Pasture utilisation

Key actions

- ✓ Aim to use 50% or more of green pasture growth to increase livestock production and profitability/ha.
- ✓ Base your grazing management on plant growth rate and growth stage for high quality and yield of pasture.
- ✓ Use tactical grazing to meet different animal and pasture objectives at various times.
- ✓ Manage pastures to ensure adequate rest and regrowth before the next grazing.

Introduction

Why is efficient utilisation of green pasture important?

Aim to increase green pasture utilisation by 10% to raise productivity

The focus of this module is on the utilisation of high quality green pasture. Increasing the use of green pasture grown can be the most cost effective way of lifting the productivity for the majority of beef enterprises. Grazing managers should aim to convert the largest amount of pasture energy and nutrients into saleable beef while leaving pasture residue in the best condition for rapid regrowth. Precise control of grazing pressure and herd structure across a total grazed area can achieve utilisation of up to 50% of green pasture grown. This level is higher than current industry estimates of 30 to 40% utilisation of total green pasture grown.

Better pasture utilisation increases pasture growth and quality

Intake of green pasture by cattle and consequently productivity is influenced by the height, bulk density, total herbage mass per area and digestibility of the sward. Increasing utilisation can also improve pasture growth and quality, leading to better feed conversion efficiency, increased beef production per unit area and a decrease in unit cost.

The most important factor in improving profitability is identifying the stock numbers (stocking density or head/ha) that the enterprise is likely to sustain when utilisation of high quality (greater than 70% digestibility) green pasture is increased. The number of animals (head/ha) will depend on the nature of the

enterprise (breeding and/or trading) but should be sufficient to ensure high utilisation of the pasture grown while maintaining the long-term sustainability of the pasture and the grazing system. To achieve an increase in pasture use, adopt a grazing management approach based on predicted seasonal plant growth patterns:

- Graze enough animals to fully utilise available pasture without depressing animal intake to below target requirements or grazing of new plant growing points.
- Ideally time grazing to begin just before first leaf senescence (dying-off) occurs for desirable pasture species.
- Monitor grazing and stop it before critical limits for minimum pasture mass, height and ground cover are reached.
- Accurately assess the regrowth period before the next grazing occurs by monitoring pasture growth rates and the number of leaves per tiller.

Increase stocking rate and adopt a plant growth based approach to grazing management

A plant-based approach to grazing management ensures that pasture eaten by cattle during the growing season is of the highest possible nutritional quality (metabolic energy is greater than 11.5 megajoules per kilogram of dry matter or ME>11.5 MJ/kg DM), while giving the greatest opportunity for pasture regrowth following each grazing event.

The aim is to implement the procedures described below across the entire beef enterprise. Investment of time and capital is needed to intensify the grazing system in most beef enterprises. A grazing plan is essential for the progression of paddock sequences around the farm (Procedure 1) to determine the level of investment that is operationally and economically justifiable. Careful management of less intensively grazed land using the same approach leads to further gains in productivity. The aim is for a sustainable and productive beef production system that maintains weed-free stable pastures and ground cover greater than 70% on flat land and low slopes to reduce run-off, prevent erosion, and improve the quality of water entering waterways.

Investments of time, knowledge and capital are needed to intensify the grazing system

Pasture mass limits

There are references throughout this module to varying minimum and maximum limits for pasture mass (kg green DM/ha). It is important to understand the reasons for these variations.

- 1,500kg green DM/ha is used as a minimum to maintain good conversion of pasture to beef.
- Grazing below this level to a minimum of 1,000kg green DM/ha will mostly not harm the pasture or its potential rate of regrowth, but animal intake will start to be severely reduced.
- At certain times of the year, for example in autumn, good pasture management requires you to graze below 1,500kg DM/ha. In these cases allocate animals that can tolerate low weight gain or loss of weight such as dry or pregnant breeders.

How does this module assist you?

Application of the principles and procedures in this module and use of the tools will enable you to lift stock numbers and better manage green pasture utilisation on grazed land. This will increase your beef productivity (kilograms of beef per hectare) and decrease your unit cost of production (cents/kilogram beef).

To achieve this you will need to:

- Identify the stock numbers (stocking density or head/ha) that the enterprise will sustain when green pasture utilisation is increased.
- Identify and monitor the most appropriate indicators to time the start of grazing.
- Stop grazing before pasture composition and ground cover are adversely affected.
- Use routine field measurements (pasture phenology, mass and height) to estimate both the number of days' rest required before the next graze and the amount of pasture mass available.
- Manage grazing pressure to ensure that planned and efficient use of available pasture mass and energy content is achieved before regrowth is grazed.
- Plan the best balance of animal performance and pasture regrowth by grouping and allocating cattle according to their nutritional requirements and determining the grazing sequence and duration for grazing units across each pasture zone.
- Set pasture and animal targets and precision-manage the grazing of all pasture zones to achieve production targets, maintain pastures and prevent soil and environmental degradation.

Linkages to other modules

This module has a pivotal relationship with *Module 3: Pasture growth*, *Module 6: Weaner throughput* and *Module 8: Meeting market specifications*. It also relies on information from *Module 1: Setting directions* and *Module 2: Tactical stock control* to forecast the grazing sequence (see Procedure 1) and rest period (see Procedure 5) for each grazing unit. The initial herd structure and stocking rate are set in *Module 1*: the tactical adjustment of stocking rate is covered in *Module 2.*

Principles of pasture utilisation

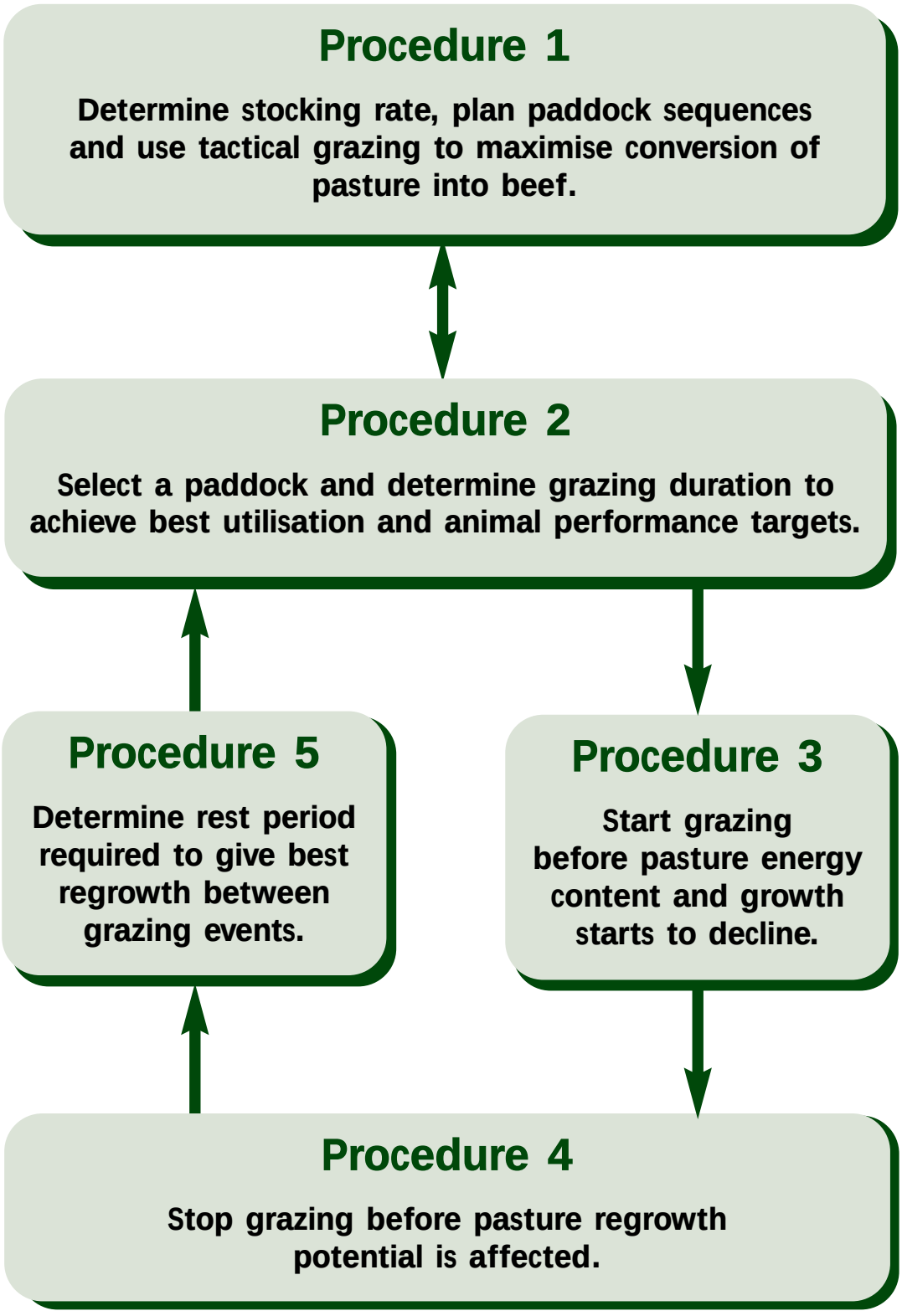
Maximum cattle performance is achieved by managing the pasture to maintain mass between 1,500kg and 2,500kg green DM/ha.

Pastures grazed in green leafy vegetative condition have the highest nutritional quality (ME>11.5 MJ/kg DM).

Animal intake and pasture quality decline when the mass exceeds 3,000kg green DM/ha.

Maintaining pasture mass above 1,000kg green DM/ha promotes rapid growth and avoids overgrazing or patch grazing.

Procedures for maximising the efficiency of pasture utilisation



Procedure 1

Determine stocking rate, plan paddock sequences and use tactical grazing to maximise conversion of pasture into beef

Guidelines for tactical grazing by planning paddock sequences

This procedure is the essential link between planning stock numbers for the cattle enterprise and achieving the highest efficiency of green pasture utilisation.

Use pasture assessment techniques to plan and set targets for each paddock to be grazed and to set the minimum and maximum limits for pasture mass and quality (see Tool 4.1 for options).

Use assessment techniques to calculate pasture mass (kg green DM/ha)

- Ensure pasture quality (MJ ME/kg DM) of all grazing units within a paddock grazing sequence is within the limits for energy criteria set for the herd (see Tool 4.2).
- Maintain the pasture mass (kg green DM/ha) of all units above the minimum that supports the intake set for the herd (see Tool 4.2). To assist you Tool 4.3 provides a guide to the estimate of daily pasture growth rates (kg DM/ha/day) in a range of localities and regions across southern Australia.
- Set a residual post-grazing pasture target to manage pasture mass over time.

The highest level of conversion of green pasture into beef can only be achieved when the paddock grazing sequences ensure that:

Balance grazing pressure by matching pasture availability with animal demand

- The most appropriate animals are allocated for grazing so that animal energy demand matches pasture energy supply;
- Pasture mass is maintained between 1,500kg and 2,500kg green DM/ha for as long as possible;
- The number of animals allocated for grazing enables the predicted grazing period to be achieved, while maintaining pasture mass above 1,000kg green DM/ha to prevent re-grazing of new growth. Ideally animals are removed when the post grazing pasture target reaches 1,500kg DM/ha.

A partial budget spreadsheet, *'The stocking rate calculator'*, is provided on the enclosed CD-ROM to help you calculate the appropriate stocking rate and length of paddock rotation.

The number of animals an enterprise can carry will be influenced primarily by pasture growth rate and growth patterns, preparedness to use supplementary feed and the nutrient requirements of each class of animal. Critical information on which to base decisions about the number of stock to be carried includes:

- Annual pasture growth rate curve and the variation across the farm;
- Likely variability in pasture growth curves over years based on historical weather data;

- Metabolisable energy (ME) value of the pasture when plant phenology changes;
- Energy requirements for each class of livestock at each physiological state;
- Minimum energy content of grass that will allow the energy requirement for each class of livestock to be met;
- Management strategies applied to the breeding herd include timing of calving and weaning, culling strategies and selling ages; and
- Fodder conservation and supplementation strategy.

Stocking density and grazing method are the keys to maximising pasture utilisation

This information can be used to establish the number of stock (stocking density or head/ha) the beef enterprise can sustain when maximising the efficiency of green pasture utilisation.

Maintaining pasture at the desired growth phase is necessary to keep the growth rate of cattle on track to meet production targets. Plan the grazing sequence of your paddocks to ensure pasture remains within the limits you set for pasture mass and quality. The growth curve of pastures can be simplified into three phases:

Phase I - Below 1,000kg green DM/ha (for a moderately dense pasture): pasture growth is slow because of insufficient leaf area; prolonged grazing depletes root reserves of perennials so plant survival is at risk and the development of bare areas leads to run-off of water, erosion and weed invasion; cattle growth rate and weight gain is low.

Phase II - Between about 1,000kg and 3,000kg green DM/ha (for a moderately dense pasture): the most rapid pasture growth occurs when sunlight is caught by increased leaf area and converted efficiently into pasture growth; cattle productivity is highest; pastures are sustainable.

Phase III - Above about 3,000kg green DM/ha (for a moderately dense pasture): plants are mature, pasture growth is slowing and quality is lower; death and decay of plant material can be greater than the regrowth; root reserves are replenished seed allowed to set; cattle growth rate is slower as pasture quality declines.

Note: These pasture availability guidelines are indicative only. Very dense, closely grazed pastures will have a higher (up to + 25%) kg green DM/ha at the same height. Conversely, more open, lightly grazed pastures have a lower kg green DM/ha at the same height. The differences due to density are greater at pasture heights above 6cm.

Manage the grazing system carefully to maintain optimum pasture levels

Check the pasture growth and add or remove paddocks from the grazing sequence to slow down or speed up the rotation. (Supplementary feed can be provided if no suitable pasture is available.) Using tactical grazing prevents under- and overgrazing of individual paddocks.

- Undergrazing of all or some areas of pasture will waste pasture energy, reduce the rate of pasture growth by shading, and affect quality.
- Overgrazing of all or some areas of pasture will decrease animal intake and reduce the rate of pasture regrowth.

Any failure to detect a change in pasture quantity and quality or animal demand will increase the risk of missing pasture and animal production targets. Overall productivity will be reduced by:

- An increase in predicted pasture growth leading to higher pasture mass and total pasture energy supply. This additional pasture will be wasted if not utilised.
- A decrease in predicted pasture growth, or unplanned events that decrease pasture availability. This will lead to declining pasture mass, lowered intake by animals and eventually overgrazing.
- Repeated overgrazing without adequate rest. This leads to a decline in pasture composition, reduced ground cover and soil and environmental degradation.

Tactical grazing

Use tactical grazing to meet different animal and pasture objectives

Successful beef producers find that strict adherence to either set stocking or rotational grazing is not the best way to achieve herd or enterprise targets. There is increasing recognition that 'tactical grazing' is the best grazing technique. Tactical grazing uses a range of grazing methods, including strategies such as set stocking and rotational grazing, throughout a single year or series of years, to meet different animal and pasture objectives at various times. A tactical approach to grazing must be flexible and able to adapt to different animal and pasture objectives. This enables a balance to be struck between the demands of various classes of stock for growth rate, reproduction and maintenance, and balances pasture supply with animal demand.

Tactical grazing is easy to implement when a rotational system is already in place

Tactical grazing is a relatively easy concept to implement on farms that already have some form of rotational or deferred grazing system. Such farms will already have the infrastructure (fencing and water supplies) to allow any grazing method to be used and to enable the switch between methods during the year to meet production targets. Under a rotational grazing system, the changes in management needed to set stock during calving, for example, are simple to implement. Further detailed information on successful grazing management practices and tactical grazing is provided in Chapter 8, 'Grazing management', of the MLA publication: 'Towards Sustainable Grazing – The professional producer's guide'.

What to measure and when

- Continually check on pasture growth and livestock performance against targets set in the grazing plan (using Tool 4.5, step 3). Tool 4.3 provides a guide to estimates of daily pasture growth rates (kg DM/ha/day) across southern Australia.
- Use a range of appropriate pasture assessment techniques (Tool 4.1) to plan and set appropriate targets for each paddock to be grazed.
- Aim to balance the level of animal intake (head/ha x intake/head should be equivalent to pasture growth/ha) in relation to predicted pasture growth rate to give the best pasture utilisation in targeted and longer grazing events.

- Continually monitor pasture and livestock performance and assess against targets.
- Review and re-plan fortnightly or weekly according to the needs of the stock class and pasture management.

The longer the grazing period, the more critical monitoring becomes as other controls, such as grazing duration, and manipulation of grazed area with temporary fencing, decline in effectiveness.

Planning data

Includes:

- Area to be grazed – hectares
- Target graze period for the paddock(s) – days
- Daily pasture growth estimates (see Tool 4.3)
- Initial pasture herbage mass – kg DM/ha
- Initial pasture quality – MJ ME/kg DM (M/D)
- Predicted pasture growth for the graze period – kg DM/ha/day
- Predicted animal intake for each class of allocated animals – kg DM/day

Monitoring data

Includes:

Pasture assessment

- Assessed pasture mass in paddock(s) – kg green DM/ha (see Tool 4.1)
- Estimated pasture energy content – MJ ME/kg DM (see Tool 4.5, *Table 3*)

Animal assessment

- Individual and average initial body condition (fat) score (see Tool 6.2 in *Module 6: Weaner throughput*)
- Current (field) estimate of range in condition score
- Weight of animals at last weighing
- Current (field) estimate of weight range
- Current liveweight

Further information

'Towards Sustainable Grazing – The professional producer's guide' published by Meat & Livestock Australia, August 2003. To order a copy, phone 1800 023 100, or visit www.mla.com.au/tsg

Procedure 2

Select a paddock and determine grazing duration to achieve best utilisation and animal performance targets

Guidelines to achieving best utilisation and animal performance

Select grazing paddocks to meet production targets

Select a paddock using pasture objectives (growth phase, mass and quality) that meet animal production targets. To determine predicted production levels and expected daily pasture intake by cattle:

1. Define the class of cattle in terms of sex, weight, stage in reproductive cycle (if female) and growth target (to gain or lose weight at a specified rate – kg/day).
2. Use the MLA Pasture Ruler (see Tool 4.1) to look up the pasture performance criteria (minimum quantity and quality) required to achieve targeted production levels.
3. Refer to Table 3 in Tool 4.5 to determine the average daily gain of steers for a range of liveweights and pasture quantity and quality options.
4. A partial budget spreadsheet, *'The stocking rate calculator'*, is provided on the enclosed CD-ROM to help you calculate the appropriate stocking rate and length of paddock rotation.

Best production is achieved when paddocks are grazed no longer than 3 days

In most grass and legume based pastures, the best utilisation and animal productivity are achieved when grazing is completed between a minimum of one day and a maximum of three days in each paddock of the planned grazing sequence. In some paddocks, tactical grazing may be applied to achieve seasonal objectives, for example to encourage desirable species such as clover to set seed, and discourage undesirables such as weeds. Tool 4.4 presents selected information sources that provide the knowledge and skills to lift the efficiency of pasture utilisation.

In practice…

Where the graze duration is more than three days:

- Pasture regrowth will be re-grazed before leaf area has recovered, reducing stores of soluble carbohydrate in roots and slowing the regrowing process. Repeated re-grazing can cause plant death and loss of productive pasture species.
- Animal performance is lowered through wastage (fouling and trampling) of pasture.

Where the graze duration is less than one day:

- Labour and capital (fencing and water) costs are high to accommodate more frequent movements of herds.

If there are insufficient stock numbers and the grazing pressure is too light:

- Useable pasture is not fully utilised and pasture energy is wasted due to an increasing rate of leaf senescence (death) before the next grazing.
- Patch grazing can occur and lead to under- and overgrazing of pasture areas within the grazing unit.

A combination of tactical grazing and adjusting the cattle class or herd size is the most practical method of ensuring that the grazing duration will achieve best pasture use and animal performance targets. If pasture mass is over the desired maximum and a larger herd is not available, reduce pasture through grazing with a lower priority herd (for example dry cows), fodder conservation (if cost effective) or pasture topping by mowing, slashing or chemical treatment to manage weeds.

Tactical grazing ensures best pasture use and animal productivity

What to measure and when

Calculations are based on:

- How much pasture is available for cattle to graze (see Tool 4.1);
- An estimate of the short-term stocking rate/ha (see Tool 4.5);
- What pasture allowance is required for growth or maintenance of various classes of cattle (for a guide see Tool 4.5, *Table 3*);
- The stocking rate over short grazing periods (one day) (see Tool 4.5); and
- The stocking rate over longer grazing periods (three days or more) (see Tool 4.5).

The more frequently these calculations are made in the lead-up to grazing a paddock in the planned sequence, the greater the precision in determining the grazing duration to achieve best utilisation and animal performance targets.

Procedure 3

Start grazing before pasture energy content (density) and growth start to decline

Guidelines for determining the start of grazing

Accurately timing the start of grazing is critical to the efficiency of converting green pasture into product and the overall productivity of a beef herd. Assess the grazing start date by adopting a plant growth-based approach to grazing management. Using this approach, the best time to start grazing a unit (paddock) is just before senescence (dying-off of the first leaf) occurs in the most desirable pasture species. This is just before the pasture energy content (MJ ME/kg DM) peaks and growth starts to decline.

- See Tool 4.6 for the lower and upper pasture mass limits (kg green DM/ha) and how to determine when to start grazing exotic (introduced) grass-based pastures. In legume-based pastures, the criterion measured is either the leaf area index (a percentage relating to the plant's ability to capture the energy from sunlight) or the condition (senescence) of the lower leaf. For more information on grazing management of grass and clover-based pastures, go to www.mla.com.au/tipsandtools for factsheets on topics such as pastures, weeds, and grazing management. See Tool 4.4 for the full list of relevant 'Tips & Tools'.

Aim to graze at a pasture mass between 1,500kg and 2,500kg DM/ha

- Use the MLA Pasture Ruler (see Tool 4.1) to measure pasture height and convert it to herbage mass. As a guide, the preferred pasture mass for grazing is between 1,500kg and 2,500kg DM/ha. At this level the pasture is of the highest nutritional quality (ME>11.5MJ/kg DM) and there is best opportunity for pasture regrowth following each grazing event.
- Aim to graze paddocks to maintain pasture in green leafy vegetative condition, and with a maximum pasture mass of 3,000kg green DM/ha.

Correct timing for the start of grazing is critical to both efficiency of pasture utilisation and stock performance. When grazing begins too early:

- The pasture regrowth period is reduced and plant health and survival may be affected through a lowering of soluble carbohydrate reserves (grasses) and reduced leaf area (legumes);
- Animal growth is reduced through less energy accumulation and lower intake on short pastures.

This can be corrected by removing cattle after a short period of grazing (where animal performance is the target) or stopping grazing before pasture reaches the minimum post-graze pasture mass limits (see Tool 4.2). To ensure plants rebuild their carbohydrate reserves, an alternative approach is to extend the regrowth period by delaying the start of the next grazing. Tool 4.3 provides a guide to the estimates of daily pasture growth rates (kg DM/ha/day).

When pastures exceed 3,000kg green DM/ha:

Animal intake and productivity decline when pasture mass exceeds 3,000kg green DM/ha

- If pasture is growing rapidly, there is the opportunity to increase stocking density to utilise the extra feed;
- Pasture quality (energy content) starts to decline as older leaves begin to die (senesce), resulting in reduced animal performance per kilogram of pasture consumed;
- Pasture growth (rate of energy accumulation) slows as shading of green tissue, senescence (dying-off of the first leaf) and seed head formation all occur;
- Output of animals to meet target specifications is lower through reduced energy intake and efficiency of utilisation.

What to measure and when

- Plant phenology: The number of live leaves (for grasses) or leaf cover or condition of the lowest leaf (for legumes).
- Pasture mass (kg green DM/ha): Where phenology indicators are not yet identified or not appropriate.

The recommended frequency of measurement is fortnightly and then daily once the predicted time to start grazing is less than seven days away.

Refer to Tools 4.2 and 4.6 for methods to set pasture grazing targets; and Tool 4.3 for daily pasture growth estimates across southern Australia.

Procedure 4

Stop grazing before pasture regrowth potential is affected

Guidelines to ceasing grazing

Good pasture management ensures adequate rest and regrowth

In pasture-based grazing systems, ceasing grazing a paddock is a critical procedure in preventing over or undergrazing and the associated impact on stock productivity, pasture regrowth and resource management.

Correctly timing when to stop grazing is critical to both efficiency of pasture utilisation and stock performance. Tool 4.6 helps you to implement a plant-based approach to grazing management and defines the lower pasture mass limits (kg green DM/ha) for cattle.

Timing when to stop grazing is critical to pasture and animal productivity

- Use the MLA Pasture Ruler (see Tool 4.1) to measure pasture height and convert it to herbage mass. As a guide, the preferred pasture mass for stopping grazing on improved perennial pastures is 1,000kg DM/ha depending on pasture type and season (see Tool 4.2 and Tool 4.3). At this level pasture recovers rapidly and overgrazing or patch grazing is avoided.
- Rest native pastures at critical times depending on the grasses present, their characteristics and the annual rainfall pattern.
- The management principles and special requirements of native-based and improved perennial pastures are presented in Chapter 6 'Making the most of native pastures' and Chapter 7 'Improved perennial pastures' of the MLA publication: 'Towards Sustainable Grazing – The professional producer's guide'.
- For more information on grazing management of grass and clover-based pastures, go to www.mla.com.au/tipsandtools for fact sheets on topics such as pastures, weeds, and grazing management. See Tool 4.4 for the full list of relevant 'Tips & Tools'.

Repeatedly stopping grazing too late (overgrazing) can have the following consequences:

Overgrazing affects rate of pasture regrowth, composition and persistence

- Grass carbohydrate reserves and legume leaf area are decreased and the rate of pasture regrowth is affected;
- Plant growing points are damaged, which may adversely affect pasture composition;
- Ground cover eventually falls below 70%, exposing the soil to erosion.

What to measure and when

Use the MLA Pasture Ruler to check post-grazing pasture height and determine residual pasture quantity in kg DM/ha. At the same time assess the ground cover and pasture mass to determine management options to protect the natural resources. These measurements and observations are taken when stock are removed from the paddock.

Further information

'Towards Sustainable Grazing – The professional producer's guide' published by Meat & Livestock Australia, August 2003. To order a copy, phone 1800 023 100, or visit www.mla.com.au/tsg

Procedure 5

Determine rest period required to maximise regrowth between grazing events

Guidelines to determining rest period

Rest pastures after grazing for regrowth and rebuilding energy reserves

Rest enables pastures to regrow and store energy reserves before the next grazing. The main predictors of rate of regrowth are temperature (maximum and minimum) and rainfall. As a rule, when pasture growth is slow (winter and dry periods), the rest period needs to be longer and when pasture growth is fast (spring) the rest period can be shorter, but generally not less than 20 days.

Post-grazing pasture phase (see Procedure 1) and ground cover are the major drivers for predicting the rest (regrowth) period required before the pasture is ready for grazing again. Plan the grazing sequence of paddocks so that each paddock will be at the desired pasture quantity (kg green DM/ha) and quality (MJ ME/kg DM) at the start of grazing. See Tool 4.6 for plant-based grazing management methods.

Use pasture growth phenology to predict the date of regrazing each paddock

- When the planned start date is too early (eg insufficient regrowth), slow the rotation by adding extra paddocks to the planned sequence or provide supplementary feed.
- When the predicted start date is too late (eg excessive growth), speed up the rotation by removing paddocks from the planned sequence.
- Allocate any removed grazing units to other stock based on their grazing needs or plan for fodder conservation, reseeding or later use as dry standing feed.

Determine the pasture rest (and regrowth) period for your farm

Tool 4.3 provides estimates of daily pasture growth rates (kg DM/ha/day) across southern Australia. This information can be used to determine the rest (and regrowth) period for your locality or region.

By using a minimum pasture base of 1,000kg DM/ha and the following formula:

(Number of days in the month) x (Daily pasture growth rate kg DM/ha/day*)
= Total monthly pasture growth (kg green DM/ha) for ungrazed pasture

* See Tool 4.3 for indicators to daily pasture growth estimates (kg green DM/ha/day) across southern Australia.

The number of days' rest can be estimated for any month by calculating each monthly pasture growth (kg green DM/ha) and adding these monthly totals to achieve a target of say 2500kg green DM/ha at the start of grazing.

For more information on grazing management of grass and clover-based pastures, go to www.mla.com.au/tipsandtools for fact sheets on topics such as pastures, weeds, and grazing management. See Tool 4.4 for the full list of relevant 'Tips & Tools'.

What to measure and when

When checking each grazed paddock, post-grazing pasture quantity (kg green DM/ha) and ground cover are the main indicators for predicting the rest (regrowth) period. Based on your measurements and observations aim to predict the start of grazing to within plus or minus two days of the actual start date (see Tool 4.6 for methods).

The predicted rest period and planned start for the next grazing event can be delayed or advanced according to the:

- Monthly rate of pasture growth (see Tool 4.3)
- Growing season (good, average or poor, see Tool 4.3)
- Botanical composition of the pasture (see Tool 3.7)
- Measurement of the post-grazing herbage mass (see Tool 4.1)
- Resource management requirements to maintain a productive pasture base.

Observations begin after removal of stock. When the planned or predicted start of the next grazing event is about seven days away, check more frequently to begin grazing just before pasture energy content and growth starts to decline.

Commonly used grazing terms

Digestibility – A measure of the proportion of pasture or feed that, once consumed, can be utilised by the animal. Higher digestibility usually means higher animal production.

Dry matter (DM) – Plant material without water. Usually expressed as a percentage of total weight of feed.

Fat score – An objective score of the extent of fat cover in live animals.

Feed intake – Amount of feed eaten by an animal, measured in kilograms dry matter per day per head.

Feed on offer (FOO) – Kilograms of total dry matter per hectare (kg DM/ha). The total amount of aboveground, attached plant material.

Grazing unit – A set of paddocks that forms a distinct grazing management unit for one or more herds. It may be a planned rotation where planned movement of the herd(s) ends back at the start point, or it may be a planned sequence, which differs from a rotation in that it is open-ended within the planning timeframe.

kg DM/ha – Kilograms of total dry matter of pasture per hectare. Sometimes called feed on offer (FOO).

kg green DM/ha – Kilograms of dry matter of green pasture per hectare.

M/D – The content of metabolisable energy in feed dry matter.
Units are MJ ME/kg DM.

Metabolisable energy – Energy from feed that can be used for animal production.

MJ ME/kg DM – Megajoules of metabolisable energy per kilogram of dry matter. A measure of the energy content of feed, directly related to feed digestibility.

Pasture availability (kg green DM/ha) – Kilograms of total green pasture per hectare. Sometimes called feed on offer (FOO).

Pasture allowance (PA) (kg DM/day/head) – The estimated maximum food intake plus an allowance for trampling and fouling. Allowance is also the pasture available divided by the number of stock.

Pasture growth rate (PGR) (kg DM/ha/day) – The daily growth in kilograms of green dry matter of pasture per hectare.

Pasture quality (MJ ME/kg DM) – Megajoules of metabolisable energy per kilogram of dry matter. A measure of the energy content of feed, directly related to feed digestibility. (It can be calculated as 0.15 x dry matter digestibility % or 0.16 x organic matter digestibility %.)

Plant phenology –The growth stage a plant has reached in its maturation process. This term can be non-specific regarding observable measurements such as plants in phase I, II and III, or specific and measurable by terms such as number of live leaves per grass tiller, or the nature of lower clover leaves (alive or dead).

Plant senescence – The point at which ageing of a plant results in growth stopping in the plant or part of the plant. At this stage energy accumulation ceases, and net utilisable energy starts to drop in the plant or plant part.

Stocking density (head/ha) – The number of stock per hectare on a grazing area or unit at any one time (usually used to describe the number of stock per unit area in a high-density grazing situation).

Stocking rate (DSE/ha) – The number of stock on a paddock or a whole farm (usually used to describe the long-term stocking rate, at least on an annual basis).

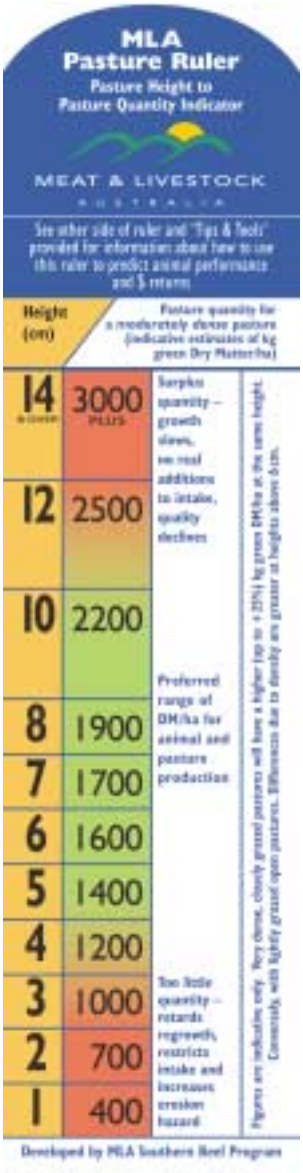
Tactical grazing – The practice of using a range of grazing methods through a single year or series of years, to meet different animal and pasture objectives at different times. This is now recognised as the best grazing method.

Toolkit 4

Tool 4.1 Pasture rulers, sticks and meters

Various paddock aids are available to assist with assessing pasture, ranging from the MLA Pasture Ruler and the PROGRAZE® stick to commercially available pasture meters:

- Pasture rulers or sticks that measure height and equate to pasture mass – calibrated to read green dry matter when 100% green, and capable of conversion to dry matter, using PROGRAZE information. These aids are simple to use and very cheap.
- Rising plate meters that measure total dry matter – most sophisticated models will store and average readings over a number of paddocks.
- Electronic probes that measure green dry matter – may collect additional manual input, such as phenology descriptors, store and average readings over a number of paddocks and download direct to office computers.



For more information on use of pasture meters and measurement of pasture mass see Tool 3.7 in *Module 3: Pasture growth.*

To obtain a free copy of the MLA Pasture Ruler, call 1800 023 100

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Tool 4.2 Methods for setting pasture targets for slow rotations and set stocking

The following list outlines the critical pasture limits for production and environmental protection:

- To maintain maximum pasture growth, have a:
  - Minimum pasture mass of 1,000kg green DM/ha
  - Maximum pasture mass limit of 2,500kg green DM/ha
- To optimise pasture performance through the year and minimise pasture decline, have a:
  - Maximum total pasture mass of 1,500kg DM/ha prior to the autumn break to promote clover germination and growth and to maximise tillering of perennial grasses.
  - Minimum pasture mass during the growing season of around 1,000kg DM/ha for high pasture quality and yield.
- To prevent water and wind erosion and protect the resource base:
  - Minimum residual pasture mass of around 800kg DM/ha depending on pasture density.
  - Depending on rainfall (pattern and intensity) and soil type, maintain at least 70% ground cover (including leaf, dead and litter material plus dung) on grazed lower to middle slopes (land class 3); and, a minimum of 100% on non-arable upper to steep slopes (land class 4 and 5).

For more detailed information refer to the 'Tips & Tools' page on the MLA website, www.mla.com.au/tipsandtools for handy fact sheets on pastures, weeds and grazing management.

Tool 4.3 Daily pasture growth estimates for localities and regions across southern Australia

The mid-monthly estimates of pasture growth rates (kg DM/ha/day) below are for average seasonal conditions for a range of localities and regions across southern Australia. They are from state PROGRAZE manuals, available from your state department of agriculture, and based on a combination of research results, growth predictions and practical experience. Although there is a large variation in rainfall pattern and feed supply within any year, when put together these monthly values reflect pasture growth in a 'typical' year for the locality or region without a reference to what growth occurred in the previous month.

These estimates provide a basis to assist with the calculations for short- to medium-term decision making in the beef business. They are *intended as a guide* and will assist with the calculations in Tool 4.5. It is recommended that the MLA Pasture Ruler (or equivalent) is used to generate similar estimates of pasture growth rates for selected paddocks or the whole farm.

Assumptions

The following assumptions are made for the range of pastures/pasture mixes unless otherwise stated in the estimates:

- Pastures are of moderate to high density;
- Soil has good moisture holding capacity, such as a clay loam;
- Pasture is maintained in an active growth phase at all times during the growing season;
- Pastures are well managed and fertilised to avoid nutrient deficiencies;
- Estimates are for the middle of each month.

The following important variables need to be considered and adjusted against the expected local, district or regional patterns, and practical experience:

  – Climate (rainfall and temperature)

  – Soil type and variability

  – Pasture species

  – Fertiliser (nutrient) requirements

  – Grazing management

Estimates of pasture growth rate

Unless stated, the estimates are for expected availability of feed of adequate quality and are based on:

- Pastures or pasture mixes with a good balance of legumes, grown on suitable soils;
- Pastures that are well managed to be maintained in the active growth phase so that quality is at a high level;
- Using some form of rotational grazing to enable pastures to rest and grow between grazing events; and
- The growth rate of the pasture, stocking rate, degree of wastage through trampling and fouling and the previous management of the pasture.

In any period the pasture type is capable of growing pasture mass of adequate quantity and quality to suit the requirements of seasonal conditions.

In the following tables, estimates are presented for localities or regions in New South Wales, Victoria, Tasmania, South Australia and Western Australia.

New South Wales – Feed year growth rate patterns

Source: NSW PROGRAZE Manual, Appendix 4, NSW Agriculture (for further information and assumptions on which these tables are based, see NSW PROGRAZE Manual or visit the department's website, www.agric.nsw.gov.au).

Northern Tablelands

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Fescue/white and sub-clover	58	57	51	28	12	9	9	11	23	38	51	59
Phalaris white/sub-clover	26	30	36	34	13	9	9	11	22	37	49	51
Red grass dominant pasture*	33	33	29	9	2	1	1	1	7	27	33	34
Microlaena white/sub-clover	39	36	29	18	8	3	3	7	19	33	40	44
Perennial rye/white and sub-clover	20	28	38	34	13	9	9	11	23	43	47	35

* Quality of red grass (with low leaf to stem ratio and rapid maturity) may not be adequate to meet livestock production targets.

The predicted growth rate could vary markedly between good and poor growing seasons.

	Good growing season	Poor growing season
Spring	30% above	40% below
Summer	30% above	40% below
Autumn	75%+ above	60%+ below
Winter	30% above	40% below

Central Tablelands

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Temperate perennial grass* + sub-clover	15	12	16	20	20	10	6	10	27	61	69	45
Microlaena/Austrodanthonia grass + sub-clover	19	15	19	22	19	7	5	8	18	52	62	51
Microlaena/Austrodanthonia grass	15	14	19	21	15	3	3	3	9	34	51	32
Summer grass# /sub-clover	24	10	15	16	12	7	4	8	28	38	25	23
Summer grass#	24	10	14	14	2	2	2	2	2	4	16	23
Annual grass/sub-clover	0	0	2	6	12	11	9	17	45	74	10	0

* Phalaris, cocksfoot, fescue or perennial ryegrass based with at least 20% clover.

\# Mainly frost sensitive grasses such as red grass.

The predicted growth rate could vary markedly between good and poor growing seasons.

	Good growing season	Poor growing season
Spring	50% above	40% below
Summer	100%+ above	70% below
Autumn	65% above	60%+ below
Winter	40% above	60%+ below

Southern Tabelands and Monaro

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Perennial and annual grass* and clover + fertiliser 1-in-2 or 3 years	7	5	7	15	13	8	7	12	32	45	20	10
Microlaena, Austrodanthonia, # clover + fertiliser 1-in-2 or 3 years	16	14	10	8	7	5	5	6	15	30	24	18
Red grass, kangaroo grass, no fertiliser applied	10	6	3	3	2	1	1	1	7	15	21	13
Introduced perennial grass and clover + annual fertiliser	10	80	20	26	20	12	10	15	45	75	55	20

*Established perennial pasture (30% introduced grass, ie phalaris, 20% native perennial grass, 20% annual clover, and 20% annual grass).

#Microlaena and Austrodanthonia grass 50–60% pasture, 25–30% clover and 10–20% annual grass.

The predicted growth rate could vary markedly between good and poor growing seasons.

	Good growing season	Poor growing season
Spring	50% above	40% below
Summer	50% above	40% below
Autumn	50% above	30% below
Winter	80% above	60% below

North West Slopes and Upper Hunter

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Phalaris/sub-clover	8	12	16	17	14	13	14	20	34	43	32	10
Summer grass dominant*	35	29	17	6	2	2	2	2	3	8	17	27
Austrodanthonia/sub-clover	19	16	11	7	5	5	7	12	24	28	22	18
Lucerne	30	29	26	21	15	10	10	14	25	40	34	31
Sub-clover dominant	0	1	1	3	4	5	6	11	28	38	28	3
Medic dominant	0	2	2	3	5	4	4	7	27	38	15	0
Tropical grass only#	48	43	32	17	3	2	2	3	4	18	34	48

*Mainly frost sensitive grasses such as red grass.

#Mix of bambatsi panic and purple pigeon grass with less than 5% sub-clover or medic.

The predicted growth rate could vary markedly between good and poor growing seasons.

	Good growing season	Poor growing season
Spring	50% above	50% below
Summer	100% above	50% below
Autumn	100% above	60% below
Winter	30% above	50% below

Central West Slopes

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Temperate perennial grass* + sub-clover	3	2	1	7	14	16	10	11	18	41	41	17
Sub-clover	0	0	0	2	7	4	8	8	15	27	10	0
Summer grass	20	24	9	2	2	2	2	2	2	3	11	25
Lucerne/sub-clover	25	25	28	31	26	17	10	10	22	45	43	26
Lucerne	25	25	28	31	24	13	9	9	18	45	43	26
Annual grass/sub-clover	5	3	1	6	16	18	12	12	23	42	10	5
Tropical grass only#	35	34	24	8	3	2	2	2	2	8	24	35

* Phalaris, cocksfoot, fescue or perennial ryegrass based with at least 20% clover.
# Mix of bambatsi panic and purple pigeon grass with less than 5% sub-clover or medic.

The predicted growth rate could vary markedly between good and poor growing seasons.

	Good growing season	Poor growing season
Spring	70% above	80% below
Summer	100%+ above	80% below
Autumn	100%+ above	60%+ below
Winter	70% above	60% below

South West Slopes

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Phalaris/sub-clover	5	7	16	25	24	17	16	26	47	64	43	12
Cocksfoot/sub-clover	9	8	16	25	24	17	16	26	47	64	43	15
Lucerne/sub-clover	12	10	17	28	26	14	11	25	49	69	54	21
Annual grass/sub-clover	3	4	10	23	24	14	10	25	45	64	35	7
Native grass*, no fertiliser	8	6	5	11	10	4	3	3	7	15	23	13
Native grass + fertiliser	11	9	11	15	14	6	5	7	17	35	26	14

* Quality of red grass (with low leaf to stem ratio and rapid maturity) may not be adequate to meet livestock production targets.

The predicted growth rate could vary markedly between good and poor growing seasons.

	Good growing season	Poor growing season
Spring	30% above	60% below
Summer	200% above	70% below
Autumn	30% above	60% below
Winter	80% above	20% below

North Coast

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Naturalised pasture*	25	30	25	10	3	0	0	0	3	5	9	15
Naturalised/clover + fertiliser	30	35	30	15	8	6	5	6	10	15	20	25
Kikuyu dominant	34	54	50	30	16	10	3	2	8	18	25	30
Kikuyu + nitrogen	80	128	146	100	45	15	3	4	14	30	40	60
Setaria/rhodes grass + clover	30	55	45	25	6	2	2	4	8	20	28	30
Forage ryegrass + nitrogen	0	0	0	30	40	30	30	30	28	10	8	5

* Dominated by carpet grass and with no introduced legumes.

The predicted growth rate could vary markedly between good and poor growing seasons.

	Good growing season	Poor growing season
Spring	70% above	60% below
Summer	60% above	60% below
Autumn	120% above	90% below
Winter	150% above	70% below

Mid North Coast and Lower Hunter

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Naturalised pasture*	17	25	23	9	2	0	0	0	2	4	8	9
Naturalised/clover + fertiliser	20	29	27	12	4	2.5	2.5	2.5	6	9.5	12	12
Kikuyu dominant	27	45	50	33	16	6	2	3	11	10	10	12
Paspalum	23	33	32	16	5	5	5	5	10	15	15	15
Setaria	29	38	44	23	8	5	5	5	10	11	11	13
Forage ryegrass + nitrogen	0	0	0	5	20	36	35	40	40	25	0	0

* Dominated by carpet grass and with no introduced legumes.

The predicted growth rate could vary markedly between good and poor growing seasons.

	Good growing season	Poor growing season
Spring	145% above	73% below
Summer	114% above	46% below
Autumn	70% above	80% below
Winter	89% above	67% below

Victoria – Feed year growth rate patterns

Source: Victoria PROGRAZE Manual, adapted from Figure 8, 'Pasture growth rates in kg DM/ha/day for different areas of Victoria', pp 20–22 (for further information and the assumptions on which these tables are based, see the Victorian PROGRAZE Manual or visit www.dpi.vic.gov.au).

Western Victoria – Hamilton

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Good pasture	0	0	20	30	30	35	35	50	90	130	100	100
Poor pasture	0	0	0	5	10	15	15	20	40	70	30	0

Good pasture = dense, introduced grass/sub-clover based pasture
Poor pasture = less dense, annual grass/sub-clover/annual weed based pasture

Western Victoria – Balmoral

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Good pasture	0	0	0	20	30	30	30	30	65	120	60	40
Poor pasture	0	0	0	0	10	5	15	15	30	40	30	0

Central West Victoria – Ballarat

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Good pasture	0	0	15	20	30	20	20	35	50	90	100	90
Poor pasture – bent grass based	30	0	0	5	10	5	5	20	40	60	70	60

North East Victoria – Rutherglen

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Average pasture	0	0	0	0	30	20	20	35	70	80	20	0

Average pasture = moderately dense annual grass/sub-clover/annual weed based pasture

Gippsland Victoria – Ellenbank

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Average pasture	18	10	19	20	18	16	10	20	55	80	70	59

Average pasture = moderately dense pasture

Gippsland Victoria – Maffra

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Average dryland pasture	5	5	0	20	17	10	2	15	30	38	30	2

Average dryland pasture = moderately dense pasture

Tasmania – Feed year growth rate patterns

Source: Darryl Johnson, Department of Primary Industries, Water and Environment, Tasmania.

Pasture composition

The measured and potential daily growth rates are for a typical pasture mix of perennial ryegrass and cocksfoot with white and red clover in the high rainfall areas and grading to sub-clover in the lower rainfall areas. The measurements were taken over four years (1992-1995) at trial sites.

North West – 900mm rainfall (Elliot Research Station)

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Trial site measurements	25	9	5	14	9	8	8	7	19	54	51	35

North Central – 700mm rainfall (Cressy Research Station)

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Trial site measurements	14	5	2	8	6	7	6	6	31	65	46	22

Southern Midlands – 500mm rainfall (Jericho)

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Trial site measurements	0	0	0	3	3	3	3	5	15	45	35	15

South Australia – Feed year growth rate patterns

Source: South Australia PROGRAZE Manual, Appendix D (for further information and the assumptions on which these tables are based, see the South Australian PROGRAZE Manual or visit www.prisa.sa.gov.au).

Mount Gambier

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Phalaris, annual grass, sub-clover – high fertility	3	3	8	17	28	27	32	59	106	108	69	17
Phalaris, annual grass, sub-clover – low fertility	2	2	6	11	18	17	18	37	76	79	48	13

Lucindale

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Phalaris, annual grass, capeweed, sub-clover	1	3	3	11	25	25	26	42	82	69	32	6

Keith

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Phalaris, annual grass, capeweed, sub-clover – high fertility	0	0	0	10	15	20	18	28	67	64	39	0
Phalaris, annual grass, capeweed, sub-clover – low fertility	0	0	0	3	8	9	8	12	34	46	33	0

Adelaide Hills (dryland)

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Perennial grass, sub-clover	0	0	0	10	30	15	15	30	60	65	20	10

Fleurieu Peninsula

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Perennial grass, sub-clover – good	0	0	0	30	25	25	25	35	55	60	35	10
Perennial grass, sub-clover – average	0	0	0	10	20	20	20	30	45	50	30	5
Perennial grass, sub-clover – poor	0	0	0	0	15	15	15	25	35	40	25	0

Kangaroo Island (Parndana)

Estimated daily pasture growth rate (mid-month) of specific pasture types (kg DM/ha/day)

Pasture type	J	F	M	A	M	J	J	A	S	O	N	D
Annual grass, sub-clover – high fertility	0	0	0	3	9	21	26	35	50	91	44	0
Annual grass, sub-clover – low fertility	0	0	0	1	4	11	14	19	31	63	35	0

Western Australia – Feed year growth rate patterns

Source: Western Australia PROGRAZE Manual, Appendix E (for further information and the assumptions on which these tables are based, see the Western Australian PROGRAZE Manual or visit www.agric.wa.gov.au).

West Midlands

Estimated daily pasture growth rate (mid-month) in kg DM/ha/day

Pasture type – annual grass, sub-clover and annual weeds	J	F	M	A	M	J	J	A	S	O	N	D
Dandaragan	0	0	0	2	15	26	28	36	57	51	10	0
Gingin	0	0	0	3	19	28	29	36	55	51	11	0
Irwin	0	0	0	1	16	25	28	39	44	37	8	0
Moora	0	0	0	1	7	13	17	28	44	32	7	0
Three Springs	0	0	0	1	6	12	17	29	36	17	8	0

Central

Estimated daily pasture growth rate (mid-month) in kg DM/ha/day

Pasture type – annual grass, sub-clover and annual weeds	J	F	M	A	M	J	J	A	S	O	N	D
Northam	0	0	0	2	8	13	15	29	48	24	9	0

Southern

Estimated daily pasture growth rate (mid-month) in kg DM/ha/day

Pasture type – annual grass, sub-clover and annual weeds	J	F	M	A	M	J	J	A	S	O	N	D
Busselton	0	0	0	6	23	26	28	37	53	58	42	0
Boyup Brook	0	0	0	4	13	17	20	31	37	34	26	0
Katanning	0	0	0	1	11	15	16	28	51	45	15	0
Lake Grace	0	0	0	2	6	11	13	26	45	34	11	0
Narrogin	0	0	0	1	7	12	14	26	50	36	12	0
Plantagenet	0	0	0	8	21	23	20	25	45	58	42	0

South East

Estimated daily pasture growth rate (mid-month) in kg DM/ha/day

Pasture type – annual grass, sub-clover and annual weeds	J	F	M	A	M	J	J	A	S	O	N	D
Ravensthorpe	0	0	0	5	10	13	17	29	52	40	23	0
Esperance	0	0	0	7	12	16	18	29	47	35	23	0

Tool 4.4 Information sources on pasture utilisation

Selected information sources and training workshops to lift the efficiency of pasture utilisation:

1. 'Towards Sustainable Grazing – The professional producer's guide' published by Meat and Livestock Australia, August 2003.

This guide describes in practical detail how to manage a more productive and sustainable grazing business. The chapters on grazing management and native and improved perennial pasture production provide further information related to this module, and the publication also presents growth pathways to successful market outcomes.

2. State PROGRAZE manuals and EDGE*network* PROGRAZE workshops
3. BeefCheque® to analyse and improve the overall production and financial performance of the beef enterprise.
4. MLA 'Tips & Tools'

The 'Tips & Tools' range of free fact sheets produced by MLA provide producers with straightforward practical information to apply on-farm. The following list includes the 'Tips & Tools' that are relevant to this module for further information on improving pasture and grazing management. Visit www.mla.com.au/tipsandtools to download you free copies.

Grazing management titles

- Controlled grazing management of annual ryegrass-based pastures
- Grazing management 1 – tactical grazing to maximise whole farm pasture and animal productivity
- Grazing management 2 – getting the best out of set stocking
- Grazing management 3 – getting started in simple time-based rotational grazing
- Grazing management 4 – intensive rotational grazing systems
- Grazing management for mixed perennial-based pastures
- Grazing management for productive native pastures
- Grazing management of cocksfoot-based pastures
- Grazing management of danthonia and microlaena-based native pastures
- Grazing management of perennial ryegrass-based pastures
- Grazing management of phalaris-based pastures in northern NSW
- Grazing management of phalaris-based pastures in southern Australia
- Grazing management of tall fescue-based pastures
- Grazing management of wiregrass dominant pastures in NSW and

southern Queensland

- Grazing management to improve 'run-down' sub-clover pastures
- Grazing management to maintain a good sub-clover-based pastures
- Grazing to manage annual grass weeds in pastures
- How to grow better tagasaste

Pastures and weeds titles

- Chicory as a perennial summer forage
- Grazing management as a tactic to control red legged earth mite
- Grazing management of bent grass infested pastures
- Looking after your pastures in drought
- Making perennial ryegrass-based pastures productive and persistent
- Making phalaris-based pastures more productive and persistent
- Making the most of phosphorus fertiliser applied to soil
- Managing annual grasses to boost pasture production
- Maximising production from kikuyu-based pastures
- Strategies to boost the productivity of native pastures
- Managing Paterson's curse to boost pasture production
- Managing saffron thistle boosts pasture production
- Managing scotch, nodding and spear thistles boosts pasture
- Managing St John's wort-infested pastures to boost production

Natural resource management titles

- Encouraging biodiversity benefits
- Encouraging birds on to your farm
- Increasing earthworms in pastures
- Managing deep drainage
- Managing ground cover to reduce run-off and water loss
- Managing soils to keep them healthy and productive
- Native vegetation 1: assessing the condition of remnant vegetation
- Native vegetation 2: improving the value of remnant vegetation
- Native vegetation 3: revegetating the farm

Tool 4.5 Grazing management options to convert pastures into beef production

Successful pasture utilisation requires precise control of the grazing pressure and herd structure of the beef business. This tool provides the basis to determine how pasture can be successfully turned into saleable beef to profit the farm business.

By using the formulas provided, following the examples and then inserting your own working examples, you will be able to:

- Estimate stocking rate over short periods;
- Make tactical grazing decisions about the short-term stocking rate/ha;
- Plan seasonal pasture and animal performance to achieve targets; and
- Calculate the gross financial benefit to the grazing business.

This information enables the grazing operation to be more precisely managed. The conversion of pasture energy and nutrients into saleable beef is achieved while leaving pasture residue in the best condition for rapid regrowth. It will also better match the seasonal feed supply with beef enterprise opportunities and business objectives.

PROGRAZE information

To make the best grazing management decisions some basic PROGRAZE or equivalent information is required *(Figure 1)*.

Information required for grazing management decisions

- The amount of pasture (kg DM/ha) in a paddock, grazing block or whole farm
- Pasture quality (MJ ME/kg DM)
- Pasture growth rate (kg DM/ha/day)
- The stock to be grazed and the target weight gain required (kg/head)

The following estimates are used in the practical working examples:

Pasture at the start of grazing	2,500kg DM/ha
Pasture at the end of grazing	1,500kg DM/ha
Pasture quality	10MJ ME/kg DM
Pasture growth rate	30kg DM/ha/day
Pasture allowance (kg DM/day)	estimate of maximum intake + 20% for wastage
Steers or unjoined heifers	300kg grown to 400kg at sale

Mature cows (British breed)	500kg, fat score 2.5–3

kg DM/ha = kilograms of dry matter per hectare
MJ ME/kg DM = megajoules of metabolisable energy per kilogram of dry matter

The tables below provide further estimations for use in calculating the important components of managing the grazing system.

A partial budget spreadsheet, *'The stocking rate calculator'*, is provided on the enclosed CD-ROM to help you calculate the appropriate stocking rate and length of paddock rotation.

1. Estimating short-term stocking rate/ha

Step 1 How much pasture is available for cattle to graze

This involves estimating the 'grazing opportunity' in kilograms dry matter per hectare (kg/DM/ha) by assessing pasture height and related density using the MLA Pasture Ruler or equivalent measurement tool. Refer to MLA Tip & Tool FP.03: *Improving pasture use with the MLA Pasture Ruler* for information on how to use the MLA Pasture Ruler to convert the height of a moderately dense pasture into an accurate estimate of kilograms of green dry matter per hectare.

In practice, the conversion of pasture into beef product is greatest when the paddock grazing sequences ensure:

- The most appropriate class of cattle is used to meet production targets;
- Pasture energy supply matches animal energy demand;
- Pasture mass is maintained in a green, leafy and vegetative condition across the paddock between 1,500 kg green DM/ha to 2,500 kg green DM/ha (around 6cm to 12cm high) and with the recommended number of live leaves and tillers for the grazing period.
- The number of animals allocated for grazing enables accurate prediction of the grazing period, while maintaining pasture mass above 1,000 kg green DM/ha (3cm high) to ensure rapid regrowth and to prevent grazing of new growth.

An estimate is needed of how much pasture is wasted through animals trampling and fouling during grazing. Around 20% wastage is a reasonable estimate and is used in the worked examples.

Step 2 What pasture allowance is required for various classes of grazing cattle

Pasture allowance is described as food needed for growth and maintenance of the stock (intake) plus an allowance (20%) for trampling and fouling. Pasture allowance is based on a pasture of at least 10 MJ ME/kg DM, and is not applicable to pastures of lesser quality.

Table 1: Guide to pasture allowance for steers and unjoined heifers at a range of weights, grazing pasture of at least 10MJ ME/kg

Liveweight (kg)	200	300	400	500
Pasture allowance (kg DM/head/day)	8	10	12	12

As an example, a 300kg steer or heifer requires a pasture allowance of 10 kg DM/day to achieve potential animal growth from pasture quality of 10MJ ME/kg/DM.

Table 2: Guide to pasture allowance for 500kg cows in different physiological conditions

Mature British breed cows (500kg, fat score 2.5–3.0)	Dry/late pregnant	Early lactation* (2 months)	Lactating* (5 months)
Pasture allowance (kg DM/head)	10	15	20

** Includes an allowance for calf*

As an example, a 500kg cow, fat score 2.5–3.0 in early lactation requires a pasture allowance of 15kg DM/day.

Table 3: Average daily gain for a range of feed quality and steer liveweights

Feed available (kg DM/ha)	**1,000**			**1,500**				**2,000**				**2,500**				**3,000**			
M/D (MJ ME/kg DM)	**9**	**10.5**	**12**	**7.5**	**9**	**10.5**	**12**	**7.5**	**9**	**10.5**	**12**	**7.5**	**9**	**10.5**	**12**	**7.5**	**9**	**10.5**	**12**
Digestibility %	**60**	**70**	**80**	**50**	**60**	**70**	**80**	**50**	**60**	**70**	**80**	**50**	**60**	**70**	**80**	**50**	**60**	**70**	**80**
Steer liveweight																			
200kg – ADG (kg/day)	0.06	0.54	1.07	-0.5	0.19	0.83	1.16	-0.2	0.32	0.99	1.23	-0.02	0.42	1.09	1.31	0.04	0.49	1.16	1.36
300kg – ADG (kg/day)	-0.29	0.36	0.95	-0.7	0.08	0.67	1.08	-0.4	0.21	0.86	1.14	-0.24	0.3	0.98	1.22	-0.1	0.38	1.06	1.28
400kg – ADG (kg/day)	-0.48	0.26	0.82	-0.9	-0	0.55	0.95	-0.6	0.11	0.74	1.01	-0.44	0.2	0.86	1.09	-0.3	0.28	0.94	1.15
500kg – ADG (kg/day)	-0.77	0.11	0.65	-1.12	-0.33	0.4	0.78	-0.9	-0.03	0.58	0.84	-0.72	0.07	0.7	0.92	-0.59	0.14	0.78	0.98

ADG = average daily gain

Source: Calculated using GrazFeed v 4.1.5

The following assumptions are used:

1. The weights and ages are 200kg at 9 months; 300kg at 18 months; 400kg at 24 months; and 500kg at 30 months.
2. Breed type is British (Angus, Hereford, Shorthorn, etc.) and their crosses.
3. Mature weight of cows of same breed type 500kg.
4. There is no cold stress.
5. Pastures are manipulated for the calculation by setting dead material at 5% for 12, 10.5 and 9 MJ ME/kg DM (M/D) and green at 1% for 7.5 and 6MJ ME/kg DM (M/D). The availability refers to amount present in the major component, eg MJ ME/kg DM 10.5 (or M/D 10.5). The green component was varied from 1, 1.5, 2, 2.5, 3t DM/ha.

Step 3 Calculate the stocking rate over short grazing periods

Follow the example to calculate the stocking rate for a 2,500kg green DM/ha pasture with a nutritional quality of (ME>10.5 MJ/kg DM) for 300kg steers growing at 1kg/day (see *Table 3*).

Example for 1 day grazing

Information for calculation:

- Pasture at start of grazing 2,500kg DM/ha
- Pasture at end of grazing 1,500kg DM/ha
- Pasture allowance (PA) 10kg DM/day/steer (see *Table 1*)
- Number of grazing days 1 day

To estimate use the formula:

$$\text{Animals/ha} = \frac{\text{(pasture mass at start of graze } \textbf{less} \text{ pasture mass at end of graze)}}{\text{pasture allowance}}$$

Animals/ha = (2,500kg DM/ha – 1,500kg DM/ha) = 1,000kg DM/ha

1,000kg DM/ha ÷ 10kg DM/day/steer PA (see *Table 1*)

Answer: 100 steers/ha for 1 day grazing

Example for 5 days grazing

Grazing a pasture of the same quantity and quality for 5 days:

= 100 steers/ha ÷ 5 days grazing

Answer: = 20 steers/ha stocking rate

Note: when calculating the short-term stock numbers while using short-term, high density grazing (from 1 to 5 days) there is no need to make an allowance for any pasture growth.

When grazing pasture for longer periods, an allowance needs to be made for the expected pasture growth during the grazing period. As a guide to mid-monthly pasture growth estimates, refer to Tool 4.3 for estimates of daily pasture growth rates (kg DM/ha/day) for typical conditions in a range of localities and regions across southern Australia.

Step 4 Determine the stocking rate/hectare over longer grazing periods

The big challenge in grazing management is being able to predict the stocking rate that takes advantage of any period of rapid feed growth. The question to be answered is "*How many cattle are required to achieve the combination of productivity **and** profitability*". A partial budget spreadsheet, '*The stocking rate calculator*', is provided on the enclosed CD-ROM to help you calculate the appropriate stocking rate for the nominated grazing period.

In this example the **stocking rate/ha (for no. days grazing)** is estimated by the calculation:

(pasture mass at start of graze less pasture mass at end of graze) + (pasture growth rate x no. days intending to graze paddock) ÷ pasture allowance x no. days intending to graze paddock.

Information for calculation:

- Pasture at start of grazing — 2,500kg DM/ha
- Pasture at end of grazing — 1,500kg DM/ha
- Pasture growth rate (PGR) — 30kg DM/ha/d (see Tool 4.3 for state regions)
- Pasture allowance (PA) — 10kg DM/day/steer (see *Table 1*)
- Number of grazing days — 7 days

To estimate use the formula:

Stocking rate

$$= \frac{\text{(pasture at start of graze } \textbf{less} \text{ pasture at end of graze) + (PGR x no. graze days)}}{\text{(PA x no. graze days)}}$$

Example for 300kg steers or unjoined heifers for 7 days grazing

Where the estimated pasture mass at the start of grazing is 2,500kg DM/ha and expected end of grazing pasture mass is 1,500kg DM/ha, pasture growth rate is expected to be 30kg DM/ha/day and the pasture allowance is 10kg DM/day.

$$\frac{(2{,}500 - 1{,}500) + (30 \times 7)}{10 \times 7} = \frac{1{,}000 + 210}{70}$$

$$= 17$$

Answer: The stocking rate for the 300kg steers = 17/ha for 7 days grazing

This calculation is suited to a wider application and can be applied to many different pasture and grazing scenarios and stock classes.

Example using the same pasture information for cows in early lactation for 30 days grazing

Information for calculation:

- Pasture at start of grazing 2,500kg DM/ha
- Pasture at end of grazing 1,500kg DM/ha
- Pasture growth rate (PGR) 30kg DM/ha/day (see Tool 4.3 for regions)
- Pasture allowance (PA) 15kg DM/day/steer (*Table 2*)
- Number of grazing days 30 days

To estimate use the formula:

Stocking rate

$$= \frac{\text{(pasture at start of graze } \textbf{less} \text{ pasture at end of graze) + (PGR x no. graze days)}}{\text{(PA x no. graze days)}}$$

$$= \frac{(2500 - 1500) + (30 \times 30)}{(15 \times 30)}$$

$$= \frac{1000 + 900}{450}$$

$$= 4.2$$

Answer: The stocking rate for lactating cows = 4.2 cows/ha for 30 days

In this example, a 30ha paddock with a pasture growth rate of 30kg/ha/day is capable of running (30ha x 4/ha) = 120 cows for 30 days; and a 50ha paddock could run 200 cows for 30 days.

Example for a 3-day rotational grazing system

Using the same calculation for the 30-day example applied to a 3-day grazing rotation, the stocking rate for lactating cows:

$$= \frac{(2{,}500 - 1{,}500 + 0 \text{ for pasture regrowth})}{(15 \times 3)}$$

$$= \frac{1{,}000}{45}$$

Answer: 22 cows/ha

A 10ha paddock is capable of running 220 cows (10ha x 22/ha) for the 3-day grazing period in the rotation.

A 30ha paddock with nil pasture regrowth is capable of running 660 cows (30ha x 22/ha) for 3 days; and a 50ha paddock could run 1,100 cows for 3 days grazing.

2. Plan seasonal pasture and animal performance to achieve targets

Information required for the calculation:

- Average pasture growth rate over the season (see Tool 4.3*)
- Number of grazing days

*Tool 4.3 contains tables providing mid-monthly growth estimates of daily pasture growth rates (kg DM/ha/day) for typical conditions at a range of localities and regions across southern Australia. Use the MLA Pasture Ruler to generate similar estimates of pasture growth rates for selected paddocks or the whole farm.

Be sure to make adjustments to suit the local seasonal and pasture growth conditions:

- In dry seasons reduce the estimate of kg DM/ha/day.
- Adjust estimates according to the growing conditions, pasture density or when there is more than 30% bare ground.

Step 1 Calculate the accumulated pasture growth over the season

Example for calculating the total pasture growth

Information for calculation:

- Average pasture growth rate 40kg DM/ha/day (see Tool 4.3 for regions)
- Number of grazing days 100 days

In this example, there is an average pasture growth rate of 40kg DM/ha/day for 100 days for a normal spring season in southern Australia. Refer to Tool 4.3 for a guide to the daily mid-monthly pasture growth estimates (kg DM/ha/day) for typical conditions at a range of localities and regions.

The estimate of **total pasture growth** is 40 x 100 = 4,000kg DM/ha

Answer: 4,000kg DM/ha (growth over 100 days)

Step 2 Calculate the number of grazing animals required/ha

Example for calculating the number of grazing animals required

Information for calculation:

- Total pasture growth — 4,000kg DM/ha (Step1 – total pasture growth calculation)
- Pasture allowance — 10kg DM/day/steer (see *Table 1*)
- Number of grazing days — 100 days

To estimate use the formula:

$$\textbf{Number of animals} = \frac{\text{pasture growth}}{\text{(pasture allowance x no. grazing)}}$$

A herd of 300kg steers with an estimated 4,000kg DM/ha total growth over the 100 days spring growth and a pasture allowance of 10kg DM/head.

$$= \frac{4{,}000}{(10 \times 100)}$$

Answer: Number of animals = 4/hectare

In this example, 120 animals (4/ha x 30ha) are required in a 30ha paddock to have the same amount of pasture mass at the start and finish of grazing through 100 days of pasture growing at 40kg DM/ha/day.

3. Estimate the stock growth rate and weight gain (kg/head/day)

Example for estimating growth in 300kg growing steers or unjoined heifers in 100 days grazing

Information for calculation:

- Steer liveweight at start — 300kg
- Pasture at start of grazing — 2,500kg DM/ha
- Pasture growth rate — 30kg DM/ha/day (see Tool 4.3 for regions)
- Quality of feed — 10.5MJ ME/kg DM (see *Table 3**)
- Average daily gain — 0.98kg/day (or approximately 1kg/day – see *Table 3**)
- Number of grazing days — 100 days

*In this example, use *Table 3* to estimate animal growth rate (average daily gain) in a pasture with 2,500kg DM/ha at 10.5MJ ME/kg DM with a growth rate of 30kg DM/ha/day.

Answer: In 100 days grazing expected weight gain is 100kg liveweight/head

4. Calculating the gross financial benefit/hectare to the grazing business

Once you have an estimate of the stocking rate and the number of days that stock will be grazing the pasture to achieve the target weight gain, the gross return per hectare can be calculated.

Example for calculating gross financial benefit

Information for calculation:

- Purchase price $600 (300kg x $2/kg)
- Sale price $760 (400kg x $1.90)
- Difference sale and purchase $160 ($760 – $600)

To estimate use the formula:

Number of cattle per hectare x (purchase price **less** sale price)

Answer: At the stocking rate of 4 steers/ha x $160, estimated gross return is $640/ha

Note: This is simply the gross financial benefit to the grazing business. The operating costs need to be deducted to arrive at an estimated gross margin.

Tool 4.6 Plant-based grazing management methods

Plant phenology and pasture height based methods to start and stop grazing a paddock in a planned grazing sequence. Best practice tactical management of pastures may require slight variation of the limits to achieve seasonal objectives, for example encourage desirable species and discourage undesirable species.

Process 1 – To start grazing

1. Based on phenology of major desirable species –for maximum productivity

- Perennial Ryegrass – graze at the 3-leaf growth stage
- Annual Ryegrass – graze at the 3-leaf growth stage
- Phalaris – graze at the 4–5-leaf stage of regrowth
- Cocksfoot – graze at the 4–5-leaf stage of regrowth
- Kikuyu – graze at 4.5 new leaves since previous grazing
- Prairie (Brome) grass – graze at 4 new leaves since previous grazing

In mixed swards, use the limit for the species that you want to encourage to be more productive.

2. Based on pasture biomass (or height)

Use when phenology limits are not defined or inappropriate for the species present in the pasture

- Minimum mass of 1,500kg green DM/ha (5–6cm) for a moderately dense pasture
- Maximum mass of 3,000kg green DM/ha (14cm) for a moderately dense pasture
- Tall fescue – provide adequate rest and regrowth to around 2,000kg green DM/ha (8–10cm)

These pasture availability methods are indicative only. Very dense, closely grazed pastures will have a higher (up to + 25%) kg green DM/ha at the same height. Conversely, more open, lightly grazed pastures have a lower kg green DM/ha at the same height. The differences due to density are greater at pasture heights above 6cm.

3. Legumes

In legumes the criterion measured is the percentage leaf area index (LAI) to capture the energy from sunlight or height in some species.

- Maximum limits:
  - All legumes – 95% LAI
  - White clover – height 20–25cm
  - Red clover – height 25–50cm

4. Native based pastures

Graze more heavily in spring to utilise the green feed and to promote flowering of sub-clover and control of annual grass. Avoid overgrazing in dry summers and in wet years manage rank growth in autumn.

Note that pasture intake of cattle will start to be depressed when grazing starts at pasture heights of less than 9cm (around 2,000kg green DM/ha). Achieving maximum intake of energy dense pasture per animal only occurs in that 9–12 cm window (2,000kg – 2,500kg green DM/ha). This only has impact if maximum growth rate of finishing animals is required to be above 1.5kg/day.

Process 2 – To stop grazing

In general:

- To maximise pasture regrowth rates – minimum limit of 1,000kg and maximum limit of 1,500kg green DM/ha (or around 3–5cm height) for all introduced species other than phalaris. Aim towards the minimum of 1,000kg green DM/ha in spring for most rapid pasture growth and to maintain control of species such as ryegrass, fescue and kikuyu.
- For phalaris based pastures the minimum limit is closer to 1,500kg green DM/ha.
- Across much of southern Australia where the growing season is between 5 and 8 months following the autumn break, the maximum limits for residual (post-graze) pasture mass will be lower than 1,000kg DM/ha in autumn and early winter.
- To provide protection of a fragile resource base a minimum pasture mass of 800kg total DM/ha and minimum of 70% ground cover (100% if slope is steep) is recommended.

Native based pastures

In higher rainfall areas:

- Recognise the special needs of desirable native grasses and use grazing systems that will encourage and maintain their productivity;
- Graze to maintain the legume content below 20% clover;
- Rest at critical times for reseeding depending on the growth characteristics of the desirable native species and predicted rainfall pattern;
- Subdivide paddocks according to grassland type and monitor the available feed to ensure that overgrazing does not occur at critical times of the year.