove those preferred species from the pasture. This allows the less preferred species to dominate. The likelihood of this eventuating depends on such factors as stocking rate; suitability of the pasture species to the location; and tolerance to grazing
- Selection of preferred pasture species may lead to patch grazing and uneven growth
- Minimises management inputs
- Stocking density can vary with differing situations. For example, lambing, calving and finishing stock

Set Stocking

- Can be used to describe continuous grazing but the term is often used to refer to relatively short grazing periods when stock are not moved. For example, for lambing, calving or finishing stock

Rotational Grazing

- Period of grazing followed by a period of rest. The rest period or rotation length is generally determined by pasture growth rate. The aim is for the pasture to have re-grown to a given stage of growth before the next grazing.

Controlled rotational grazing, block, crash, mob stocking and strip grazing, as well as cell or time controlled grazing, are varying forms of rotational grazing.

- Rotational grazing may be implemented for part of the year or, in the case of time control grazing, conducted over the whole year
- Rotational grazing can vary from a two-paddock system to one of 30 paddocks or more
- Grazing systems, such as those described above, are promoted from time-to-time. However, the most effective one for you is likely to be a combination of features of those grazing systems, which are used at different times through the year to achieve specific targets. The actual system used by you will be determined by factors such as livestock classes and their changing requirements, seasonal peaks or troughs in pasture production, and the pasture composition in individual paddocks

For any grazing system always consider the needs of livestock and move stock off a paddock after they have grazed down to the nominated dry matter volume or feed supplements or accept a lower production level.

As well, strategies such as judicious hay or provide silage making, possibly the use of herbicides, and fire, are likely to be included in the system.

Subdivision of Paddocks

The number of paddocks on a farm significantly influences the efficiency of grazing management. Subdivision provides the opportunity of increased stocking density, an important grazing management tool. Increased stocking density and subdivision provide greater control over where and what stock will eat and so provides greater flexibility in the management of both pastures and animals.

Increased stocking density and subdivision restricts preferential grazing (over-grazing) of desirable species, reduces patch grazing as well as improves utilisation of pasture.

While there is no easy answer to the ideal amount of permanent subdivision required to achieve high stock densities, one factor influencing this is the maximum

mob or herd size a manager is prepared to accept. Obviously with larger mob/ herd sizes a manager can achieve higher stocking densities with existing subdivision. Therefore, emphasis should be towards larger mob/herd sizes.

Other factors to be considered on paddock size and number include:

- Water points
- Stock movement
- Soil and pasture types
- Slope and aspect

Existing paddocks may be subdivided using 2 to 3 temporary wire electric fences for high density grazing. This type of subdivision can be designed to use existing water points.

Grazing Management for Worm Control in Deer

Increased animal production can be achieved by a clearly defined management strategy, matching livestock requirements with pasture production and good parasite control is critical to such an outcome. This section points out how grazing practices can incorporate sheep and cattle worm control programs to maximise profit.

Survival of Worms on Pasture

Parasite burdens occur in animals because they graze pasture containing infective worm larvae. The worm larvae migrate onto the herbage after hatching from eggs passed in animal dung.

Most types of worm larvae can last for long periods on pasture provided the weather is not too hot or too dry. Paddocks grazed by livestock are rarely worm free but graziers can create clean pastures with low worm numbers by

Resting Paddocks or Controlling Contamination so that High Levels of Worm Larvae are Avoided

Resting paddocks in summer can aid for worm control where hot, dry, conditions prevail for at least 6-8 weeks. If the summer period is not hot and dry for prolonged periods, rapid rotation of stock around paddocks does not control worm populations because the resting phase is usually too short to be effective. However, prolonged resting of paddocks for worm control may be impractical on small properties or those with limited feed. Worm control obtained by resting paddocks in summer rainfall or mixed season rainfall areas is limited.

Alternate Grazing with Sheep and Cattle

Alternate grazing of deer paddocks with sheep or cattle exploits the fact that major deer worms do not affect cattle or sheep and vice versa (exceptions include liver fluke and lungworm). For example, in periods of peak pasture production cattle and sheep can usually be grazed on deer paddocks and weaner deer are drenched onto sheep/cattle-grazed pastures.

Avoid Contaminating Pastures where Susceptible Stock Will Graze.

Certain classes of livestock are easily infected and affected by worms because they have either not developed resistance (young animals) or have their resistance temporarily depressed (lactating hinds). Similarly, aged dry animals develop resistance to worms.

Resistant stock can graze pastures that will be used later by susceptible stock. Similarly, resistant animals can safely graze paddocks that have been grazed previously by susceptible stock.

Livestock can be ranked for priority access to clean paddocks and for their capacity to prepare clean paddocks.

Highest Priority for Clean Pastures

Deer priorities are similar to sheep and cattle and a suggestion of susceptibility to internal parasitism is:

Least resistant:

- Weaners (less than 1 year old)
- Late pregnant and lactating females
- Weaners (less than 18 months old)
- Yearlings (18 to 24 months old)
- Females with young (combined with nutritional stress)

Most resistant:

- Dry (adult) females (more than 2 years old)
- All adult dry deer (more than 2 years old)

Strategies for Worm Control

Paddocks identified to be worm free should only be grazed by the alternate species; or secondly, by resistant stock of the same species. Pregnant cattle can prepare pasture for both deer and sheep weaners but heavily pregnant deer (more than 4 months) should not be used to prepare paddocks for weaner deer.

The maximum benefit from grazing management comes when it is used in conjunction with a strategic drench program. Strategic drenching programs recommended by Departments of Agriculture in each state. For information on a program suitable to a particular area, contact a local Department of Agriculture office.

Supplementary feeding and drenching are available to increase the flexibility of grazing options for worm control but they are costly and not always necessary.

As part of the grazing plan that was discussed earlier, include strategies for worm free paddocks for susceptible stock. Susceptible stock usually have high nutritional needs, so plan to create low worm, high nutrition paddocks.

Graze weaning paddocks with stock that will assist in making it worm-free. For clean weaning paddocks, avoid grazing with susceptible stock from the previous autumn. Weaners must always be drenched onto the prepared weaning paddock.

A lack of nutrition and parasitism can have serious consequences. As for other livestock, an early warning or monitoring system should be developed for deer.

Monitoring Progress

Monitoring of parasite burdens is done by counting parasite eggs in dung (faecal egg counts) and is especially useful in young deer.

Samples of faeces are collected from 10 representative animals from mobs. These samples are then sent for analysis. Worm eggs are counted (or identified if required) and, in consultation with your veterinary adviser, a decision made about the need for drenching.

Worm tests enable more appropriate use of drenches. Deer that are not wormy are not drenched; deer that are very wormy are drenched before deaths occur.

Summary

- Grazing plans need to be formulated for at least a season and revised as the season changes. They are a combination of stocking strategies used at different times of the feed year to achieve a particular target
- Set stocking and various forms of rotational grazing can be used over the feed year to get optimum pasture and animal production:
 - Set stocking to maximise pasture intake but avoid set stocking for greater than 6-8 weeks (eg over joining, lambing or calving)

- Rotational grazing
- Flexible rotational grazing length depending on pasture regrowth
- High density fast rotation for weed control, utilisation of pasture
- Slow rotations for rationing feed
- Deferred grazing to allow plant re-establishment (eg after grazing period or at the autumn break)
- Strategic (alternate) grazing pasture with sheep and cattle can be used to provide 'clean' paddocks with a low worm burden

Measuring Herbage Mass - Median Quadrat Technique

The following is a step-by-step description of the median quadrat technique. Equipment required:

- 1.5 m x 0.5 m median quadrat. It is important that the dimensions are followed accurately (see Diagram 17)
- Battery or hand operated shears
- Plastic bags
- Four marker pegs
- Force draft or microwave oven
- Scales capable of weighing to a gram
- Forceps or tweezers
- Pen and paper

- Step 1.* Choose the area of pasture to be assessed. This should be about 30 m x 30 m and its boundary identified with pegs one in each corner. If this technique is used to predict the herbage mass of paddocks, selection of an area that adequately represents the paddock will be critical for an accurate assessment. Before selecting the representative area it is essential to evaluate all parts of the paddock to obtain an appreciation of the extent of the paddock's variation. The area selected should represent average yield (herbage mass) and composition (green, dead, legume and weed) of the whole paddock.
- Step 2.* Following selection, walk a set number of paces (5-10) from the edge of the area and place the quadrat at your toe. Herbage that has been bent over by the quadrat should be straightened.
- Step 3.* Eliminate the two highest and two lowest yielding sub quadrats by eye. Cut all herbage within the remaining sub quadrat to ground level and store in a plastic bag. Remove stones, dirt and faeces from the sample.
- Step 4.* Starting from the cut area, change direction and repeat Steps 2 and 3

- Immediately following collection, the sample should be microwaved for 30 seconds. If a microwave is not available, samples should be placed in an esky with ice and frozen.
- If a drying oven is available, dry to a constant weight at 60E to 70EC. Depending on moisture content, this may take over 24 hours. If an oven is not available, freeze the sample. Samples fully dried by a microwave are not suitable for laboratory analysis.
- The dried or frozen sample is then sent to the laboratory for analysis. Frozen samples should be sent on overnight transport and packed so they do not thaw during transit.

The VIC Pasture Research Institute, Hamilton offers a feed analysis service. Details of the service and analysis request forms can be obtained from local Department of Agriculture offices.

These services may also be used for testing supplementary feeds.

Feed	Energy (MJME/kg DM)	Crude Protein (%)
Grains		
Lupins	13.0	31.2
Oats	12.0	10.6
Sorghum	12.4	13.1
Wheat	12.9	13.8
Pasture		
Short vegetative (80% digestible)	11.6	25.0
Flowering (60% digestible)	8.2	12.0
Dry stalks (50% digestible)	5.7	8.0
Hays		
Lucerne	9.1	16.3
Oaten	7.7	6.0
Pasture (mainly grass)	8.0	7.0
Pasture (mainly clover)	8.5	10.0
Cottonseed meal	12.6	42.0
Silage	0.5-1.0 MJ higher than the above hays	1.0-2.0% higher than the above hays

Table 29: Energy Values of Common Feeds
(© PROGRAZE Manual 1996)