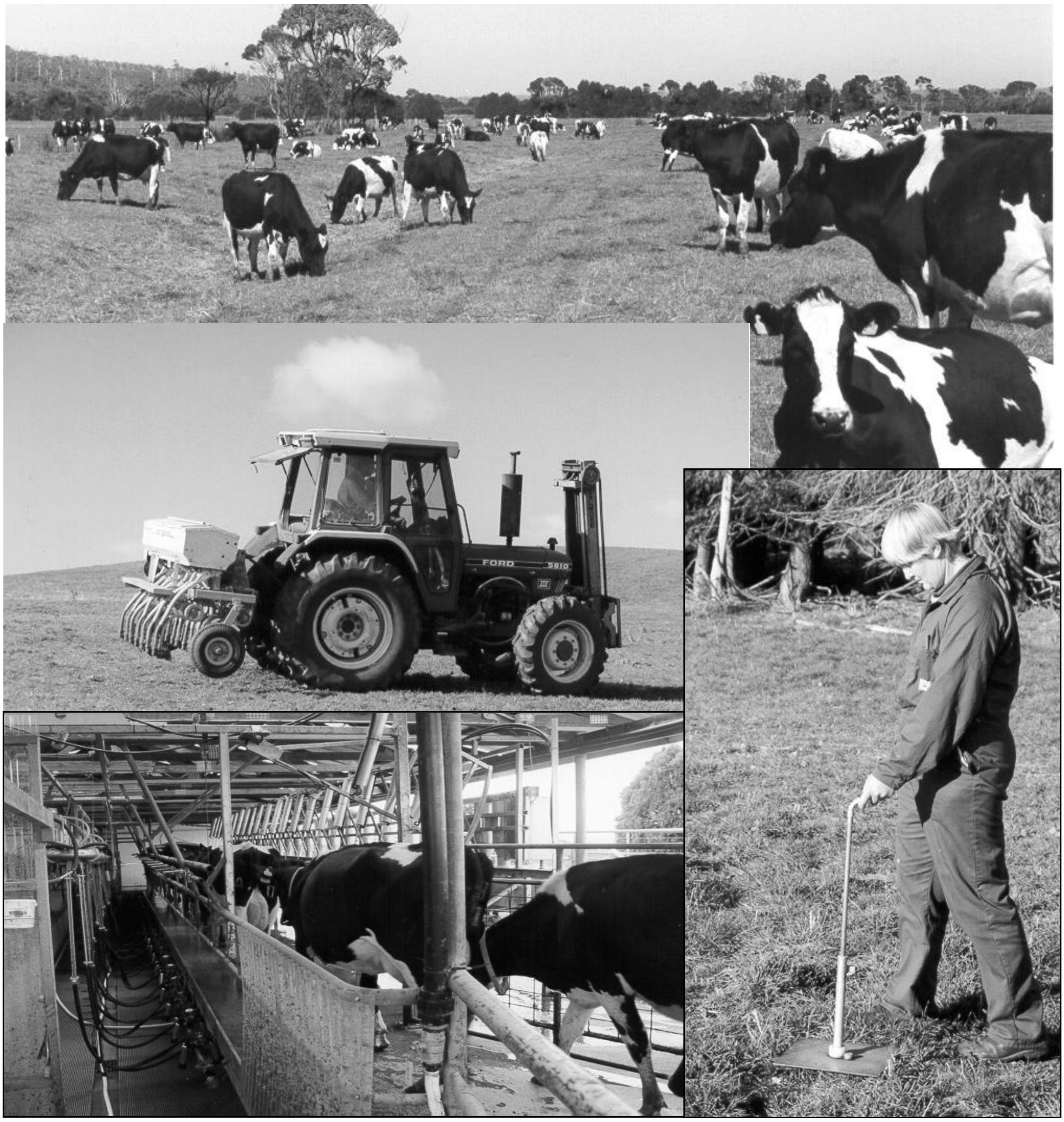
Pasture PLU$
Tasmanian dairy farmers increasing profit

PASTURE MANAGEMENT FOR TASMANIAN DAIRY FARMERS



Our objective is to provide an easy-to-read reference manual to be used in conjunction with Intensive Pasture Management workshops.

B.M. Doonan and L.D. Irvine (Editors)

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Pasture Management for Tasmanian Dairy Farmers

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This publication is based on the previous grazing management manual produced for Tasmanian dairy farmers:

- ***Spring Intensive Pasture Management, edited by P Tyson, W Fulkerson and P Michell, published by Department of Agriculture, Tasmania.***

The production of this manual was also assisted by the use of similar publications from Victoria and Western Australia:

- ***Pasture Management for Dairy Farmers published by the Department of Agriculture, Victoria***

- ***Pasture Grazing Management published by the Department of Agriculture, Western Australia***

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Chapter 1 Introduction – Why Pasture?

Tasmania has a temperate climate that is well suited to growing high quality pasture at a low cost. The temperate climate also means that cows are able to graze pasture year-round. In comparison, the supply of concentrates as an additional or alternative feed source is relatively expensive. The most profitable option for a dairy farmer is to utilise as much pasture as possible as the main feed source. Farmers should be looking to provide 85-95% of the cow's diet as pasture, or pasture-based supplements.

The amount of pasture grown on a hectare (ha) varies greatly depending on climatic factors and the management that is imposed. Average pasture utilisation in Tasmania is around 5-7 tonnes of drymatter (DM) per hectare per year, however on some farms it is as high as 15 tonnes. This means that on some farms up to 50% of pasture grown is not being utilised and is therefore wasted. The major objective of this course is to learn management strategies that reduce this wastage. Figure 1.1 illustrates that as the amount of pasture utilised increases, so does Gross Margins per hectare. This means that as more pasture is eaten (utilisation increased), more money is returned.

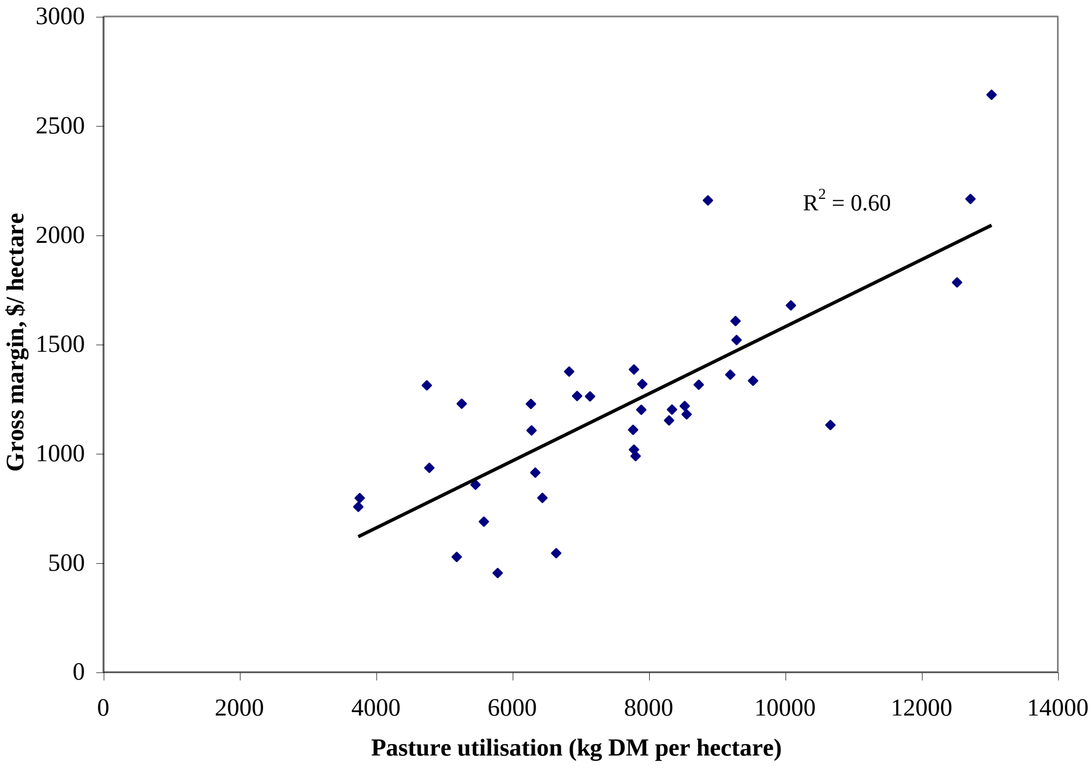

Figure 1.1 Pasture utilised and Gross Margins per hectare for a group of Tasmanian farms. Source: 2003 Dairy Business of the Year Award.

The difference in farms is a result of different management techniques. This manual is designed to help you improve your pasture management and hence improve your farm's profitability.

Chapter 2 How Pasture Plants Grow

Learning objectives:

To understand:

1. ***The basics of plant requirements for growth.***
2. ***How clover and ryegrass differ in growth and reproduction, and the different management strategies that must be employed.***

In maximising pasture production it is important to consider both the quality and quantity of pasture since animal production is directly linked to these two factors. Pasture quality and quantity are influenced by both environmental (rainfall, temperature, topography and soil fertility) and management factors. All plants require four basic inputs for growth; light, water, temperature and nutrients. No plant can survive without adequate levels of each of these inputs, however, requirements will vary depending on the individual species.

Light

In temperate climates, light is generally not a limiting factor other than over the winter period.

Water

The amount of water available to plants varies within the year and from year to year. During wet periods, drainage is important in ensuring that plants do not become waterlogged. During dry periods, farms that are able to irrigate can optimise plant growth by preventing water stress from occurring. Successful irrigation means applying sufficient water at the correct time. This avoids a reduction in plant growth due to water stress. Successful irrigation also means avoiding soil saturation or wastage of the water due to excessive application.

Temperature

Growth of all pasture plants is temperature dependent and generally relates to the parts of the world in which they evolved. As can be seen in Figure 2.1 ryegrass has an optimum temperature for growth of around 20°C while white clover does not reach maximum growth until the temperature has reached 25°C. For this reason, pasture tends to be ryegrass dominant through the winter while white clover content increases in spring and summer.

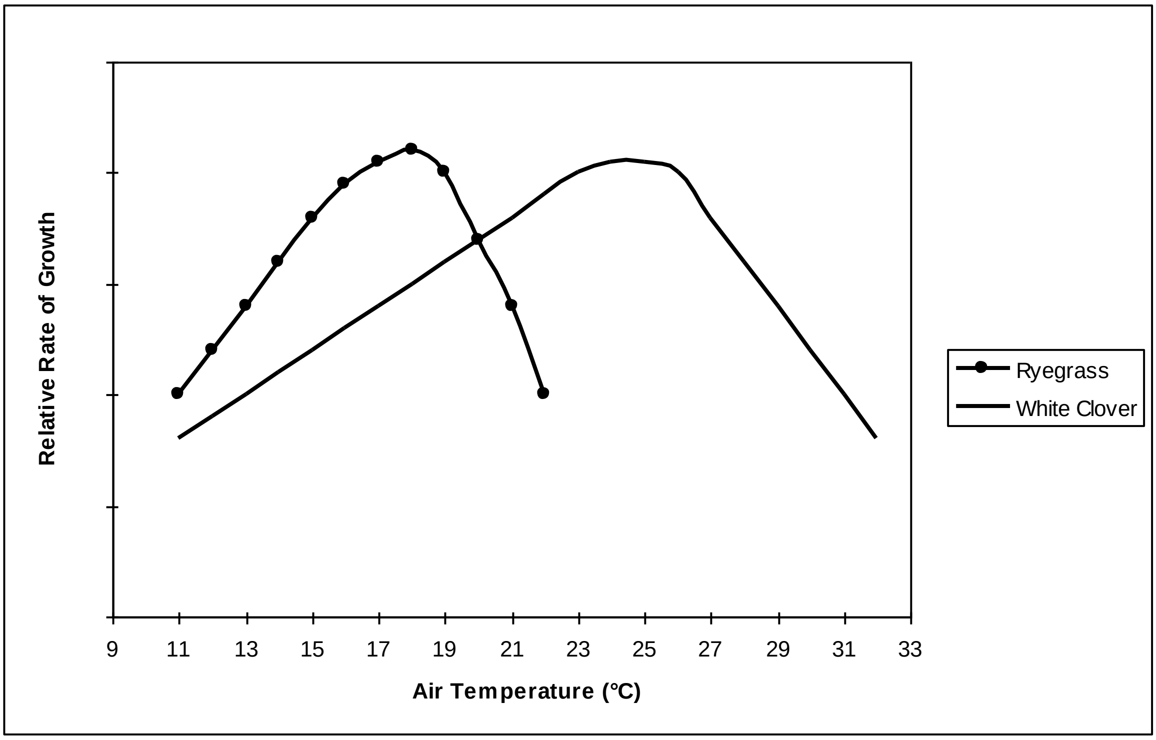

Figure 2.1 Temperature requirements for the growth of ryegrass and white clover.

NUTRIENTS

The nutrients required by the plant can be divided into two categories, macronutrients (required by plants in large amounts) and micronutrients (required in small amounts). The most important macronutrients for dairying in Tasmania include phosphorus (P), potassium (K), nitrogen (N), sulphur (S) and calcium (Ca). The micronutrients that are particularly important with respect to pastures are copper (Cu), molybdenum (Mo), and zinc (Zn).

Macronutrients

Nitrogen (N): Nitrogen is the nutrient most in demand by plants. The most common sign of nitrogen deficiency, apart from poor growth, is a yellowing of the pasture or crop. Low nitrogen availability may also result in a patchwork pattern of growth developing. Intensive grass growth occurs in urine patches due to the return of large amounts of nitrogen. The remainder of the pasture shows poorer growth with less grass dominance. In pasture systems, the amount of nitrogen in the soil can be increased by incorporating clover in the pasture sward.

Nodules on clover roots contain bacteria that are able to convert nitrogen in the air to a form that is available to plants. A reasonable level (greater than 30%) of clover might fix 50-200 kg N/ha/year. A common cause of nitrogen deficiency in pastures is poor clover growth due to soil nutrient deficiencies. Ensuring there are adequate levels of nutrients in the soil can prevent this.

The ability of clover to 'fix' nitrogen does not totally remove the need to apply nitrogen as a fertiliser. At certain times of the year, plants need more nitrogen than is available in the soil to achieve maximum growth rates.

Phosphorus (P): Almost all soils in Tasmania are naturally deficient in phosphorus and this is the most limiting nutrient to increased pasture production. Phosphorus deficiency results in small, stunted plants with limited root systems and thin stems. Leaves and stems may take on a reddish or purplish colour. This colouration can generally be seen in the older leaves first.

Levels of phosphorus should be between 23-28 mg/kg Olsen (measured to soil depth of 7.5 cm) or 25 mg/kg (Colwell P) on sandy soils to 110 mg/kg (Colwell P) on clay soils. Phosphorus deficiency is usually corrected by applying a fertiliser containing phosphorus such as single superphosphate (9% phosphorus) or triple superphosphate (20% phosphorus). High rates are often necessary to build P levels (approximately 5 kg P/ha above maintenance is required to lift soil levels by 1 Olsen P unit on sandy soils, or 13 kg P/ha to lift soil levels by 1 Olsen P unit on red soils) followed by annual applications to maintain/replace nutrient removed as animal products.

Potassium (K): Plants require a relatively large amount of potassium. Deficiency symptoms usually occur in the older leaves of the plant first - yellowing and browning occurs on the margins and tips of the leaves. In some plants (eg. clover, lucerne) potassium deficiency will show up as white spots on the leaves. Patchy clover growth (that is; good clover growth around dung pats, with small clover plants and weeds between) may also be indicative of potassium deficiency. These signs are most common in dairy pastures cut regularly for hay or silage. An average hay or silage crop removes the equivalent of about 150 kg of muriate of potash per hectare.

Potassium levels in the soil should be around 100-150 mg/kg Colwell on a sandy soil to 180–300 mg/kg Colwell K on a red soil (measured to a depth of 7.5 cm). A deficiency of potassium is corrected by applying a fertiliser containing potassium such as muriate of potash (50% K). In most Tasmanian dairy pastures, maintenance applications of potassium need to be applied annually to replace losses. Applying too high a level of potassium can cause animal health problems.

Sulphur (S): Many soils in Tasmania are naturally deficient in sulphur. Deficiency symptoms can be easily confused with those of nitrogen deficiency. Plants suffering from sulphur deficiency have a slow growth rate, and are small and spindly with short, slender stalks. Generally the normal rates of single superphosphate (and other low analysis) fertilisers supply enough sulphur to correct the deficiency. In more recent years the use of high analysis fertilisers (which are low in sulphur) has reduced the amount of sulphur applied. Sulphur levels should be monitored as part of the soil testing program. Deficiencies can be prevented in most instances by an annual application of approximately 40 kg S/ha.

Calcium (Ca): Calcium is needed in large amounts by plants. It is also thought to encourage earthworm activity and thus assist in the natural aeration of the soil. The amount of calcium available to plants decreases as the soil becomes more acidic. A standard dressing of 100kg/ha of superphosphate adds enough calcium to the soil for the year. Gypsum, lime and dolomite are other sources of calcium.

Micronutrients

Molybdenum (Mo): Molybdenum deficiency commonly occurs throughout the high rainfall dairy areas of Tasmania. Deficiencies are particularly common on soils with a pH lower than 5.5. The usual sign of molybdenum deficiency is poor pasture growth despite adequate applications of phosphorus and potassium. Clover growth is usually stunted, and because of this the pasture will generally show signs of nitrogen deficiency indicated by yellowing of older leaves.

Molybdenum deficiency is corrected by applying small amounts of molybdenum (50-70 g/ha) mixed with other fertilisers, typically about once every five to six years. Molybdenum is a 'trace' element and is required in very small amounts. Excessive use can create stock health problems. High intake of molybdenum by stock in the presence of adequate levels of sulphur reduces the absorption of copper and hence may cause copper deficiency. The application of molybdenum to pastures in areas where there is a marginal copper deficiency should be accompanied by an application of copper either to the pasture or to the stock.

Copper (Cu): Clover is particularly sensitive to copper deficiency. Severe copper deficiency reduces plant growth and can also affect animal health. While minor deficiencies do not have a great impact on plant health, stock health can still be a problem.

Copper deficiency can usually be corrected by top-dressing pasture regularly with copper mixed with the normal fertiliser at 1-2 kg/ha. A marginal deficiency can be corrected either by applying a copper fertiliser to pastures or by administering copper treatments to animals. Like molybdenum, excessive copper can be harmful to stock so care is needed when it is used.

Zinc (Zn): Zinc deficiency is rare, mostly occurring in sandy or alkaline soils. Symptoms of zinc deficiency include stunted leaf growth and yellowing of the plant. An application to zinc deficient soils of 1 to 2 kg Zn/ha lasts for about 5 years.

pH (acidity or alkalinity)

The pH of the soil has a large effect on the availability of nutrients to plants (Figure 2.2). pH also has important implications for nitrogen fixation. When soil pH falls below 5.2 on heavy soils and 4.9 on light soils the bacteria (rhizobia) in the root nodules of the clover are less effective at removing nitrogen from the air. This initially reduces clover growth and eventually total pasture production declines.

On red soils an application of 1 tonne of lime per hectare will increase soil pH by around 0.1 units. The ideal pH range for a ryegrass/white clover pasture is 5.6 – 6.5.

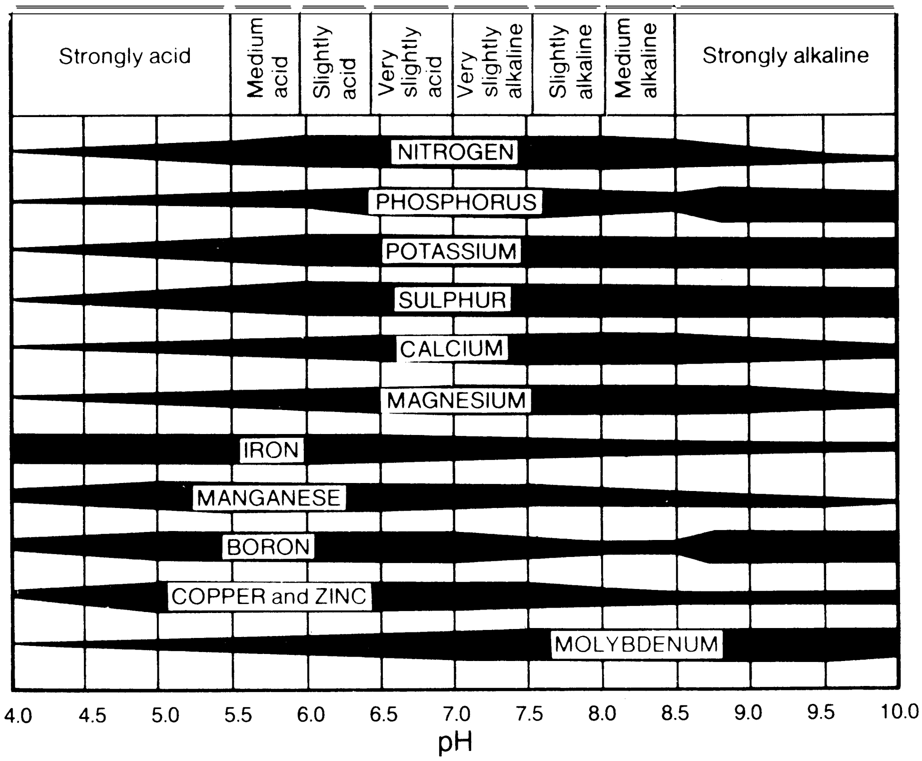

Figure 2.2 Availability of nutrients at varying pH levels (the width of the bar indicates the relative availability of each element).

Soil fertility

Chemical fertilisers are the basis for increasing soil fertility levels in most dairy systems. If soil fertility is below optimum levels, applying fertiliser to improve these levels can greatly increase pasture production. To maintain pasture growth, adequate amounts of fertiliser must be applied each year to replace what is being removed in animal product. On a dairy farm producing 350-525 kg milksolids (MS)/ha (200-300 kg milkfat (MF)/ha), the levels of nutrient removed each year are in the order of 14-20 kg of P and 40-65 kg of K (equivalent to 250-375 kg/ha of 2:1 super potash fertiliser). This is known as the maintenance requirement of the pasture as it must be replaced in order to maintain soil fertility. To increase soil fertility it is necessary to apply fertiliser above that required for maintenance, known as capital fertiliser dressing. The nutrient status of the soil and hence the fertiliser requirements, can be determined by soil testing. Soil testing should be done regularly and in the same areas to monitor changes in soil fertility. It is also a good idea to use the same soil testing facility each time to avoid variation in the results due to the different testing methods used. Not being consistent could give a false indication of whether your soil fertility is increasing or not.

PASTURE SPECIES

Dairy farming in Tasmania is based around the use of perennial pasture species as the major source of feed. Perennial plants are those which live for more than two years, annual plants are those which have a lifespan of one year. The major benefit of perennial plants over annuals is that, having survived the summer, they can take full advantage of the autumn break and provide a more even feed supply. The major challenge to perennial plants is to survive the summer. In very dry summers a high proportion of plants may die.

Annual plants survive the dry summer period by producing seeds in spring prior to the plant dying. These seeds lay dormant in the soil over summer and germinate after rain in autumn. The proportion of annual and perennial plants found in a pasture is often a reflection of the severity of the previous summer.

Tasmania's major dairy regions are well suited to perennial ryegrass and white clover. Sowing other pasture species with ryegrass and white clover is not recommended because of the unmatched growth and regrowth, and difference in establishment. These differences make managing the pasture very difficult and often result in poor pasture quality and utilisation.

Ryegrass

Basic structure

Ryegrass plants, as shown in Figure 2.3, are made up of a number of individual single stemmed units called tillers. Each tiller has its own leaf and root system which enables it to survive independently, however, being interconnected at the base, tillers are able to share nutrients, water and carbohydrates (made in the leaves using the energy from sunlight). Tillering is influenced mainly by light and nutrient supply (especially N, also P & K). The optimum temperature for tillering to occur is between 13 to 25°C (air temperature). Moisture stress will reduce tillering. New tillers are dependant on the parent tiller until they have produced their own leaves and roots, this takes at least a month even under fast growing conditions.

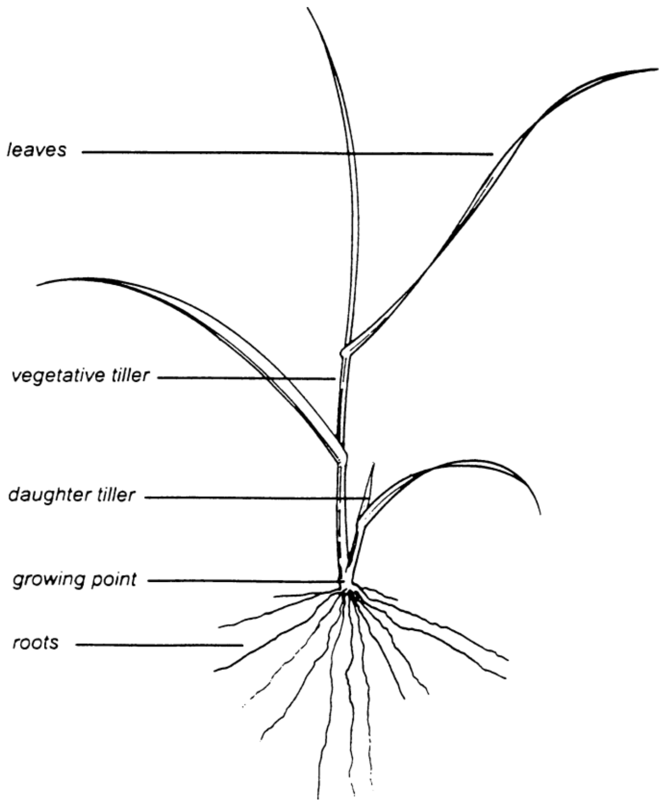

Figure 2.3 Basic structure of a ryegrass plant.

The growing point of an individual tiller is close to the ground so as to avoid damage during grazing. Leaves are produced continually from these growing points at a rate varying from one every leaf 6 to 10 days in mid-spring, to 20 to 35 days in mid-winter. These new leaves grow up through the centre of the old leaf sheaths so that the youngest leaf is always at the top of the plant, older leaves are situated progressively nearer the base (Figure 2.4). The new (Number 1) leaf is the only one that is growing, the older leaves finish their growth at about the time the new leaf appears. Leaf emergence (appearance) is influenced mainly by temperature and also soil moisture, while leaf size (length and width) is influenced mainly by nutrient supply (especially N), moisture, light and temperature.

The 3-leaf stage
Ryegrass plants typically maintain about three live leaves per tiller and once this **3-leaf stage** has been reached the oldest leaf will die each time a new leaf is produced. Thus the lifespan of a ryegrass leaf varies from about 18-30 days in mid-spring to 40-60 days in winter.

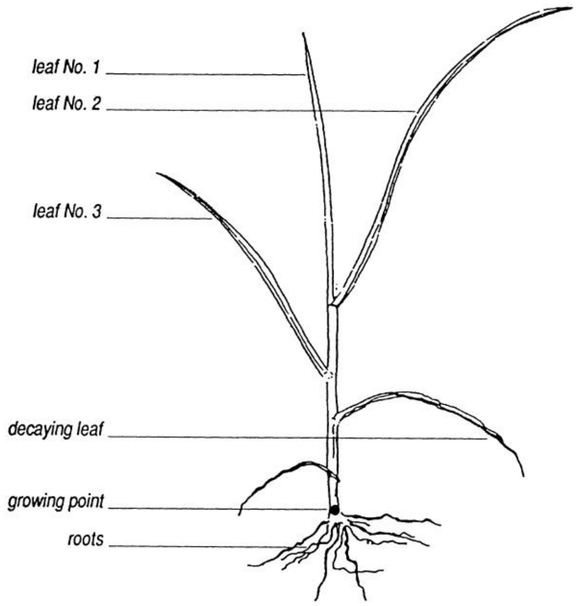

Figure 2.4 Structure of a ryegrass tiller.

While leaf death is a normal process in pasture swards, it should be remembered that leaves not removed by grazing or cutting, die and decay, and are therefore wasted. To reduce leaf wastage the grazing frequency (or rotation) should be related to the leaf appearance rate. Therefore the grazing interval should change throughout the year as leaf appearance rate changes. In winter when the leaf appearance rate is slowest, the grazing rotation should be at its longest. In spring when the leaf appearance rate is at its fastest, the grazing rotation should be at its fastest.

Grazing ryegrass
Plants contain energy reserves that are stored in the plant for future use in maintenance and growth. In ryegrass, the majority of energy reserves are stored in the base of the tiller, with a little also stored in the roots. These reserves are important to the plant when the production of energy through photosynthesis (the process of using sunlight to produce energy) cannot keep up with demand. This occurs just after grazing and also when light is unable to reach the plant (eg. night time, shading by other plants, or cloud cover).

When a plant is grazed, the leaves are removed preventing the plant obtaining energy from the sun. This is when energy reserves are used. The priority for energy reserves is firstly leaf regrowth, followed by root regrowth, resumption of tillering and then replenishment of reserves. Plants that have higher energy reserves before grazing have greater initial regrowth and are able to start photosynthesising sooner, building up energy reserves faster. Regrowth is hindered by frequent grazing as this prevents the build-up of energy. Close grazing physically removes part of the energy stores which also hinders regrowth.

The optimum time for grazing to maximise persistence and productivity of ryegrass plants is around 2 to 3 leaves per tiller. In the long term, a grazing interval close to this results in larger tillers with higher energy reserves than under a more frequent grazing regime. The initiation and survival of daughter tillers is greater from these larger parent tillers than from smaller parent tillers.

The growing point of the ryegrass tiller is modified in late spring, generally early October, as the onset of reproductive growth occurs. Eventually a seed head emerges (early November) and the tiller is no longer able to produce leaves. In swards where this process is allowed to continue uninterrupted, growth rates reach high levels due to the growth of the seed stem, while the production of new leaves ceases. Once the process of seeding has finished the tillers die. This is a contributing factor of reduced summer growth.

Heavy grazing (or cutting) of the pasture removes the growing points of the flowering tillers, causing them to die. Younger vegetative tillers will grow, stimulated by the increased light penetrating the sward. This may cause the growth rate to be lower in spring but the growth will consist of leaf in contrast to stem, resulting in higher quality pastures in late spring and summer. The growth rates in summer should be higher because of the increase in tiller numbers.

White clover

Basic structure

Perennial white clover is the major legume of high rainfall dairy pastures in Australia. Following emergence from seed, the growing point at the end of the stolon provides continual outward growth. The stolon is segmented by nodes that are the sites at which petioles bear leaves, nodal roots form and the stolon can either branch or form a flower. In Figure 2.5 the stolons, petiole, growing point, node and roots are illustrated.

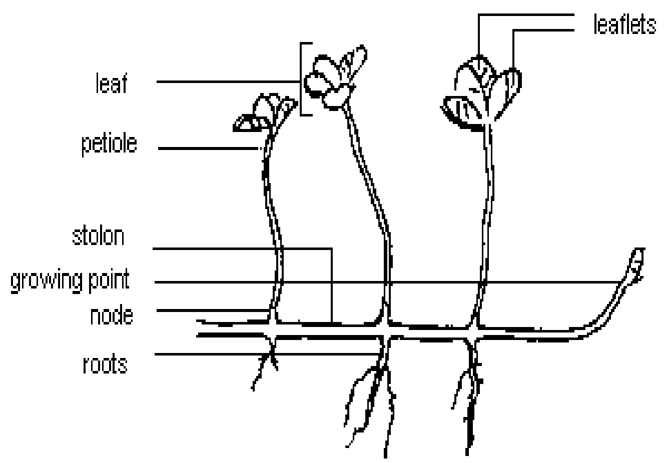

Figure 2.5 Basic structure of a white clover plant.

When a white clover plant is established from seed, a taproot is produced which firmly anchors the plant and provides a source of water and nutrients for the developing stolons. This taproot dies after about eighteen months, leaving the mature stolons to rely on the fibrous roots that grow from the nodes. Nodal roots will not form if the soil is too dry. The nodal roots are important not only for the survival of the clover plant but also for nitrogen fixation. On a stolon, only the youngest 3 or 4 nodes back from the growing point bear live leaves. The rate of appearance of leaves is influenced mainly by temperature, the optimum for clover being 18 to 30°C. The size of the leaves is influenced mainly by light - even mild shading is detrimental to growth and function.

Similarly to ryegrass an individual white clover stolon usually has three growing leaves although the actual number varies from two to six depending on the time of the year. However, unlike clover, the leaf stage of the plants cannot be used in any sort of meaningful way. Once the leaves of clover are grazed they do not re-grow.

The stolon is able to branch from nodes and spread out in the pasture. The new stolon formed at a branch is called a daughter stolon as indicated in Figure 2.6. If clover is shaded daughter stolon production is reduced. Increased light intensity speeds up the production of daughter stolons. As each daughter stolon grows forward at the growing point, the oldest part of the plant dies off. To maximise clover production it is important to encourage more daughter stolons as this ultimately increases production.

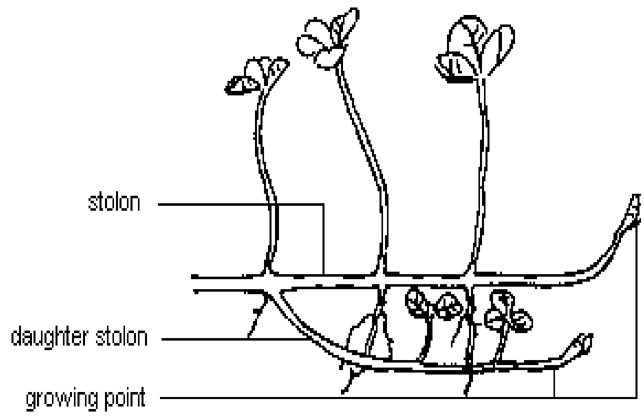

Figure 2.6 White clover plant with daughter stolons.

Grazing white clover

The energy reserves of clover are stored in the stolon and roots. White clover is generally more resistant to grazing than ryegrass for a number of reasons. After grazing, white clover usually retains more active leaf area than ryegrass. This is because its growth habit means that there will be leaves at varying heights from the ground, some of which will not be grazed. White clover is also able to adjust its shape under frequent and/or close grazing. It does this by decreasing leaf size, decreasing petiole length and increasing stolon branching. This results in a more prostrate, spreading plant. Another advantage that clover has, is that the stolons, being close to the ground, are rarely grazed so reserves are available for subsequent regrowth.

The optimal grazing interval for clover-based or clover dominant pastures is just as the lower leaves in the pasture canopy begin to yellow. In practice, for the large-leafed cultivars grown in dairy pastures, this time interval coincides with the 3-leaf stage of the accompanying ryegrass component of pasture.

Chapter 3 Effect Of Grazing Management on Pasture Growth

Learning objectives:

To understand:

1. ***That management is the most important determinant of pasture growth and utilisation.***
2. ***That rotation length and stocking rate play a major role in both pasture growth and utilisation.***
3. ***The various management techniques associated with pasture growth and maintaining quality over the season.***

PASTURE PRODUCTION

In the previous chapter, the growth of individual plants was considered. However, in real life these individual plants grow together to form a pasture sward. The growth of this pasture is controlled by the grazing management placed upon it. Grazing management is a tool over which all farmers have control. The three factors of grazing management that need to be considered are: grazing interval, grazing intensity and duration of grazing.

Grazing Interval (Cycle, Frequency or Rotation Speed)

Understanding the growth pattern of pasture

Generally speaking pasture mass increases as the interval between grazing (rotation length) increases. Comprehensive trials at the Elliott Research & Demonstration Station (ERDS) indicate a 28% increase in the pasture utilised as rotation length increased from less than 2 leaves per tiller to 3 leaves per tiller in autumn/winter.

The reason for the increase in pasture growth is the sigmoid growth pattern of pastures (Figure 3.1). This sigmoid growth pattern has three different phases:

Phase 1. Immediately after grazing, pastures grow slowly as they rely on the energy reserves (in the stubble) to send out the first leaf.

Phase 2. As the leaf grows the plant is able to begin photosynthesising. The leaf continues to increase in size and the energy obtained from the increasing leaf area allows new leaves to be produced. This is where the maximum growth rate occurs.

Phase 3. Once the plant has reached its maximum number of leaves (3) the older leaves will begin to die and decay as the new leaves emerge. The combination of decay and reduced growth due to shading results in a reduction of total pasture growth.

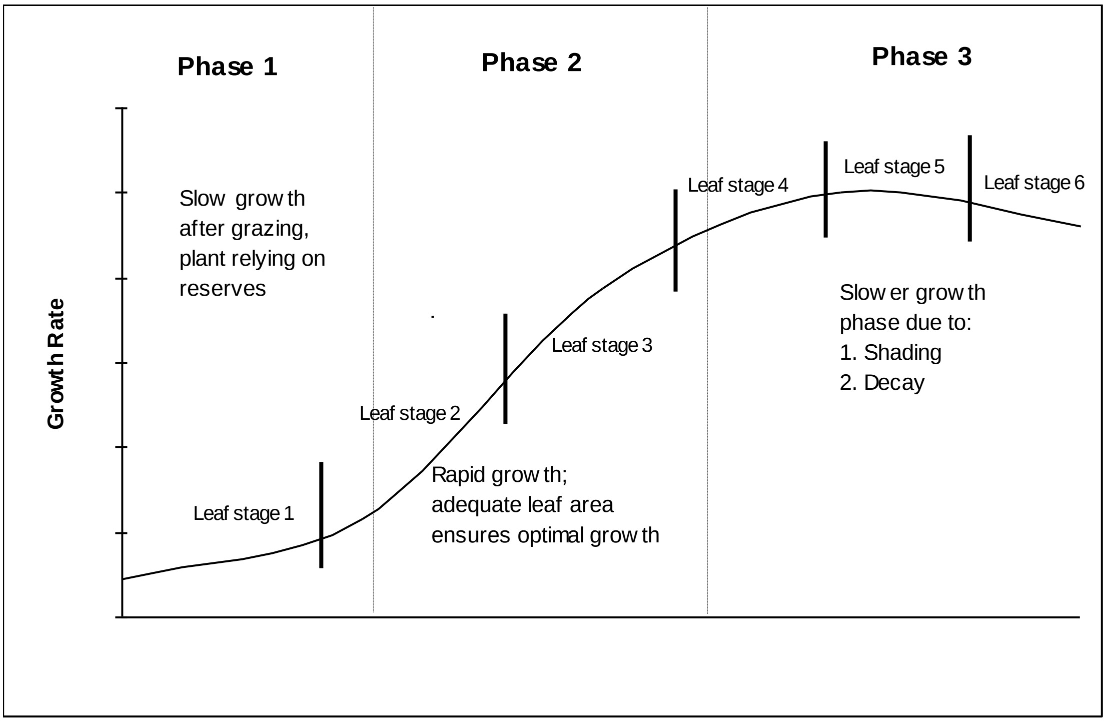

Figure 3.1 Sigmoid growth pattern for ryegrass following grazing or harvest.

As shown in Figure 3.1, the pasture growth rate increases over time with the maximum growth rate occurring at around the 3-3.5 leaf stage. An example of these growth rates that have been measured for each leaf stage are shown in Table 3.1.

Table 3.1 Pasture growth rates during spring at different leaf stages.

Leaf stage	Growth rate (kg/ha/day)
1-leaf	10 - 20
2-leaves	20 - 40
2.5-3 leaves	60 - 80
3 leaves	80 - 100

This means that at a leaf appearance rate of about 7-8 days, increasing rotation length from 10 days to 15 days will grow an extra 100-200 kg/ha but increasing the rotation length from 20 days to 25 days will grow an extra 300-500 kg/ha. Both of these increases in rotation length are 5 days but there is a large difference in the amount of extra pasture grown. This is because the pasture moves from being grazed at the 1-2 leaf stage to the 2.5-3 leaf stage.

After the 3-leaf stage, the pasture growth rate continues to increase however this is matched by an increasing decay rate. Therefore leaving the pasture beyond the 3-leaf stage will not result in an increased amount of pasture available.

Deciding when to graze

The optimum time to graze ryegrass is when there are 2.5-3 leaves per tiller as this maximises the persistence and productivity of the sward. Pasture height can be used as an indication of when a pasture is ready to be grazed, however differences between cultivars and genotypes of ryegrass and differences in pasture composition may lead to inaccuracies in estimation. Also, pasture height (plant size) is influenced strongly by nutrition, water and temperature so is not always an accurate method of the plant's stage of development.

Because of this, the decision of *when* to graze pasture should be based on the number of leaves per tiller. Pasture height and DM should be used to determine *how much* pasture to allocate on a daily basis, not when to graze.

Grazing at intervals less than 2 leaf stage lead to:

- a decline in energy reserves;
- retardation of the root system;
- a decrease in tiller emergence;
- an increase in tiller death;
- a high K:Mg + Ca ratio;
- high protein levels; and
- unpalatability to stock.

Grazing at intervals longer than the 3 leaf stage, even though an increase in overall growth can still be measured, lead to:

- an increase in wastage of feed (because leaves are dying);
- an increase in shading;
- an increase in rust infestation (if rust is present); and
- a reduction in energy density

The only time an interval of less than 2 leaves per tiller is recommended is if rust infestation is particularly bad (ie. over 30% of leaf area is infested with rust at this stage), or if growth rates are particularly high and plants begin to lodge (fall over) or set seed. In these specific cases, a rotation closer to 3 leaves will result in a poorer quality pasture.

Grazing Intensity

Grazing intensity (how hard the pasture is grazed) depends on the stocking rate and the length of time that stock are left on the pasture. Although reference to the sigmoid curve (see Figure 3.1) indicates that lax grazing should lead to more rapid regrowth after grazing (ie. pasture recovering spends less time in Phase 1 of the sigmoid growth curve), this only considers the growth aspect of pasture production and not decay. Trials at ERDS indicate that available feed over the autumn/winter period is maximised when pastures are grazed to about 2 cm in height (1,000 kg DM) (Table 3.2) and the time to regrazing is increased.

Table 3.2 Drymatter harvested (kg/ha) over the winter/spring when mown at 2 cm or 4 cm post-grazing residuals.

Post-grazing residual height	Post-grazing residual mass (kg DM/ha)	Harvestable Pasture (kg DM/ha)
2 cm	1,050	1,806
4 cm	1,450	754

Continual lax grazing results in a high decay rate of pasture below harvest height. In trials, grazing to a lower level resulted in more than twice the amount of feed utilised than if the pasture was not so severely grazed.

As the season becomes progressively drier in spring, more pasture should be left after grazing or mowing. This practice allows high animal intake and production, while optimal root growth and vegetative cover assists the pasture to cope with moisture stress in late spring/early summer. The recommended residues left after grazing, silage and hay cuts are shown in Table 3.3.

Table 3.3 Recommended pasture cutting/grazing residuals in various months.

Month	Pasture or mowing residual height*	Pasture or Mowing Residual mass (kg DM/ha)*
June/July (dry cows)[#]	2-3 cm	1,000 - 1,200 (dry cows)
All other months	4-6 cm	1,400 - 1,600

* Recommended cutting/grazing residuals will vary from State to State and also on the density of the pasture.
[#] This residual only applies to dry cows, if cows are milked throughout this period, residuals should be 4-6 cm (1,400 - 1,600).

If root development has been restricted by grazing at less than 2 leaves per tiller or shorter than 4 cm in spring, the result may be poor growth in summer/autumn and ryegrass pulling by stock in autumn.

Duration of Grazing

Available evidence indicates that cows should be grazed on blocks for 12 or 24 hours to reduce selectivity. Grazing should not last longer than 2-3 consecutive days otherwise regrowth suffers as plant energy reserves are exhausted. Prolonged grazing (more than 4 days) often results in cows eating new succulent regrowth rather than more stemmy grass left from previous grazings. If a leader/follower grazing system is adopted (milkers followed by drys, or calves followed by milkers) it becomes more difficult to graze the area in under three to five days.

Chapter 4 Maintaining Pasture Quality

Learning objectives:

To understand:

1. ***Management strategies that can be used to maintain pasture quality.***
2. ***The effect of pasture pests on pasture quality.***
3. ***How to measure the population of pests in a pasture.***

Maintaining an appropriate grazing interval and intensity year-round (as described in the previous chapter), will optimise pasture quality. However, there may be other strategies required to maintain pasture quality under certain circumstances.

CONSERVATION

As growth exceeds herd requirements in spring, adequate grazing pressure can generally only be maintained by dropping blocks for silage and hay. If these blocks are closed for conservation too early, restrictions will be placed on feed intake and a drop in milk production or liveweight (lwt) will occur. Conversely, if blocks are closed for conservation too late, the accumulation of dead matter in the pasture will cause a deterioration in pasture quality and quantity and an increase in the time it takes to recover after cutting. At ERDS, blocks are dropped from the round as dictated by the feed budget, generally in late September (although these blocks may not have been grazed since early August). An example of how to drop blocks out of the rotation is given later in Chapter 6.

The choice between hay or silage is based solely on when a genuine pasture surplus occurs. Surplus cut before the end of November can be made into silage. After the end of November hay can be made, weather permitting. Fodder conservation has a very positive role to play in maintaining late spring and summer pasture quality and growth.

TOPPING

A mower can be used to remove herbage left ungrazed by cows. The most important time to top is in late spring. The principle objective being to remove developing seed heads and thus help maintain both quantity and quality of the pasture. Sometimes, particularly on low stocked farms, rank pasture can accumulate over summer. In such cases, topping in the autumn may be beneficial as it encourages ryegrass tillering and improves late autumn and winter growth by suppressing and removing poorer quality and less palatable feed. It is essential to top with the mower set as close to 4 cm as possible to ensure a clean cut that removes the bulk of the dead material. To achieve the same result with lactating cows would cause an unacceptable drop in production.

Remember, topping should be used as the last resort to clean blocks after grazing. If pastures become too rank to graze effectively (more than 3,000 kg DM/ha - 12-18 cm in average height and yellow at the base), cutting before grazing and allowing to wilt for about 12 hours increases utilisation by decreasing the cows' opportunity to selectively graze.

WEED MANAGEMENT

A weed is a plant growing where it is not wanted. Weeds reduce the yield, quality and life of pastures. These unwanted plants compete with desirable pasture species for light, nutrients and moisture. In general, weeds are not high yielding and/or high quality and hence reduce the overall productivity of the pasture.

The management, control and prevention of weeds must be considered in a whole farm context because the factors that impact on weeds (including pasture plant and weed biology, drainage, renovation, mowing, soil fertility, grazing practices and the use of herbicides) are all related. The management required will often depend on the type of weed and the severity of the problem. Weeds such as thistles, Brown Top and ragwort should be controlled even if present in small numbers whereas it is often uneconomical to remove weeds such as Poa, Sweet Vernal and many of the flat weeds unless they are present in high numbers. The weed management required will also depend on the pasture. Appropriate grazing and fertiliser use will reduce or remove an invasion of Poa, flat weeds and Brown Top without the need to spray in an established pasture. In a newly sown pasture, weeds have a larger impact and spraying may be required to prevent the pasture from being swamped by weeds.

Weed management involves:

- The prevention of weed invasion.
- Restoration of weed-infested pastures.

Prevention of weed invasion

Weed invasion of pastures indicates that there is a problem affecting the growth of desirable species. This may due to grazing management, soil fertility, pH, drainage, drought, insects or disease. Less than optimal growing conditions for desirable plant species results in stress which makes these plants less competitive and provides the opportunity for weeds to establish and grow. Identification and correction of the problem(s) will reduce weed levels in the long term.

Restoration of weed-infested pasture

If a pasture does become infested with weeds, a control program that integrates several different management and control strategies is generally more successful than relying on only one method. Primarily, weed control and management is about increasing the growth of desirable species so they are able to out-compete the weeds. As was mentioned above, correcting any problems that may be limiting the growth of desirable plant species will help to achieve this.

Soil fertility

Maintain optimum pH and soil fertility. Soil tests should be conducted annually and used in conjunction with calculating maintenance fertiliser requirement. Simply increasing soil fertility levels can result in an improvement of the productivity and palatability of many plant species.

Drainage

Poorly drained soil promotes the growth of weed species therefore it may be necessary to set up a drainage system on the farm to prevent waterlogging from occurring.

Grazing management
Grazing management is an effective weed management tool although if not done properly it is also a factor in causing a weed invasion problem.

Grazing pasture when ryegrass is at the 2.5-3 leaf stage will maximise the productivity of the pasture and help it to remain competitive against weeds.

Overgrazing the pasture means that the regrowth of ryegrass and clover is delayed which provides weeds with an opportunity to grow. Overgrazing also results in an increased number of tillers dying, creating bare patches in the pasture, a perfect environment for weed invasion.

Herbicide
Herbicides should only be used when appropriate and cost effective. Ensure that you use a chemical that is registered for the weed you are spraying and follow the directions on the label.

Renovation
If the pasture is severely infested with weeds it may be necessary to renovate the pasture in order to improve its productivity. The impact that the weeds are having on pasture productivity, animal productivity and hence your profit should be assessed when making a decision on whether to renovate. Further information on renovation can be found in the pasture renovation section below.

PASTURE RENOVATION

There are many factors that contribute to pasture productivity including climate, soil fertility, pasture species and grazing management. Farmers have control of all of these factors except climate. Good management of each will ensure that pasture quality is maintained. However if a pasture has poor composition; that is, contains large quantities of low quality grasses and weeds, it may need to be renovated. As a guide, an ideal pasture would be one made up of 60% ryegrass and 40% clover. Paddocks with 20-30% ryegrass and 20-30% clover could be satisfactory and improved with fertilisers and grazing management. Once the percentage of clover and grass drops below this, pasture renovation may be necessary. In order to make the decision of whether to renovate the costs and the expected benefits over the lifetime of the pasture should be calculated to ensure you are making a worthwhile investment.

Prior to renovation it is necessary to fix the problem(s) that caused the poor composition and low productivity. Areas that should be looked at include: soil pH, soil nutrient levels, weeds, drainage and grazing management. Pasture renovation is an expensive process and if existing problems are not corrected, the renovated pasture will again deteriorate quickly.

Factors that affect seedling establishment

1. Seed Quality

Seed quality is very important. A decision to use 'cheap' seed of low quality defeats the purpose of establishing a new pasture. When buying seed ask for a certificate of seed analysis. On the certificate of seed analysis check the following:

- *Lot number*
  - Check that the lot number on the certificate matches the lot number on the bag of seed.
  - Check the name of the cultivar also matches.
- *Date*
  - The certificate should be current ie. the date of issue should be within the last 12 months.
- *Purity*
  - Top quality seed has a purity of 95.5-100%
  - Look at the other seeds listed and make a decision on whether you want to bring these plants on to your property.
- *Germination*
  - If the seed isn't going to germinate it won't grow. Seed with low germination will need to be sown at a higher rate to get the required number of plants in the pasture.
  - Look at the interim count figure – the higher this figure, the better. A higher figure means that the seed is likely to have greater vigour and superior field performance.
  - Look at the final count figure – this should also be high, ideally 90% or higher.
- *Look at the whole certificate*
  - There should be no evidence of changes having been made.

2. Clover inoculation

- Clover seed and inoculum should be bought separately and the seed inoculated just prior to sowing.
- Check that the inoculum isn't past the use-by date before buying/sowing and make sure that it is stored according to the directions.

3. ***Seed Banks***

The density of seed already present in the soil or on its surface is a major source of competition for sown seed. The density of sown seed can be much less than the density of seeds already present in the seed bank. For example, subterranean clover sown at 10kg/ha results in approximately 100 seed/m^2. In contrast, seed banks of barley grass may exceed 20,000 seeds /m^2.

4. ***Time and Depth of Sowing***

These two factors together determine the availability of soil water to the seed and the soil temperature. The time of sowing in practical terms can be considered as either autumn or spring. Sowing in autumn allows seed to go into a warm, but sometimes dry, seedbed with declining temperatures. These conditions are well suited to ryegrass however establishment can be delayed due to insufficient rainfall. When renovating pasture in autumn, sowing should be carried out as soon after the autumn break as possible to allow the seedlings time to establish before winter. Sowing before the autumn break is risky if you don't have irrigation because the plants need moisture to germinate and follow-up rains to keep them alive. Spring sowing will ensure adequate moisture and rising temperature, but the onset of an early dry period will cause plant death if irrigation is not possible.

Sowing depth is critical in achieving satisfactory levels of establishment. Although moisture levels may be more favourable at lower depths, the maximum sowing depth is determined by the seed energy reserves. The seed needs these reserves to support its growth before it reaches the soil surface. If sown too deep, they will run out of reserves and not emerge. Clover seed should be sown no deeper than 12 mm (about a 5 cent coin). If sown deeper than this the germination rate will be greatly reduced. Ryegrass should be sown from 12–25 mm deep. These differences in sowing depth mean that the two species should be sown separately for best results.

Methods of cultivation

There are three systems of pasture renovation commonly used:

- cultivation
- spray/direct drill
- direct drill/no spray

Cultivation

This will usually result in the most successful establishment and will eliminate a lot of undesirable species. The aim of complete cultivation is to reduce weed competition and to create a level seed bed. Where ground has been badly pugged it may be the only practical method of levelling the block. Under these circumstances tyned implements that do not invert the soil are best to use - such as a chisel plough or a tyned drill.

Where tussock, or bracken are present cultivation with a disc plough is the preferred technique. However, if the topsoil is very shallow tyned implements should be used. On deep soils the number of workings will depend on the amount of tussock and root matter present.

Seed should be drilled into the ground as this enables it to be spread more evenly across the paddock and also means that the fertiliser is concentrated near the seed.

Cultivation takes the paddock out of production for a longer time than the other two methods and if stocking rates are high it may put too much grazing pressure on the rest of the farm. It is also the most expensive renovation method.

A forage crop can be incorporated into a cultivation renovation program.

Spray/direct drill

This method reduces the amount of time that a pasture is out of production. The area must be hard grazed and regrowth sprayed out when soil moisture is available. If you have irrigation, the earlier renovation is done the better (February - early March). Pasture will then be well established before growth slows due to low temperatures and declining day length. If no irrigation is available, it is best to wait until the autumn break. This may mean that if the autumn break is late, the pasture won't be ready to be grazed until spring which can create a feed "pinch."

Herbicides to be used with direct drilling are available. Check on the label for the correct application procedures.

Direct drill/no spray (sodseeding)

This is a method that is commonly used because it is a quick and cheap option for pasture renovation. It is the least preferred method because the new platns then have to compete with the existing plants and generally do not survive the first grazing.

Management of new pasture

It is important that the new pasture is managed properly to get the most from the investment. Check the pasture regularly for signs of pest damage and take control measures if needed. Weeds may also need to be controlled to prevent them out-competing the new pasture. Grazing of the pasture should be done carefully while it is establishing. The first grazing should occur once the plants cannot be easily pulled out of the ground. The first grazing should also be a light, quick grazing.

HARROWING

Harrowing pasture to spread dung is a waste of time. It may give a cosmetic effect of less patchy regrowth around dung patches but there are no real benefits. Situations where harrowing can be useful are: to smooth out badly pugged areas (along with oversowing) or to spread uneaten hay or silage after intensive grazing.

DEEP RIPPING

Deep ripping pastures has a positive effect on spring growth and also breaks down any compaction caused by stock. Before deciding to rip, the soil should be looked at to determine if it is compacted, and if it is, the depth of the compacted layer. To do this, dig a hole about 300 mm deep and look at the pore (space between soil particles) and particle sizes and shapes. Compacted soils have various characteristics such as: lack of pores, few plant roots, smooth faced soil particles, horizontally layered soil clods and are hard to dig.

The other reason for looking at the soil is to determine if it is at the right moisture content for ripping. To do this, take a handful of soil from different levels. Roll it into a ball and then attempt to form a sausage about 3-5 mm round by rolling the sample between your palms. If you are able to easily form a sausage 3 mm thick, the soil is too wet for ripping. At the optimum moisture content, the soil sausage will crack and break into short lengths. If the sample crumbles, ripping can be carried out but it may not be as effective as at the optimum moisture content.

The depth of ripping will depend on soil type and the depth of compaction but generally, ripping soils to a depth greater than 300 mm is unnecessary. Ripping between 200 mm and 250 mm is more effective.

HOOF AND TOOTH TREATMENT

Improved pasture species such as ryegrass and white clover have been bred specifically to withstand grazing and treading, while less desirable species such as Brown Top and Yorkshire Fog grasses do not easily survive this treatment. Grazing down to 2 cm and even light pugging (2-3 cm) during June and July should do no permanent damage and will often increase the proportion of improved species in the pasture.

PASTURE PESTS

The impact of insect damage on pastures will vary from farm to farm. The economic importance of an insect attack is determined to a large extent by the time of the year it occurs. Often it will coincide with a seasonal feed gap, say a dry period that favours the insects breeding pattern.

Pasture pests can be reduced by grazing management. For example, corbies and winter corbies are discouraged by good grazing management as this prevents the build-up of dead matter and stops the pests from over-wintering in the pasture.

Effective control of any pest relies on three factors:

- Correct identification of the pest.
- Correct assessment of its population level (ie. is it present in sufficient numbers to warrant treatment?)
- Correct timing and distribution (targeting) of treatment.

Identification relies on self-education or the use of an expert in the field. Assessing the population level at which damage occurs is more difficult since it varies from pest to pest. Correct timing of treatment will allow the maximum amount of pasture to be saved and this relies on quick action after early identification.

Corbies

There are two types of corbies, common corbies and winter corbies. Damage is caused by the grubs which are about 3 mm in length when newly hatched, growing to about 60 mm when mature. Corbie grubs have a smooth, blue-grey skin with a shiny, dark-brown head. Corbies do not eat weeds, preferring ryegrass and clover. Bare patches in pasture caused by the caterpillars become infested with weed and, as a consequence, the pasture becomes less productive. Corbies, unlike black-headed cockchafers, do not leave a mound of soil beside the holes they dig.

There are two practical ways of assessing the population of corbies:

1. Using a spade dig a square 20 × 20 cm about 20 cm deep in May-June for winter corbie and August-September for corbie. At these times, the grubs will be about 3-4 cm long and in shallow tunnels. A square should be dug every 10-20 paces across the paddock. An average of 2 corbies per spade square warrants spraying.

2. Another method is to cut thin metal plates about 30 cm square (or one foot square). Using a sharpened spade, skim off a 30 cm × 30 cm flap of pasture and lay the plate on the bare ground where the pasture was removed from. Next day, lift the plate and any corbies present will have re-opened neat holes which are easily counted. Lay a minimum of about five plates per hectare. Three corbies or more per plate warrant treatment.

When treating, graze pastures short and spray late in the afternoon with recommended pesticides.

Black-headed pasture cockchafer

Damage is caused by the grubs which are white or greyish white with a shiny black head. The grubs are about 15 mm long when mature and tend to lie in the shape of a ‘C’. Black-headed cockchafers dig burrows in the ground leaving a mound of soil next to the hole. They remain in these burrows during the day and come out at night, except when it is frosty, to feed.

Pasture thinning occurs April/May through to September and soil should be sampled to a depth of 20 cm in late autumn. Three or more grubs per spade full usually warrants spraying. For best results, sprays should be applied before the end of June.

Red-headed pasture cockchafer

Red-headed cockchafer grubs are a whitish-grey with a red head, dark posterior and are generally found laying in the shape of a 'C'. When the cockchafers hatch they are about 5 mm long, growing to 30 mm when mature. Damage is caused by the grubs feeding on the roots of plants, usually within 5 cm of the surface. This weakens the plant and promotes up-rooting by stock. The movement of the grubs under the surface of the soil creates tunnels in the soil and makes the ground feel spongy underfoot. It also increases the amount of pugging that occurs. Damage from this pest is most serious in late autumn (March to late June).

Red-headed cockchafer cannot be controlled with the use of chemical sprays. A biological control is available.

Lucerne flea

The lucerne flea is a small yellow-green wingless insect about 3 mm in size when mature. It feeds on clover. Lucerne fleas dislike dry or excessively wet conditions. Severe outbreaks usually occur after late summer rains and cause the majority of damage in autumn. Control of this pest is principally by spraying with a recommended chemical, close grazing also reduces their numbers. Spraying in spring is sometimes necessary as well as in the autumn. When spraying in autumn, three to five weeks after the opening rains is the critical time.

Armyworm

The term 'armyworm' refers to the larval stage of two species of native moths. The young grubs are pale yellow or cream in colour, as they grow older they develop a pattern of grey or black stripes. Mature armyworm grubs are 20 to 30cm long. Southern armyworm grubs cause damage from mid-December to late January. After late January, damage is likely to be from the so-called common armyworm. Armyworms cause damage by chewing through the leaves of grasses and clovers. Older grubs do the most damage, climbing up the stems to feed, usually at night. During the day, armyworms tend to be inactive and can be found lying curled up at the base of plants or under clods of soil.

The DPIWE monitors the number of adult moths caught in September/October and issues a warning if numbers are above average. If a warning is given, particular attention should be given to the monitoring of pastures for signs of the pest. However it is possible that an outbreak can occur without a warning being given if, for example, migratory moths land in an area that is not monitored. Therefore it is important to regularly check your pasture for the presence of armyworms.

Armyworms can be controlled by using a chemical registered for the purpose. In severe infestations, numbers of armyworms can reach several hundred per square meter. Pastures, unlike crops, are not seriously affected by high numbers in late spring. The main problem that armyworms cause at this time is fouling of the pasture, especially hay paddocks. If this is occurring it may be necessary to spray. When making a decision to spray also look at the size of the larvae. Young armyworms (small in size) spend most of their time at base of the pasture and are less likely to be killed by insecticides. Once the armyworms are larger they become more active in their feeding and are more likely to consume a lethal dose of insecticides.

Red-legged earthmite and Blue oat mite

These insects are very small in size, fully grown they are about the size of a pin head. They have a dark blue or black body with red legs. The blue oat mite can be distinguished by a red spot near the rear end of the body and its legs are redder than the salmon-pink ones of the red-legged earth mite. The highest populations of red-legged earth mites are found on lighter, well drained soil types while the blue oat mite can be found in most pastures throughout Tasmania.

Mites generally cause damage to the clover component of the pasture. They feed by rasping the surface layers of the plant and then sucking up the juices. The damaged foliage takes on a silvery, bleached appearance. Young plants are most susceptible but damage can occur at any stage. Mites are active during autumn, winter and spring. The warmer, drier summer months are spent as eggs that hatch with the autumn break. Irrigation may prolong the activity of mites.

Cutworm

Cutworms are the caterpillars of two species of moths, brown cutworm and common cutworm. While cutworms do over-winter in Tasmania, there are also migratory flights into Tasmania each spring from core breeding areas in southern Australia. Eggs are laid in the soil surface, often in clusters under plant debris. There is only one generation of the caterpillars hatched in spring-summer. Eggs and young caterpillars are killed by heavy rainfall. The caterpillars of the two species are similar; they are a dull grey colour and reach 45 mm when fully grown. When the grubs are disturbed, they curl up into a ball.

Damage is generally done to fodder crops, however, newly established pasture is also susceptible. Newly hatched caterpillars are 1-2 mm in length. They head toward light climbing up the plants and chewing holes in the leaves. Older caterpillars move away from light. They live in the soil and feed by cutting seedlings at ground level and then chew the leaves. In summer, the caterpillars go into cocoons in the soil with moths emerging in February.

The density of cutworm caterpillars that will cause economic damage varies with the age of both the caterpillars and the crop. A fallow of at least two weeks will help in the control of cutworm. There are also chemicals registered for their control. Larger caterpillars are harder to kill.

Chapter 5 Feed Requirements of the Grazing Animal

Learning objectives:

To understand:

1. ***The difference between using leaf stage to decide when to graze and using pasture mass to decide how much pasture to allocate to the herd.***
2. ***The nutrients contained in pasture DM from an animal feeding perspective.***
3. ***How pasture DM is utilised by cows to satisfy the requirements associated with reproduction, milk production, pregnancy and liveweight change.***

In the previous chapters we have established that the decision of when to graze a paddock needs to be based on the leaf stage of the ryegrass plant, with 2.5-3 leaves per tiller being the optimum for pasture production and persistence. In the following chapters we will be looking at how much of the pasture to allocate to the herd. When grazing at the 3-leaf stage the amount of feed available will vary depending on the time of year. Therefore to work out how much pasture to allocate it is necessary to consider the herd's requirements and then look at how much pasture is required to meet these needs. Any reference to pasture height or mass from this point forward is assuming that the pasture is being grazed at the 3-leaf stage (unless otherwise indicated).

COMPONENTS OF PASTURE

The reason for growing pasture is to feed animals and obtain an economic return from the product produced. To understand how this relationship works it is necessary to understand what nutrients pasture supplies to meet the requirements of the grazing animal.

Pasture is made up of two broad components - dry matter and water (Figure 5.1). Dry matter contains the basic ingredients for cow survival and production; energy, protein, fibre, vitamins and minerals.

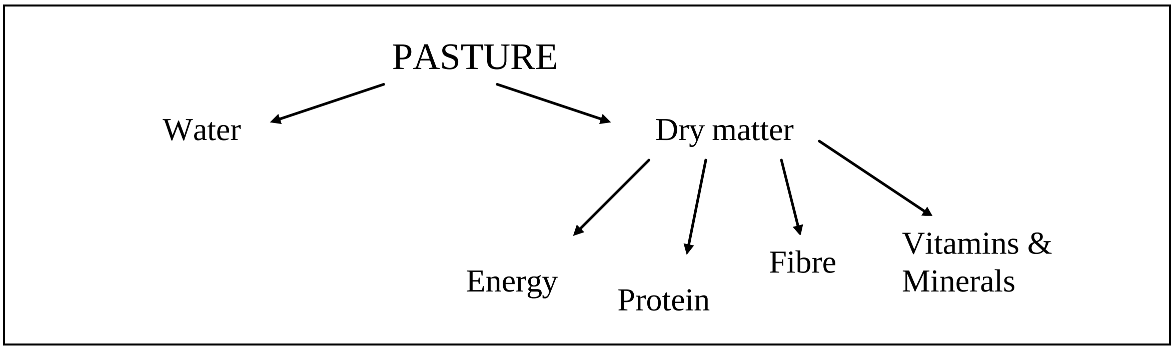

Figure 5.1 The components of pasture.

Energy

In most temperate pasture-based farming systems it is energy that limits the level of production achieved.

Energy is required by the cow for:

- Maintenance (breathing, walking, grazing, circulation, tissue repair, digestion and regulation of body temperature)
- Pregnancy
- Growing or gaining condition
- Producing milk

Energy is measured as Megajoules (MJ) of Metabolisable Energy (ME). Metabolisable energy is the energy available for use by the cow. Not all of the energy in a feed is metabolisable, some is lost in the faeces, urine and as gas. The proportion of the total energy that is able to be used (metabolised) is determined by the digestibility of the feed. Digestibility is measured as a percentage. For example, if a cow eats 10kg of pasture and 3kg is excreted, the pasture has a digestibility of 70%. Therefore digestibility is an indication of the quality of a feed. A highly digestible (more than 70%) feed means that it will be of more benefit to the cow (ie. it can digest and use more of it). A feed that has a low digestibility (50-60%) will have a greater percentage excreted and is therefore less useful to the cow (eg. straw, old hay).

The main sources of energy are carbohydrates, fats and oils.

Carbohydrates

Carbohydrates are the main source of energy for grazing cows. Plants are made up mainly of carbohydrates, including water soluble (WSC) and structural (fibre) carbohydrates.

Fats and oils

Pasture plants contain only small amounts (2-3%) of fats and oils.

Table 5.1 shows ME and digestibility values of commonly used feeds.

Table 5.1 Digestibility and metabolisable energy of feeds commonly used in dairy production.

Feed	Digestibility (%)	ME Value*
Ryegrass – leafy	72 – 75	11 - 12.5
Ryegrass – reproductive	55	6.5 – 9
White Clover	70 – 80	11 - 12.5
Silage – mature to leafy	60 – 72	8 – 11
Hay - mature to leafy	55 – 72	7 – 11
Wheat (grain)	84 – 89	11 – 13
Barley (grain)	80 – 86	11 - 13
Oats (grain)	65 – 79	8 - 11
Triticale (grain)	83 – 87	11 - 13
Brassicas	80 – 85	12 - 13
Pellets		11 - 13

** ME units are megajoules per kilogram DM*

Protein

Protein is the material that builds and repairs all body tissue. It is also required for the efficient utilisation of energy. Protein influences milk yield but not to the same extent as energy. Crude protein or total protein in feed is expressed as a percentage of the feed's dry matter.

In early lactation, the diet of dairy cows should contain at least 16% crude protein and up to 18% in high producing dairy herds (30 litres or more per cow per day). This level can be reduced to 14% crude protein in mid lactation and 12% in late lactation. A minimum of 9% crude protein must be supplied in the diet otherwise the ability of the rumen microbes to break down feed is affected. Table 5.2 describes the protein content of some feeds commonly used in dairy production.

Table 5.2 The crude protein content of feeds commonly used in dairy production.

Feed	Crude Protein (%)
Ryegrass – leafy	18 - 22
Ryegrass – reproductive	12 - 14
White Clover	16 - 24
Pasture Silage	16 - 17
Pasture Hay	6 - 16
Wheat (grain)	9 - 16
Barley (grain)	7 - 15
Oats (grain)	5 - 13
Triticale (grain)	11-14
Brassicas	9 - 16
Pellets	8 - 23

Fibre

Fibre is the physical bulk of the diet. It is necessary for rumen function as it helps to maintain rumen pH by preventing acid build-up. Each kilogram of fibre eaten produces about 5-6 litres of saliva during cud chewing. Saliva contains sodium bicarbonate, a natural buffer against acid build-up. As the fibre content of feed increases (ie. more bulk), animal intake decreases. Fibre also promotes rumination (cud-chewing). The by-products of fibre digestion are required to produce milk fat.

Fibre is commonly expressed as a percentage of the diet. There are several different ways of measuring fibre in the diet. These include:

Crude fibre (CF): This measures the fibrous component of the feed. Although it is still commonly used in guidelines for feeding cows, it is a poorer measure of fibre content as it does not include all the fibre that is present in the feed. In general, the percentage of crude fibre indicates the coarseness of forage or feeding stuff. Feeds like straw, seed hulls, etc. are usually highest in crude fibre.

Neutral detergent fibre (NDF): This measures all the fibre, both digestible and indigestible, in a feed. The NDF% is often found to be higher than CF%.

Acid detergent fibre (ADF): This measures the less digestible or indigestible parts of plants. The ADF% is used to calculate the digestibility of a feed - the higher the ADF value, the lower the digestibility of a feed.

About 35% NDF (17% CF) is required in a cow's diet. Low levels of fibre result in an acid build-up that alters the digestive process and can cause the fat test to drop. In extreme cases, cows may suffer from acidosis. The crude fibre and neutral detergent fibre content of feeds commonly used in dairy production is outlined in Table 5.3.

Table 5.3 The level of crude dietary fibre and neutral detergent fibre in feeds commonly used in dairy production.

Feed	Crude Fibre (%)	Neutral Detergent Fibre (%)
Ryegrass – leafy	20 – 25	30
Ryegrass – reproductive	18 – 22	35 - 45
White Clover	17 – 25	38 - 42
Pasture Silage	25 – 30	35 - 60
Pasture Hay	25 – 40	45 - 60
Wheat (grain)	2.7 - 3.2	9 - 17.5
Barley (grain)	4 – 8	13 - 37
Oats (grain)	10 – 14	26 - 36
Triticale (grain)	3.5	8
Brassicas	10	18
Pellets		15

Most feeds have sufficient levels of dietary fibre. Research trials have only encountered low fibre problems in situations where the cows were being fed in excess of 5 kilograms (1/3 of the diet) per day of grain or brassica fodder crops and grazing on very high quality spring or autumn pasture. In these cases a drop in milk fat test indicates a possible problem with low fibre levels and the diet should be investigated more closely.

Vitamins and Minerals

Gross shortages or excesses of these two components can be readily identified as animals will show the symptoms typical of vitamin or mineral toxicity or deficiency.

In general, Tasmanian soils (except for light coastal soils) are able to supply sufficient amounts of vitamins and minerals for plant and animal requirements. However, problems may arise in pasture fed animals in some areas of Tasmania. Similarly problems may also occur if a large amount of a cow's diet is fed as supplements.

COW REQUIREMENTS

Energy

A cow has four main requirements for energy in a 12 month period:

- maintenance
- pregnancy
- milk production
- body condition changes (liveweight gain)

The priority for energy partitioning will generally be in the order of maintenance → pregnancy → milk production → body condition. As a result, when energy is limiting, milk production and body condition will be the first to suffer. However, cows of high genetic merit can prioritise energy to milk production to the detriment of condition and pregnancy.

Maintenance. The amount of energy required to keep the cow alive is known as the maintenance requirement. It is generally a third of the peak production requirement. The maintenance requirements for different stock classes are outlined in Table 5.4.

Table 5.4 Feed requirements of dairy stock (for guidance only).

	Stock class/action	Energy requirement (MJ of ME/day)	Requirements (kg DM/head/day)*
Maintenance	200 kg lwt	32	3.0
	350 lwt	49	4.5
	400 lwt (average Jersey)	54	5.0
	500 lwt (average Friesian)	63	6.0
	600 lwt (large Friesian)	73	7.0
Pregnancy	6 months pregnant	8	0.5 kg extra
	7 months pregnant	14	1 kg extra
	8 months pregnant	25	2 kg extra
	9 months pregnant	43	3-4 kg extra
Liveweight gain	To gain one kg lwt		6 kg extra**
	• When lactating	34	
	• When dry	43	
	To gain one condition score:		
	• Jersey (1 CS = 26 kg)		156 kg***
	• Friesian (1 CS = 42kg)		252 kg***
Milk production	To produce one litre milk	5.5	0.5 kg extra
	To produce one kg milkfat	125	11 kg extra
	To produce one kg milksolids	85	6.5 kg extra

* Requirements (kg DM/day) are based on each kg of DM yielding 10.5 MJ ME
** This is the approximate dry matter feed requirement for dry cows over winter to gain 1 kg liveweight given that feed is usually of lower quality at this time of the year.
*** Total liveweight gain requirement. To determine how much feed the cows need each day, divide this figure by the number of days the cows have to gain weight. For example, if the cows (Jersey) need to gain one condition score in 4 weeks, divide 156 by 28 days (156 ÷ 28 = 6 kg DM/day). This needs to be fed in addition to any maintenance, pregnancy and milk production requirements.

A more precise measure of a cow's maintenance requirement is:

$$\text{Maintenance (MJ ME/day)} = 0.6(LW^{0.75})$$

* Where LW is the cow's liveweight in kg

Heavier animals have a higher maintenance requirement as more body tissue needs to be kept functioning. Any additional stress placed on cows will increase energy requirements by up to 10 to 25%, depending on the amount of activity. This would mean a 500 kg cow may require an extra 0.5 to 1.5 kg of pasture DM per day above the base maintenance value shown in Table 5.4.

Reproduction. The energy required for pregnancy is low for the first five months. This increases sharply thereafter and is an important consideration when feeding dry cows approaching calving. The maintenance allocations for various stages of pregnancy are outlined in Table 5.4.

Milk Production. A cow requires approximately 6.5 kg of pasture DM over and above maintenance for every 1 kg of milksolids produced.

Body Condition. For a cow to gain condition, feed above that required for maintenance and milk production is needed. To gain 1 kg of live weight a cow needs to eat an extra 6 kg of pasture DM. One condition score (CS) is equal to 42 kg of liveweight (for a 450 kg cow). Table 5.4 is a guide to the requirement for condition gain.

The importance of cow condition

At calving, each additional condition score above 3 will result in the cows producing approximately 17.5 kg MS/cow (10 kg MF) more during the next lactation up to condition score 5.5. There are also reproductive benefits of calving between condition score 4.5 and 5.5.

Cow condition at calving is particularly important when cows are expected to peak at more than 1.75 kg MS/day (1 kg MF/day) as soon after calving as possible. It is physically impossible for such high producing cows to eat sufficient grass to produce this amount of milksolids plus satisfy maintenance requirements. As a result, these cows inevitably lose body condition. It follows that if there is not 'spare' condition (ie. fat on the back to be mobilised) peak production levels will not be reached even if feeding levels are high.

While it is inevitable that cows will lose condition in early lactation, large changes in liveweight and body condition of cows, both over time and within the herd, are an indication of inefficient feeding. Ideally, all cows should be at condition score 5 all year round, avoiding the inefficiencies that occur when cows lay down body reserves in periods of overfeeding and then mobilise these later when there is insufficient feed. Practically this is not possible but changes in liveweight should be minimised as much as possible.

Efficient feeding to maintain condition

The aim of feeding during early lactation is to maximise intake of all cows. During this period it is impossible to overfeed a cow on pasture as they will be using any feed supplied above maintenance to produce milk. This is often to the detriment of body condition with one of the most obvious characteristics of a high producing cow being that of body condition loss. As production per cow begins to decline in mid-season, feeding in excess of milk production requirement becomes possible. This results in the restoration of body condition lost earlier and should not be considered as wasteful. It is only late in the season, when requirements for milk production are low and condition is good that over-feeding starts to become possible. However, at this time, limited rationing also becomes possible by applying restrictions to the milking herd, selective drying off and establishing a 'dry' herd that can be fed maintenance, or even sub-maintenance levels if necessary.

In order to get cows to a condition score 5 or above at calving may mean drying off low condition cows early so they have time to put on weight. Cows can gain one condition score in one month (1 kg lwt/day) but they will need to be very well fed (10-12 kg DM/day, ie. double maintenance) to achieve this. Normally it will take about 5-6 weeks to gain one condition score. Thus, cows in condition score 3 will need at least 10 weeks to increase condition score by 2 units prior to calving. Cows close to calving will not gain weight readily because of the requirements for pregnancy accompanied by reduced appetite. Thus, cows in condition score 3 should be dried off 2-4 months before calving and cows in condition score 4, 2-3 months before calving and fed well. It is important to allow enough time and feed for cows to gain the weight.

Efficient feeding is basically accurate rationing of feed to each cow in the herd. This can only be achieved with complete success by feeding on an individual basis which is impractical under free grazing conditions. However, the general principle applies that the smaller the number of cows in the group, the more efficient the feeding.

Once the herd is completely dried off, groups of cows with similar feed requirements should be established and fed to requirement. Group criteria may be age, liveweight, condition and calving date. Cows can be re-allocated between groups over the dry period as cow condition and feed requirements change.

For example, if a herd of 100 cows, with feed requirements per cow evenly distributed from 4-10 kg DM/day was fed their average requirement of 700 kg DM (7 kg each) in bulk, then roughly 50 would be underfed and 50 overfed. Adequate feed for all stock would be obtained by feeding at the upper level of 10 kg per cow - resulting in an overfeeding of 300 kg DM per day.

If the same herd was split into two groups of 50 (based on bodyweight or condition score), the individual feed requirements in each group would range from 4-7 and 7-10 respectively. Adequate feeding would then be achieved by feeding 350 kg total DM and 500 kg total DM = 850 kg DM - so that unnecessary overfeeding would be reduced to 150 kg DM/day.

An accurate profile of feed requirements over the dry period can be calculated with the accurate identification of numbers and groups of cows and their daily requirements. This in turn can be compared with the amount of feed reserves on hand at the start of the dry period (pasture on hand, agistment, crop, hay, silage) plus the anticipated pasture growth. The result will be a feed ‘budget’ (see Chapter 9) giving the supply and demand situation in feed terms. With spring calving herds, feed planning is most essential during the non-milking period when the feed supply is most limited and critical. Fortunately, this is also the time when it is most practical because the cows are dry.

Chapter 6 Management and Feed Utilisation

Learning objectives:

To understand:

1. ***How stocking rate influences pasture utilisation.***
2. ***The effect of calving date and calving spread on the herd's capacity to harvest seasonal pasture growth.***
3. ***The critical nature of drying off date and how to make this decision.***
4. ***How the above factors are aimed at maximising returns by increasing pasture utilisation through grazing practice and fodder conservation.***

POTENTIAL PASTURE UTILISATION

At ERDS, the amount of pasture utilised per year varies from 6,000 kg DM/ha (dryland) to over 20,000 kg DM/ha (irrigated). ERDS has set the target of utilising an average of 20,000 kg DM/ha under irrigation and an average of 12,000 kg DM/ha under dryland conditions.

POTENTIAL COW PRODUCTION

The average Tasmanian Friesian cow is genetically capable of producing 440 kg MS/lactation (250 kg MF). However, aiming to achieve this level of production per cow is not as efficient as aiming for high production per hectare. Aiming for high per cow production reduces pasture utilisation and often involves the use of high levels of supplements. It can also cause problems with getting the cow back in calf, often resulting in her being culled. On an all-grass, dryland farm, aim for a production of 315-350 kg MS/cow/lactation (180-200 kg MF) which maximises production per hectare and reproduction.

If production is below 280 kg MS (160 kg MF), either stock is poorly grown, cow genetic merit is low, cows are being forced to graze too hard or pasture is of poor quality. If production is above 385 kg MS (220 kg MF), cow genetic merit is either well above average or, more likely, luxury feeding is occurring which leads to excess wastage of pasture.

Where a substantial area of pasture is irrigated (more than one-fifth of a hectare per milking cow), or on swamp land in the Circular Head area, average production of 350 kg MS/cow (200 kg MF) should be achievable. This is because of greater lactational persistency (longer lactation) as well as higher daily feed intake in quantity and quality over summer.

High pasture utilisation and production per hectare will always involve compromising production per cow. Having high production per hectare is more profitable than achieving high production per cow.

POTENTIAL TO IMPROVE MILKSOLID PRODUCTION

With a knowledge of potential pasture production and the most desirable level of production per cow, we can speculate on the potential milksolid production for various areas. From ERDS data, we know that it takes 4,200 kg DM (pasture)/year to support a cow producing 315 kg MS (180 kg MF) and running no replacement stock.

Elliott Research and Demonstration Station
Dryland
Growing 12,000 kg DM/ha

12,000 kg DM/ha/yr ÷ 4,200 kg DM required/cow/yr = 2.9 milking cows/ha

or

2.9 cows/ha × 315 kg MS (180 kg MF) = 914 kg MS/ha (522 kg MF/ha)

Irrigation
Growing 20,000 kg DM/ha:

20,000 kg DM/ha/yr ÷ 4,700* kg DM required/cow/yr = 4.3 milking cows/ha

or

4.3 cows/ha × 350 kg MS (200 kg MF) = 1,505 kg MS/ha (860 kg MF/ha)

* higher DM requirement because cows are producing 350 kg MS rather than 315 kg MS.

These figures give some idea of potential production under highly efficient pasture management systems. The key element to obtaining these targets is high utilisation of feed grown. The critical periods that determine total annual pasture utilisation are spring and autumn. Optimal rates of utilisation will be possible only if pasture genuinely surplus to animal needs is conserved.

OPTIMISING PASTURE UTILISATION

Providing optimal conditions to grow pasture goes part-way towards high pasture utilisation, the final step in the chain is to convert as much of this pasture to milk as possible. This means efficient feed utilisation. Figure 1.1 demonstrated the importance of high pasture utilisation, as there is a direct link between pasture utilisation and Gross Margins. There are two areas that need to be considered to optimise utilisation:

- Efficient harvesting by livestock ie. use most of the pasture grown.
- Efficient conversion of feed 'harvested' to milksolids ie. animal performance.

On an annual basis, utilisation of pasture is affected by four key management policies. These are:

1. Stocking Rate
2. Calving Date And Spread
3. Dry-Off Date (Or Length Of Lactation)
4. Matching Feed Demand And Feed Supply

In this section we will consider the influence these factors have on the feed availability/requirement curve.

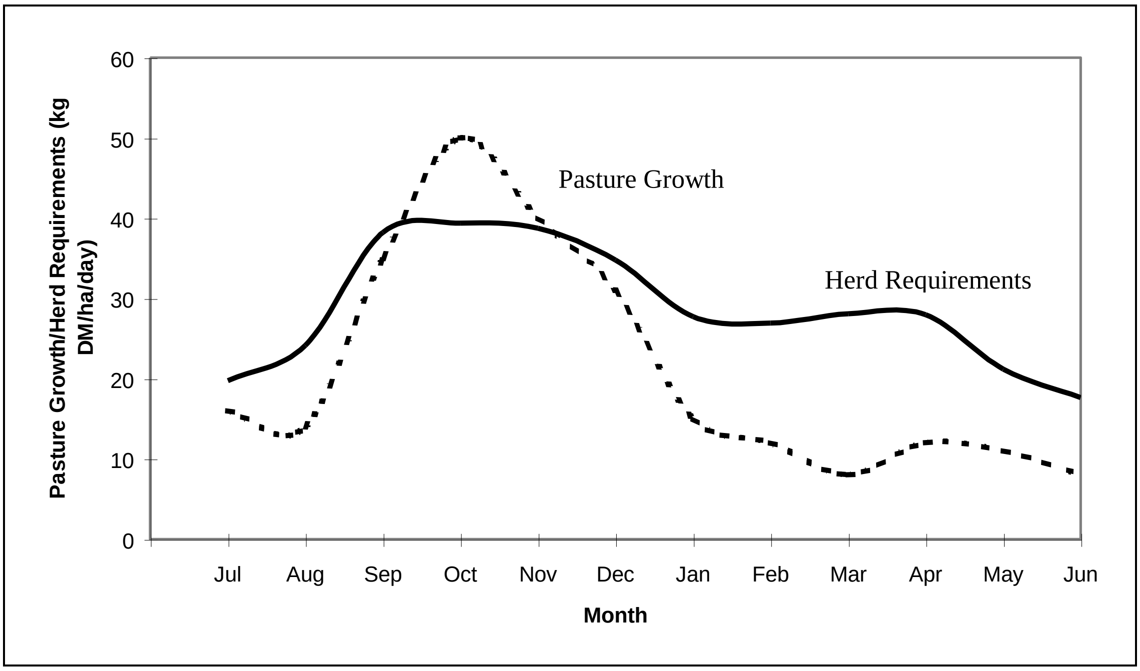

Figure 6.1 Pasture growth compared to herd requirements from the dryland, wintered on, spring calving farmlet stocked at 2.5 milking cows/effective milking ha, Elliott Research and Demonstration Station.

1. Stocking Rate

Stocking rate has a powerful effect on pasture utilisation with the amount of pasture eaten per hectare increasing with an increase in stocking rate. Research has shown that the amount of pasture eaten can increase by more than 3 tonnes of DM per hectare as the stocking rate increases from 2.76 cows/ha to 4.28 cows/ha (Figure 6.2). This is an increase from 68% utilisation to 87% utilisation of pasture grown. While an increased stocking rate can reduce production per cow it results in increased pasture utilisation and production per hectare

At very low stocking rates (less than 1 cow/ha) increasing the stocking rate can also have a positive influence on pasture composition. Increasing the stocking rate can reduce shading caused by grass in the sward, leading to an increase in clover content. Increasing stocking rate can also promote the growth of species such as ryegrass that have been developed for use in intensive grazing systems in place of less productive species. Another follow-on effect of increasing the stocking rate is an increase in ryegrass tiller density. The number of tillers produced is dependent on the amount of light reaching the base of the sward, hence, the increased pasture utilisation created by increasing the stocking rate allows more light to penetrate and encourages tillering. A higher tiller density means a stronger, more vigorous pasture that is highly productive.

Also, a higher stocking rate helps to maintain pasture quality in spring by keeping pasture in the vegetative growth phase for longer.

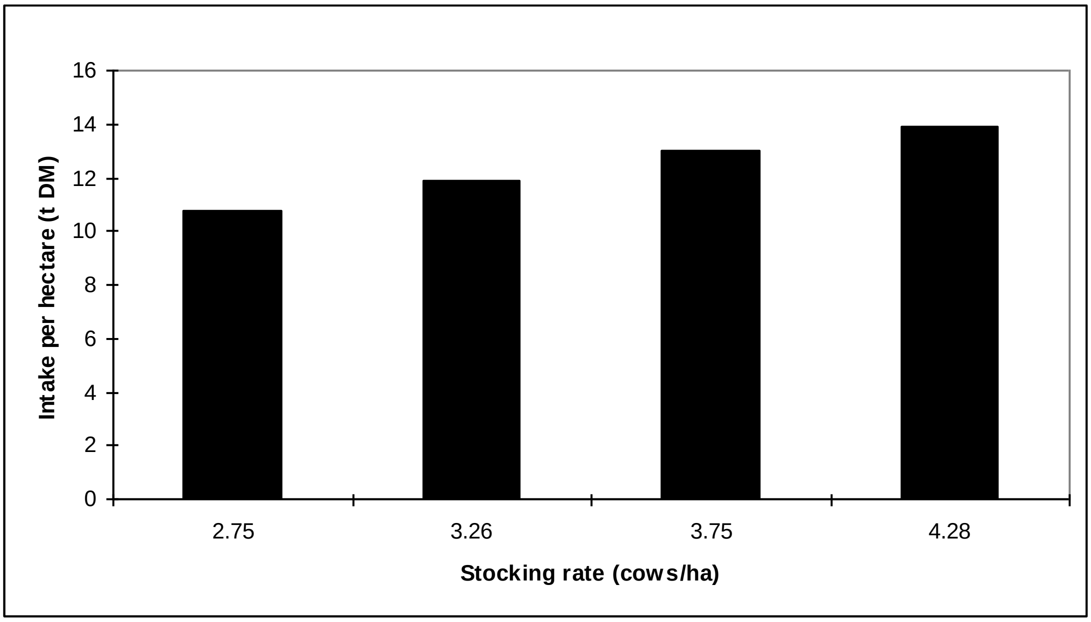

Figure 6.2 The effect of stocking rate on intake per hectare. Source: Holmes and Parker, 1992[1].

A negative effect of increasing the stocking rate is the damage that can be done to the soil. If a soil is prone to pugging damage, increasing the stocking rate may exacerbate the problem. To reduce this impact, the use of sacrifice paddocks or feed pads may be necessary.

Another factor that needs to be taken into account when deciding to increase stocking rate is the removal of nutrients. Increasing the stocking rate increases the quantity of pasture harvested per hectare, and thus the amount of nutrients lost from the system. Dairy cows are responsible for the removal of significant amounts of phosphorus, potassium, and in some situations, sulphur. Maintaining pasture nutrient levels under higher stocking rates requires a higher input of fertiliser.

Farms differ in their stage of development and potential productivity. Rather than increase stocking rate and hope for the best, a better and safer, option is to construct a feed plan to see what adjustments to stocking rates can be made the following year, aiming to achieve production within the 280-350 kg MS/cow/year range (160-200 kg MF).

2. Calving date and spread

In an environment, such as Tasmania, with such a marked seasonal fluctuation in pasture growth - 50% of total annual pasture growth occurs in two months of spring - calving date is a crucial factor determining efficiency of production. Studies at ERDS and elsewhere indicate that average calving date should not be more than one month away from the onset of spring growth (when cows begin to leave visibly more pasture residue after grazing - at ERDS this is usually in early September). As well as this, it is important that the calving spread is relatively short; 15-20 days to calve 50% of herd.

[1] Holmes, CW & Parker, WJ. 1992. Stocking rate and its effect on profitability. Dairyfarming Annual, Massey University, New Zealand. 49: 4-14.

Onset of spring growth

There are a number of factors that may alter the onset of spring growth:

- Pasture species vary in seasonal growth pattern. Ryegrass usually commences growth before cocksfoot. Soft grasses like Sweet Vernal and Brown Top commence growth after ryegrass but show very rapid growth for a short period.
- Heavy infestation of corbies or cockchafers can delay onset of spring growth either through less vigorous plants (damaged root system) or changed pasture composition (from ryegrass to other grasses and weeds).
- Grazing to 1000 kg DM/ha (2 cm) in autumn/winter leads to more tillers in spring and should improve growth. Alternatively, if the period between grazing is less than 2-2.5 leaves per tiller (25-30 days) and grazing is hard (residuals less than 3 cm) during August/September, the onset of 'spring' can be severely delayed. This is why rotations of 15 to 20 days are not recommended until spring proper (October/November).
- Nitrogen application between May and August may enhance the onset of spring growth.

The importance of pasture cover at calving

Research has shown that for every 100 kg DM/ha increase in average pasture cover (APC) at calving an increase in milk production of 17.5 kg MS/ha (10 kg MF/ha) can be expected (Figure 6.3). This is due to a combination of higher intakes and higher pasture growth rates.

The benefits of a higher APC at calving will only be realised if there are enough stock to eat the extra feed. Hence, it is useful to do a feed budget (see Chapter 9) and work out how much feed is required after calving. Applying nitrogen fertiliser after calving can greatly increase pasture growth rate and decrease the average pasture cover required at calving. If pasture growth can keep up with animal demand after calving, there is no need to have an APC of more than 1,800 kg DM at calving.

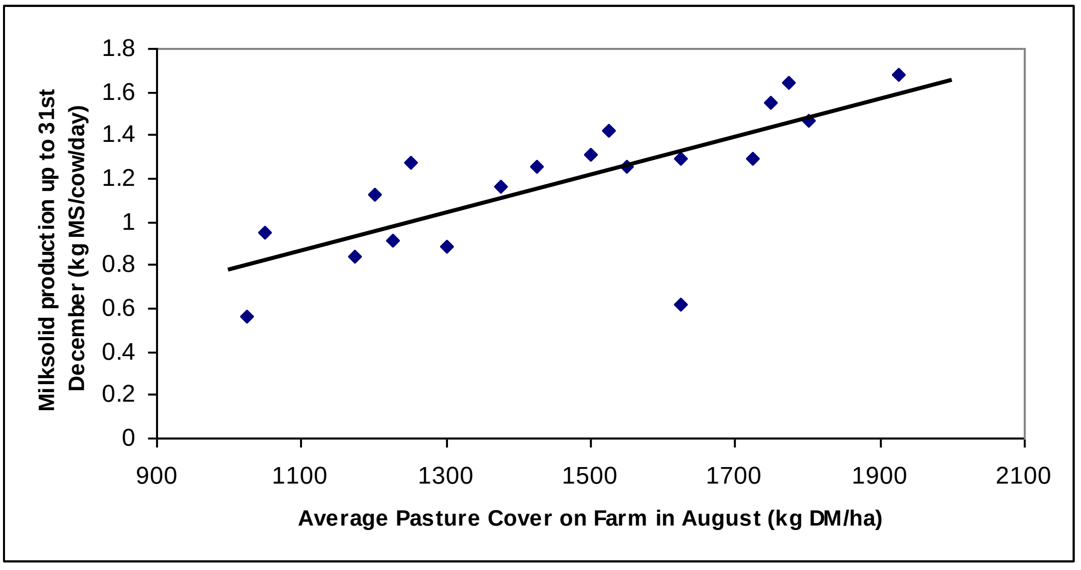

Figure 6.3 The relationship between pasture availability and milksolid production in early lactation (3 year average).

Calving too early: If calving begins before the optimal date, there will not be enough pasture to sustain high milk production. Figure 6.3 shows the effect of low pasture cover at calving on production.

As well as the effect on milk production, calving too early also affects pasture growth rates. Because of the low pasture cover, the rotation tends to be fast which means that pasture is grazed too hard and too often. This prevents the pasture from reaching Phase 2 (see Chapter 3) of pasture growth where maximum growth rates occur.

If calving does occur too early and there is not enough pasture, there are several options:

- feed supplements - grain, fodder crops and high quality silage (above 70% digestibility) are the only supplements capable of sustaining high production
- accept lower production
- accept a heavy loss of cow condition - the willingness of cows to lose body condition will depend on their condition at calving and genetic merit. Figure 6.4 demonstrates that cows with a higher condition score will lose more condition after calving, that is, they partition more energy toward milk production than those with a lower condition score.

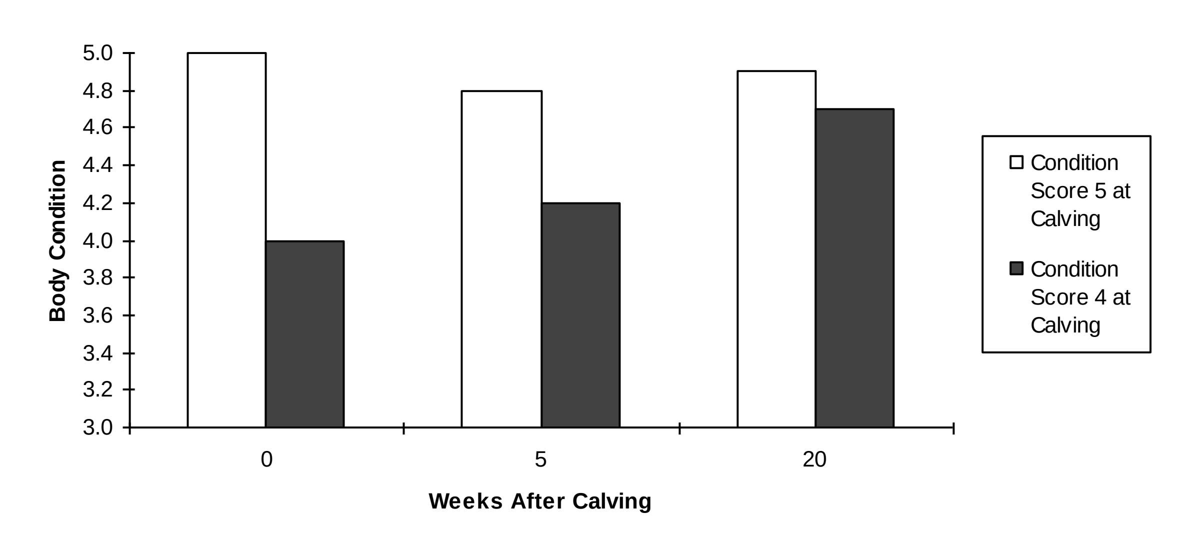

Figure 6.4 Change in body condition after calving relative to condition at calving.

Calving too late: Calving later than the desirable date means that some cows will 'miss' the spring flush of pasture growth resulting in the herd reaching unacceptably low production before the onset of dry summer conditions. In addition to this, the amount of surplus pasture required to be conserved usually increases and profitability declines.

3. Dry-Off Date

Dry-off date depends on cow condition, APC, pasture growth rates, time of calving and pasture cover required at calving. Drying off a cow that is producing 10 litres of milk per day halves her feed requirements. Therefore, drying off can make scarce feed go twice as far.

Cow condition

Ideally cows should be dried off in the desired calving condition, between condition score 5-5.5. This is because it is extremely difficult to improve condition over winter. Furthermore, lactating cows are more efficient at converting feed to body reserves than dry cows. In other words, if adequate feed is available towards the end of lactation, build condition; if not, dry off. Remember that six weeks of ad lib feeding are required to add one condition score.

Time of calving
Cows require time to rejuvenate their milk secretory system prior to the start of the next lactation. Six weeks is the minimum amount of time required to do this. It has proven to be false economy to rob cows of an adequate dry period in order to gain winter milk premiums.

Pasture cover
Some farmers monitor pasture cover on their farms on a weekly or fortnightly basis. This simply means walking over each block with a pasture meter (taking 40 - 50 readings/block) and calculating average pasture cover on the farm. The pasture cover can be compared to a feed budget to give a guide on when to dry off cows based on pasture cover required at calving.

4. Matching feed supply and demand

The shape of the feed availability curve (Figure 6.1) can be changed substantially, to better match supply and demand. This can be achieved by various systems of pasture management including:
(a) Conservation of grass as hay and/or silage.
(b) Substitution of current grass production by growing a forage crop that can be fed later.
(c) Use of nitrogen fertiliser.

(a) Fodder conservation
The concept of conserving genuine surplus pasture in spring is different to past practice of ‘locking up’ a set area in anticipation of yearly hay or silage requirements. ‘Locking up’ in a good spring leads to excess waste on the remaining grazed area, whilst in a poor spring, cows are underfed. To conserve a genuine surplus, blocks not required for immediate animal requirements, are ‘skipped’ or ‘dropped’ out of the grazing sequence. In this way, silage conservation is used as a pasture management tool with blocks dropped out of the rotation in order to keep pressure on the remaining grazing area so that post-grazing pasture residues do not exceed 5-6 cm (1,500-1,600 kg DM/ha).

How well this system works depends on the ability of the manager to estimate herd requirements (or what pasture is genuinely surplus to cow requirements). This decision can be made easier by realising that cows can graze down to 5-6 cm without significantly depressing per cow production. Use post-grazing residues as the basis for how well the herd is being fed. If the cows are leaving behind residues longer than 5-6 cm and there are lots of ‘clumps’ in the pasture, they are being offered too much pasture. A residual shorter than 5-6 cm indicates that the cows are still hungry and milk production is likely to be suffering.

At ERDS blocks are dropped out of the rotation towards the end of September, although these blocks may not have been grazed since early August. Figure 6.5 illustrates the meaning of ‘dropping blocks’ out of the rotation in order to conserve fodder genuinely surplus to immediate cow requirements.

Example farm of 30 blocks

Block No.	1	2	3	4	5	6	7	8 etc.
				Dropped for silage				
	↓	↓	↓				↓	
Post-grazing residue (kg DM/ha)	**1,450**	**1,500**	**1,700**				**1,700**	

Figure 6.5 Example of dropping blocks for fodder conservation.

- The farm is split into 30 blocks and one block is fed each day (the rotation length is 30 days).
- Blocks 1 and 2 have just been grazed, and cows left residues of 1,450 to 1,500 kg DM/ha.
- Block 3 was grazed and 1,700 kg DM/ha was left behind. The pasture was clumpy.
- Blocks 4, 5 and 6 are dropped out of the rotation, the time since last grazing on block 7 is then reduced to 27 days. If the growth rate is not higher than the previous grazing rotation, then the cows will receive less feed.
- Block 7 was grazed and residues were again 1,700 kg DM/ha, so that another 3 blocks were dropped and rotation length reduced to 24 days. If the residual was 1,400-1,500 kg DM/ha we would have continued on the present rotation for several more days.

The ability to graze to 1,500 kg DM/ha in early spring without substantially affecting cow production depends mainly on two things:

Previous grazing. Grazing management in August/September sets up pasture quality for the rest of the season. Lax grazing in early spring means that there will be a lot of residual pasture remaining. As the season progresses, this residual pasture becomes rank and unpalatable. Cows will avoid eating this rank pasture, intakes will drop and milk production will be compromised. Also, longer residues increase the level of shading which leads to a reduction in tillering in spring. As a result, the pasture in late spring-summer is sparser and so there is less feed available for the cows later in the season.

Species mix. If blocks are grazed to suit ryegrass and clover, other species, like cocksfoot, may escape grazing and become rank. Hence, species that do not have complementary growth patterns should not be sown together.

Another way to determine how much pasture is genuinely surplus to requirements is to use an accurate and up-to-date feed budget. From the feed budget the predicted growth rate can be compared to feed requirements and the surplus calculated as in Table 6.1.

Table 6.1 Example: Using a feed budget to calculate the percentage of the milking area that can be used for fodder conservation.

Area to be conserved for fodder conservation	
Predicted growth rate	60 kg DM/ha/day
Stocking rate	2.5 cows per hectare
Requirements per cow	15 kg DM/cow/day
Daily requirements/ha	2.5 × 15 = 37.5 kg DM/ha/day
Percentage of pasture needed for immediate feed requirements	37.5 ÷ 60 × 100 = 63%
Percentage of pasture that can be used for fodder conservation	100 - 63 = 37%

From the above example, if the milking area was 230 ha, 85 ha (37% of 230) could be locked up for fodder conservation.

(b) Growing a fodder crop

There are many different fodder crops that can be grown in Tasmania including brassicas, annual ryegrass, and oats. The choice of which to grow will depend on how long they take to mature, how many grazings are required and the fertility status of the paddock.

Deciding whether to grow a fodder crop should be thought about carefully with regard to the costs and benefits. In a good year, when there is plenty of feed, fodder crops grow well but in a bad year, the fodder crop is often low yielding, resulting in a loss.

Fodder crops can be very useful when used as part of a pasture renovation program. The fodder crop acts as a break crop between the old pasture and the new pasture. This reduces the competition from weeds when the new pasture is sown.

(c) Using nitrogen

Nitrogen fertiliser can be used to boost pasture growth but will not help plants that are not growing. For nitrogen applications to be successful, the grass has to be in a growing state. If the grass is not growing, the plants will not take up the nutrient. The response that can be obtained from applying nitrogen depends on numerous factors such as:

- soil fertility
- soil temperature - should be above 8°C
- type of plants
- soil moisture
- sunlight

Each of these factors influences the growth rate of plants and hence the uptake of nitrogen.

Nitrogen should be applied soon after the cows have been removed from a paddock to give the grass the maximum amount of time to grow before being grazed again.

Using nitrogen to fill a feed gap can be a cheap option compared to other supplements. However if the extra pasture grown is not fully utilised it becomes expensive.

STORAGE OF ENERGY AS COW CONDITION

Storing energy as cow condition when there is plenty of feed and later underfeeding to utilise this is another way of overcoming feed gaps. However this is a less efficient use of feed than converting the feed directly to milksolids. A considerable proportion of the energy content of the feed (15%) is used in converting it from body fat back into milk production. Cows that are fed pasture as a high proportion of their diet are not physically able to consume enough energy in early lactation to satisfy production and maintenance requirements. Therefore, expect cows to lose weight in early lactation (and this weight loss will be greater as genetic merit increases). This expected weight loss must therefore be held in reserve as cow condition. It is recommended that the herd calve at or above an average condition score of 5 (all cows in the herd should be between a condition score of 4.5 and 5.5) to prevent major reductions in early lactation production.

Chapter 7 Cow Grazing Performance

Learning objectives:

To understand:

1. ***How the quantity and the quality of the cow's diet directly effects the performance of the grazing cow.***
2. ***How animal behaviour relates to the amount of pasture consumed and total production per hectare.***

The performance of any grazing animal is dependent on a number of factors. Primarily, the amount and quality of pasture and supplements being fed, the stocking rate, and the ability of the pasture to regrow after grazing. An understanding of the dairy cow's grazing behaviour is useful in making on-farm management decisions.

EFFECT OF PASTURE ALLOWANCE ON INTAKE

The amount of pasture offered to grazing animals directly affects the amount of pasture eaten. A large allocation means that bite size (the largest determinant of intake) is maximised and cows do not have to work hard to achieve high intakes. To be fully fed cows need to be offered around 4 times what they are capable of consuming which results in wastage of pasture. This is the basis of the dilemma between high cow intake (maximising production per cow) and efficient use of pasture (maximising production per hectare).

Low allocations of short pasture means that the cow's bite size is reduced so the cow must work harder to eat the pasture. Pre-grazing pasture covers of 1,600 kg DM/ha mean the cow will spend more time grazing (take more mouthfuls) to compensate for the fact there is less in each bite. Often the extra time spent grazing does not fully compensate for the smaller bite size and so intake falls. Intake also falls when small areas of pasture are offered to the herd. In both cases high pasture utilisation and relatively little wastage are achieved.

Intake and Pasture Allocation

The intake of the herd is far more complicated than might first be thought. If for instance we have a paddock with enough pasture to fully feed the herd for a single grazing and we allocate one quarter of the paddock for the day, intake would be highly restricted, the pasture grazed very hard and milk production would be poor. Obviously the cows are being severely underfed in this case and to increase production it is necessary to increase pasture allocation.

As the amount of pasture offered to cows increases they put less effort into grazing and this becomes increasingly so as cows get close to being fully fed. The obvious result of this in the paddock is large amounts of pasture being left ungrazed.

Research has shown that when cows are offered a quarter of their daily pasture requirement, they use close to 70% of the feed offered. When this was increased to half their daily requirement, 45% of the feed was utilised. As feed intake reached three quarters of feed requirements, they consumed 30% of the feed offered and by the time they were fully fed cows used only 25% of the pasture offered.

One of the consequences of achieving high per cow production from grazed pasture is that the herd must be offered much more than they can eat, and as a result, a large amount of feed is wasted. If the quality of the feed left behind remained unaltered between grazings this would not be a problem as the cows could consume it at a later date. However, this is not the case. Ungrazed plants decay and/or develop reproductive tillers or become stemmy, all of which result in a drop in pasture quality.

Pasture ungrazed during the previous rotations is less palatable, cows prefer not to graze these areas so the problem becomes self perpetuating. These areas are commonly seen as clumps in the pasture sward. Feeding to obtain high per cow production results in a reduction in pasture utilisation, declining quality, and eventually a reduction in animal production if mechanical means are not used to maintain quality (eg. topping).

The problem, therefore, is to achieve a compromise between the amount of pasture utilised and production per cow. After grazing, pastures need to be in a state that will result in good quality feed being on offer at the next grazing. One option would be to increase the grazing pressure and leave less behind after the cows have grazed. This can be achieved by offering the herd a smaller area or by putting more cows in the same paddock (that is, increasing stocking rate).

The example in Table 7.1 illustrates the effect of increasing stocking rate on the utilisation of, and production from, a constant amount of pasture. Say we allocate 60 kg of pasture DM to cows stocked at 1, 1.5 and 2 cows/ha. As the stocking rate increases the amount of pasture wastage is reduced. This is because the proportion of the 60 kg DM consumed by the cows has increased. However, this will not automatically result in an increase in milk production because as stocking rate increases so too does the proportion of pasture consumed as maintenance. In the example, a stocking rate of 1 cow/ha on 60 kg of pasture resulted in 1.8 kg MS (24 litres of milk), 1.5 cows 2.3 kg MS (30 litres) and 2 cows 2.4 kg MS (32 litres of milk). In this example increasing stocking rate increased the amount of pasture eaten, decreased production per cow but increased total milk production.

Table 7.1 Effect of offering 60 kg of pasture DM/day to different numbers of cows.

Number of Cows	**1**	**1.5**	**2**
Kg DM eaten/cow	18	16	14
Total eaten/day	18	24	28
Less maintenance requirement/ha 6 kg DM/Cow/Day	6	9	12
kg DM left for MS production/day	12	15	16
Milk production (kg MS/ha/day)	1.8	2.3	2.4

While the figures in Table 7.1 are true for a particular amount of pasture, something different is frequently observed when cow numbers are increased on a farm. Quite often, an increase in production per cow results as cow numbers increase. This can be attributed to the fact that the extra cows eat more pasture and so there is less decaying material in the pasture. The resultant improvement in pasture quality increases production per cow. This is generally only the case at very low stocking rates, and production per cow will fall if no additional inputs are used in most cases where stocking rates exceed 1.5 cows/ha.

At low stocking rates high production per cow will often occur even though pasture quality is on average very low. This is because at very low stocking rates cows have the opportunity to be highly selective and graze the high quality areas within a pasture ignoring the low quality areas. Cows produce well because what they do eat is high quality, which is all right while there is plenty of feed to choose from but it does increase the average cost of pasture consumed dramatically. Once pasture growth rates slow, cows are forced to eat the lower quality pasture and milk production begins to drop despite high intake. To reduce this effect, it is common for high-energy supplements (eg concentrates) to be fed to reduce the decline in milk production or for topping of pastures to occur. Both of these strategies result in wasted pasture and decreases the profitability of the grazing system.

Chapter 8 Estimating Feed Quantity and its Allocation

Learning objectives:

To be able to:

1. ***Calculate the amount of feed in a paddock and the proportion available to cows.***
2. ***Calculate herd requirements at different times of the season.***
3. ***Calculate the area the herd needs to graze for one day to satisfy their requirements.***
4. ***Plan feeding strategies for different times of the season.***

PASTURE ASSESSMENT

The ability to accurately assess the quantity of pasture available is a major part of feed budgeting. It is also the most prone to error. Generally the amount of feed in a paddock is expressed in terms of herbage mass. This is the total plant material above ground level and includes dead and live material (leaf, tiller and stalk material), that is, kg DM/ha.

Measuring and estimating pastures

There are four ways to estimate the amount of pasture (kg DM/ha) in a paddock:

1. Use a rising plate meter.
2. Use an electronic probe.
3. By eye (eyeball technique).
4. Take pasture cuts and weigh them.

The plate and the probe are very useful in helping to cultivate eye assessment of pasture. If used properly, both are accurate and very quick.

Using the rising plate meter

Most plate meters measure in ½ cm increments so the average reading must be divided by two to convert back to centimetres.

A rising plate meter is very easy to use once you get the hang of it:

- Read and record the starting reading eg. 25,000.
- Take at least 50 measurements across the paddock then re-read and record the meter reading eg. after 50 measurements the gauge might read 25,670.
- The difference is 670 (25,670 - 25,000).
- Divide by the number of measurements taken, in this case 50 (670 ÷ 50 = 13.4).
- Divide by 2* to convert to centimetres (13.4 ÷ 2 = 6.7 cm.)
  *plate meter measures in ½ cm increments

Average calibration equations for the rising plate meters (Massey or Ellinbank meters) for well-utilised dairy pasture in Tasmania can be used in most situations and are as follows:

- **Autumn, winter, spring (April to November) + irrigated pasture**
  Herbage mass (kg DM/ha) = 250 × average meter reading (cm) + 500
- **Summer (December to March) dryland pasture**
  Herbage mass (kg DM/ha) = 320 × average meter reading (cm) + 500

In this example, 250 × 6.7 + 500 = 2,175 kg DM/ha.

Using the electronic probe
The electronic pasture probe is easy to use. It gives a fast result but is no more accurate than the rising plate meter under most conditions. The results can be down-loaded on to computer for use in some pasture management programs. The main drawback is the purchase cost and that it doesn't work well in wet conditions.

Using the eyeball technique
With practice a high degree of accuracy can be obtained by visual assessment ('eyeballing') if these assessments can be calibrated against pasture of known herbage mass using the pasture meter, probe or cut quadrats.

Pasture cuts
On farm, another assessment of DM mass can be obtained by simply harvesting herbage in a 50 cm × 50 cm square area selected to be average for the paddock. Weigh this on kitchen scales and multiply by 0.15 (ie. average DM = 15%) and then multiply by 40 to convert from grams per 0.25 m² to kg DM per ha. Cutting to ground level will provide a measure of total DM. In grazed pastures a large number of quadrats need to be cut to get a reliable estimate of average yield and this is very time consuming. However, pasture cuts are very useful for calibrating the eye and plate meter periodically.

When it comes to making effective day-to-day decisions on pasture management, there are four key measurements that need to be made:

1. Average pasture cover
2. Pasture available for consumption
3. Feed requirements of the herd
4. Expected pasture growth rates

1. Average pasture cover (APC)

Average pasture cover is a measure of the amount of feed on the farm. It can be likened to the amount of money in your bank account. Pasture growth and supplements are deposits and stock demands are withdrawals. If you take more money out of the bank than you put in each month then you run your balance down. This is fine if you have a surplus or there will be large deposits in the next month but you soon find yourself in trouble if withdrawals are more than deposits for an extended period. The same can be said for APC.

The APC is measured in kg DM/ha and is determined by calculating the cover on each paddock (as measured by the plate meter, probe, pasture cuts or eye), multiplying by the area of each paddock, adding all these together and then dividing by the total area (Table 8.1). It is not the average over one paddock. It is important to take account of differences in paddock size or the figure will be distorted.

Table 8.1 Example of APC calculation.

Paddock	Area (ha)	Pasture cover (kg DM/ha)	Pasture cover × area (kg DM)
1	1	2,500	2,500
2	1	2,200	2,200
3	1.5	1,900	2,850
4	3	1,700	5,100
5	1	1,400	1,400
Total	7.5		14,050

The APC is found by dividing the 'total pasture cover × area' by the 'total area' (14,050 ÷ 7.5 = 1,873 kg DM/ha).

Rapidly estimating average pasture cover: If you have a lot of paddocks, working out the average pasture cover can take several hours. It can be estimated quickly by taking the average of the five paddocks with the most feed and the five paddocks with the least feed. This is usually quite close to the mark.

2. Amount of pasture available for consumption

Once the total amount of pasture in a paddock is known, the amount available to the cows can be determined quickly and easily. All we need to know is the desired post grazing residual ie. how much pasture should be left in the paddock after the cows have grazed it.

Generally speaking, at any given time of year, the more pasture left behind in a paddock the more the cows will have eaten (Figure 8.1) and the higher their milk production will be. This is because, as pasture is grazed progressively shorter, the cow's bite size is reduced which reduces intake. Bite rate and grazing time are usually unable to be increased sufficiently to overcome this, therefore total intake declines.

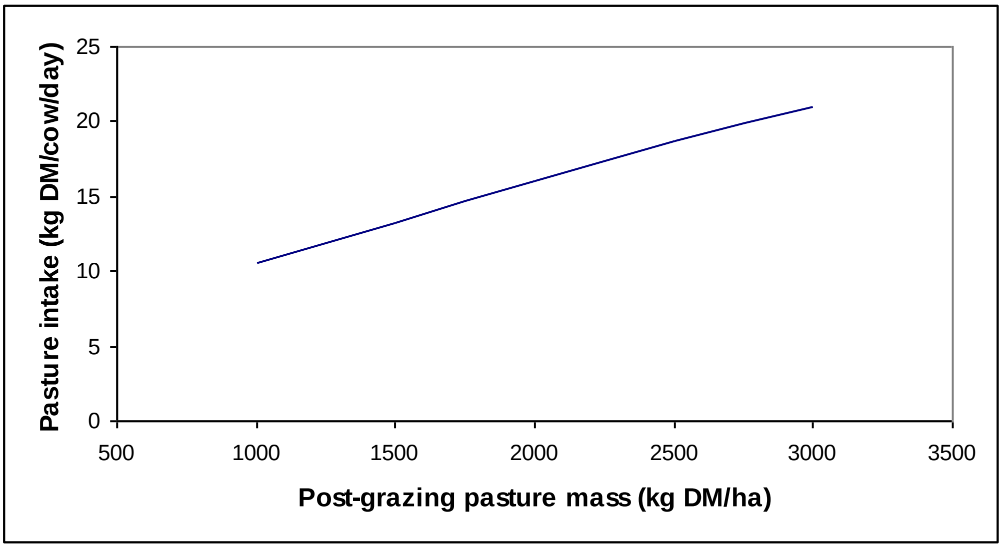

Figure 8.1 The influence of post grazing pasture mass on pasture intake of lactating cows (500kg liveweight).

When the herd is at peak lactation we want the cows to eat as much as possible (without letting pastures get rank) so the amount left after grazing should be high (1,500 - 1,600 kg

DM/ha). In late lactation, as production declines, the herd can graze down harder (leaving 1,300 kg DM/ha) as they do not need to eat as much. This also helps prepare for the autumn break. If pasture is not grazed down prior to the autumn break the pasture may 'get away' and quality will be compromised. Dry cows can graze to 1,000 kg DM or lower if they are not required to gain weight. The amount of feed available can be easily calculated and is illustrated in Table 8.2.

Table 8.2 Calculating the amount of pasture available per hectare at different times of the year/stages of lactation (spring calving).

Time of the Year (stage of lactation)	Pre-grazing Pasture Mass (kg DM/ha)	Post Grazing Pasture Mass (kg DM/ha)	Pasture Available (kg DM/ha)
Spring (early lactation)	2,500	1,500	1,000
Autumn (late lactation)	2,500	1,300	1,200
Winter (cows dry)	2,500	1,000	1,500

Now that we can confidently estimate the amount of feed in a paddock, we have to look at how much feed the cows need to eat. Then we can calculate the area they need each day.

3. Calculating feed requirements

From chapter 5 we know that feed is required to meet the cows' maintenance, milk production, bodyweight and pregnancy requirements and that these requirements vary with the age and state (early lactation or dry) of the animal and the time of the year (summarised in Table 5.4).

Example: How much feed do your cows need for one day?

If a herd of 300 Friesian cows is producing 1.8 kg MS/day (24 litres of milk with 4.2% MF & 3.6% protein), is in the 4th month of pregnancy and is not changing weight. How much feed do you need?

Table 8.3 Example calculation of feed requirements.

Requirements (kg DM/day)	
Maintenance	6 kg DM/cow/day
Milk 1.8 kg MS x 6.5 kg DM	12 kg DM/cow/day
Weight gain	0
Pregnancy	0
Total	18 kg DM/cow/day
Total for the herd	300 x 18 = **5,400 kg DM/day**

4. Pasture growth rates

Pasture growth is measured in kg DM/ha/day. In winter the growth rate usually varies between 0 and 20 kg DM/ha/day and in spring the growth rate peaks between 50 and 150 kg DM/day. As a rule, areas with harsher winters will have higher growth rates in the spring because of the release of nitrogen that has been stored up in the soil over the winter. This is a management problem because it makes matching the pasture demand with supply more difficult and means fodder conservation will be a much bigger part of the equation than it is in milder climates.

Calculating growth rates on your farm: Growth rate data is available for most districts (Table 8.4) but should only be considered as a rough guide for any particular farm because of the inherent variation between properties and seasons.

Table 8.4 Average dryland pasture growth rates for a number of Tasmanian districts (kg DM/ha/day).

Month	Mella	Brittons Swamp	Kimberley	Lileah	Caveside	Yolla	Elliott	Flowerdale
January	29	33	23	28	18	25	25	16
February	22	23	8	12	13	10	9	3
March	28	17	13	13	16	10	5	1
April	16	25	12	17	13	11	14	5
May	21	19	9	10	6	8	9	6
June	14	11	5	5	3	5	8	4
July	10	10	10	6	5	13	8	3
August	11	11	14	9	12	19	7	12
September	34	18	29	25	32	28	19	23
October	50	43	50	52	51	50	54	51
November	74	77	41	40	41	53	51	52
December	48	48	32	40	34	33	35	31

Working out the growth rates on your farm is quite easy:

- Measure the pasture after it has been grazed eg. 1,400 kg DM/ha.
- Measure again before grazing eg. 2,400 kg DM, a difference of 1,000 kg DM.
- Divide this by the number of days between measurements eg. 23.
- The average growth rate is 43 kg DM/ha/day (1,000 ÷ 23).

This information can then be used as a guide for the next grazing round. After a while you will build up a file of data that can be used for feed budgeting purposes, and continually improving your accuracy.

USING THIS INFORMATION TO MAKE DECISIONS

Once all the information is gathered, it can be used to make decisions on the day to day running of the farm (Table 8.5).

Table 8.5 Example: Calculation of feed requirements and pasture available.

Farm Details	
Month	January
Number of cows	300
Milking area	110 ha
Stocking rate	300 ÷ 110 = 2.7 cows/ha
Rotation Length	20 days
Area offered per day	110 ÷ 20 = 5.5 ha
Requirements	
Maintenance	6 kg DM/cow/day
Milk 1.5 kg MS × 6.5 kg DM	10 kg DM/cow/day
Weight gain	0
Pregnancy	0
Total	16 kg DM/cow/day
Requirement per hectare	16 × 2.7 = 43 kg DM/ha/day
Pasture available	
APC	1,800 kg DM/ha
Pre-grazing mass	2,100 kg DM/ha
Post-grazing mass	1,500 kg DM/ha
Growth rate	25 kg DM/ha/day
(Growth – Requirements) =	**- 18 kg DM/ha/day**

From Table 8.5 it can be seen that the cow requirement per day on this farm is greater than the growth rate. This means that the APC will fall by 18 kg DM/ha/day. If this continued for 30 days the APC would fall by 540 kg DM/ha (18 × 30) to 1,260 kg DM/ha and the farm would be effectively out of feed for milking cows. What are the options?

Option 1: Fill the feed gap with a supplement.

Table 8.6 Example: Filling the feed gap with a supplement.

Amount of Supplement Required	
Supplement required per hectare	18 kg DM/ha/day
Supplement required per cow	18 ÷ 2.7 = 6.7 kg DM/day
Supplement required over whole farm	18 × 110 ha = 1,980 kg DM /day
Using silage @ 250 kg DM per bale	1,980 ÷ 250 = 8 bales of silage per day

To fill the feed gap with a supplement, in this example silage, will require 8 bales to be fed per day or 248 bales for the month.

Option 2: Extending the rotation and filling the feed gap with supplement.

The amount of pasture grown will be maximised if paddocks are grazed when they reach the 3-leaf stage. In the above example, rotation length is 20 days. While leaf emergence rates will vary from season to season depending on moisture and temperature, we can expect that fully irrigated pasture over summer will take 25-35 days to reach 3-leaf stage and dryland pasture will take 45-60 days to reach 3-leaf stage. The rotation length should be extended to match this. In this way, the amount of pasture utilised will be increased and the overall need for supplement will be less.

Table 8.7 Example: Extending the rotation.

Extending the Rotation		
Leaf appearance rate	15 days	Days to 3-leaves is 3×15 days=45 days
Req. rotation length	45 days	Rotation matches 3-leaf stage
Area to be fed each day	110÷45 days=2.4 ha	Milking area divided by the rotation length
Herd requirements per hectare	43 kg DM/ha/day	How much feed do the cows require per ha/day? (from Table 8.5)
Available pasture	2,100 – 1,300 = 800 kg DM/ha	Subtract post-grazing mass from pre-grazing mass to determine available pasture
Daily intake from pasture	800 × 2.4 ÷ 110 = 17 kg DM/ha	Available pasture multiplied by the area being fed and divided by the milking area.
Amount of supplement required	43 – 17 = 26 kg DM/ha	The cows are eating 17 kg DM/ha of pasture and require 43 kg DM/ha total intake. If intakes are to be met, supplement will be needed to fill the gap.

To extend the rotation, supplement was fed and the cows forced to graze the pasture cover down further to 1,300 kg DM. This enabled the rotation length to increase from 20 days to 45 days. Although APC is lowered as residuals are lower, the extra 25 days of growth allowing pasture to grow from 2 to 3 leaves will result in more total growth than remaining on a 20 day rotation. However, if the conditions remain dry, growth rates will fall but growth will still be highest through matching rotation length to the 3-leaf stage than if the faster rotation was maintained.

Option 3: Reduce feed intake by restricting cows.

It is possible to decrease the area allocated to the cows without feeding supplements. If this restriction is severe, milk production will fall and cows may lose condition. While this is undesirable, it can be used to get through short term feed pinches and is often a better management strategy than maintaining feeding levels and running out of feed totally.

For example, at a pasture growth rate of 25 kg DM/ha/day and a stocking rate of 2.7 cows/ha, to maintain pasture cover, cows can be allocated 9 kg DM/day (25 ÷ 2.7) of pasture. This will reduce production from 1.5 kg MS (20 litres) to 0.5 - 0.6 kg MS (6-8 litres).

Option 4: Dry off/cull cows.

Another option is to decrease demand by drying off problem cows, low producers, empty or thin cows.

Other options include running the pasture cover down until another feed source is available (eg. a turnip crop) or a combination of all of the above options.

Is rotation length really important?

Rotation length is critical to achieving high pasture utilisation. Rotation length should always be determined by leaf stage with the aim being to graze pastures between 2.5 to 3 leaves.

Grazing pastures earlier than this will result in lower pasture growth rates – and you can't utilise what you don't grow.

Rotations lengths longer than 3.5 leaves will result in lower quality pasture and lower utilisation as cows will generally refuse to eat the dead matter at the base of the pasture.

Rotation length needs to be adjusted throughout the season and from season to season based on the leaf appearance rate of the pasture. This is determined by temperature and the moisture available for growth.

Chapter 9 Feed Planning

> ***Learning objectives:***
>
> ***Understand:***
>
> ***1. Feed planning is a vital part of pasture management.***
>
> ***2. How to create a feed budget.***
>
> ***3. How to choose a supplement based on energy content.***

FEED PLANNING

Feed planning is one of the main drivers of farm profit. It allows better use of the farm's feed resources by introducing a planned approach to feeding animals. The time frame for a feed plan can vary from a daily basis to a yearly basis. Short-term plans are generally called feed budgets or grazing plans, while longer-term plans are feed profiles.

Feed profiles can extend for periods of over a year and are generally used for making strategic decisions such as stocking rate, calving date and supplement policy. Feed budgets are generally used to calculate the most economic way of overcoming short-term surpluses or deficits in feed supply. An example of this might be overcoming a pasture shortfall by applying nitrogen fertiliser to increase pasture growth or by feeding a supplement (eg. silage or grain).

A feed budget will help identify periods of the year where it may be very difficult to feed the milking herd. A feed budget for an autumn calving herd may demonstrate that on average over the winter period only 5 kg DM of pasture can be supplied daily to each cow. If the cow's requirements are 15 kg per day then 10 kg must be given in supplements. It would not be possible to do this solely with concentrates (eg. grain or pellets). A source of high quality roughage must be found as part of the supplement (eg. silage or winter grass crop). Agistment of dry or young stock may enable more pasture to be fed to the milking cows.

A feed budget is an important part of any grazing management program. It is about matching feed demand and supply as much as practical and either filling the feed gaps or accepting reductions in production. The principle of feed budgeting is to work out the amount of feed on hand, how much feed the cows are likely to require over the budget period and compare this to how much is likely to grow. Informed decisions about drying off cows, using nitrogen and feeding supplements can then be made. Feed budgeting is essentially an extension of the day-to-day planning outlined in previous chapters. Where it differs from the day-to-day management is that there are targets for average pasture cover, cow condition and milk production that are worked toward.

Average pasture cover targets

It is useful to have targets for the average pasture cover to work towards and make sure that there is enough pasture on the farm at all times. An example is shown in Figure 9.1. The most important target is at break-even date ie. the day when pasture growth is equal to cow requirements, usually in spring. This usually occurs in Tasmania around late September but varies from district to district and year to year depending on climatic conditions, farm fertility, management and stocking rate. The target APC for break-even date should be about 1,700-1,900 kg DM/ha. If the APC is lower than this cows are likely to be underfed unless a supplement is used.

Another important APC target is at calving. The actual target will vary with stocking rate, calving date and calving spread, but is likely to be between 1,800 and 2,200 kg DM/ha. APC at calving should be higher than 1,800 DM/ha on spring calving farms because pasture demand is normally higher than growth during this period and APC will fall. An APC higher than 2,200 kg DM at calving is excessive and will normally result in poor quality feed or feed wastage at the first grazing. If extra feed is required just after calving it is better to increase pasture growth rates using nitrogen fertiliser than to increase the APC before calving.

It would be ideal to keep the APC between 1,800 and 2,200 kg DM/ha all year (Figure 9.1) as the cows would be well fed and pasture quality would be high. Grazing pasture at the 2.5-3 leaf stage will help to achieve this. However at certain times of the year it is possible that the APC will drop below 1,800 kg DM/ha or increase above 2,200 kg DM/ha and at these times a decision needs to be made on how to adjust the APC to bring it back in line with targets as economically as possible.

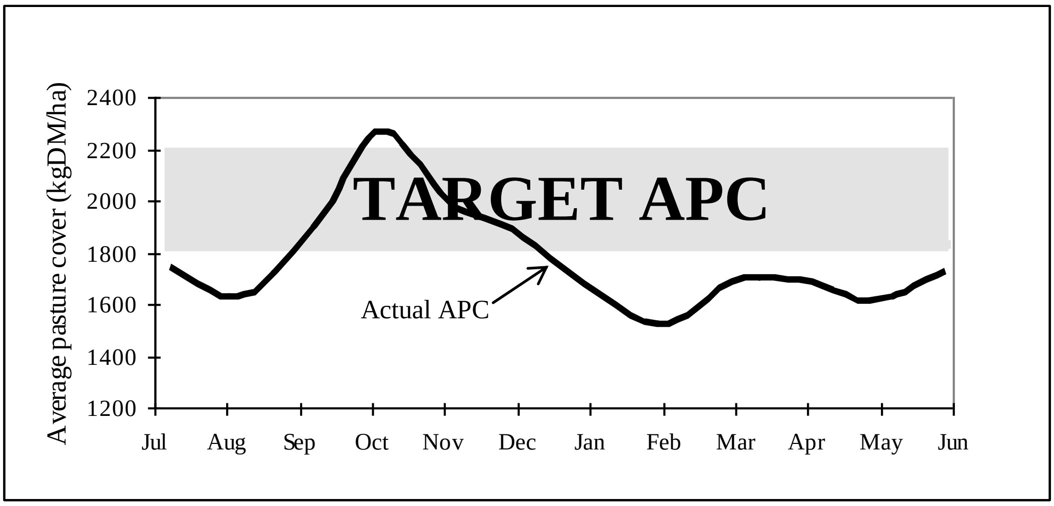

Figure 9.1 Target and actual APC for a dryland herd stocked at 2.5 cows/ha and wintered on the milking area.

Setting up a feed budget

The graph shown in Figure 9.1 indicates the times of year when there is likely to be a feed shortage or a feed surplus. Setting up a feed budget as shown in Table 9.1 provides a more accurate picture of the feed situation on the farm and also helps analyse different options to correct feed shortfalls. Feed budgets are only useful if they are monitored and updated on a regular basis and actions are implemented. The pasture growth rate is difficult to predict accurately (especially in autumn) and this is a major factor in the budget. If the budget is not updated regularly and actual growth rates are not as predicted, the results can soon become meaningless.

The feed budget shown in Table 9.1 aims to ensure there is enough feed on hand at the start of calving (August) and at break-even (September) and that all cows are fed adequately during the dry period to calve in condition score 5 or better. Supplements are added into the system to balance feed demand with pasture growth during the winter. Everything is converted back to a per hectare basis to make the results relevant and manageable.

Table 9.1 Example: feed budget (March to September) for a farm with 300 cows running on 110 ha and all young stock grazed off farm.

	Month	Mar	Apr	May	Jun	Jul	Aug	Sep
A	Milking area (ha)	110	110	110	110	110	110	110
B	Cows milking	280	250	250	100	0	100	200
C	Requirements/cow (kg DM/day)	14	14	13	11	0	14	15
D = (B÷A) × C	Requirements/ha (kg DM)	36	32	30	10	0	13	27
E	Dry cows	20	50	50	100	300	200	100
F	Requirements/cow (kg DM/day)	6	6	6.5	7	8	9	9
G = (E÷A) × F	Requirements/ha (kg DM/day)	1	3	3	6	22	16	8
H = D + G	**Total req./ha/day**	**37**	**35**	**33**	**16**	**22**	**29**	**35**
I	Pasture growth rate	20	25	22	15	10	16	30
J = I - H	Pasture surplus/day	-17	-10	-11	-1	-12	-13	-5
K = J × no. of days	Pasture surplus/month	-527	-300	-341	-30	-372	-403	-150
L	Supplements fed (kg DM)	50,000	40,000	30,000	30,000	50,000	20,000	0
M = (K × A + L) ÷ A	Surplus after Supplements	-72	64	-68	242	83	-221	-150
N = N - M (for last month)	**APC**	**1,800**	**1,728**	**1,792**	**1,724**	**1,966**	**2,049**	**1,828**

In the example feed budget (Table 9.1), 220 tonne of DM is fed as supplement and 100 cows are run off the farm in June to balance the budget (ie. to achieve the target APC of 1,800 kg DM/ha in September). If these options are not available, increasing pasture growth rates with nitrogen fertiliser or drying off cows earlier may help. If we monitor the average pasture cover and find that at the end of March it is 1,600 kg DM/ha rather than 1,730 kg DM/ha as predicted, we can make further management changes to move closer to the required APC at the start of calving.

Feed budgets help with deciding when to dry off and determining the feed inputs necessary to achieve the targets set. There are other budgets that are simpler and calculate the feed surplus or deficit over a given period (Appendix A). These budgets are very useful for making management decisions, can be done quickly and require limited information.

For the most effective management planning, feed budgeting should continue throughout the year at intervals that correspond to decision making. This will enable determination of factors such as drying-off pattern, the number and size of wintering mobs, their feeding levels, the amount of saved pasture to move into winter and the amount of silage to make. Other strategies will need to be considered if these cannot be adjusted to ensure likely feed supply equates with demand.

Choosing a supplement

After completing a feed budget it may have become evident that a feed input will be required to achieve the targets set. Supplements need to be chosen carefully as they are not all equal in quality or cost. Supplements should be compared on the basis of the amount of energy they provide for a given price because energy is normally the most limiting factor in temperate pasture systems. The energy in a feed is usually measured as megajoules of metabolisable energy per kilogram of feed DM (MJ ME/kg DM). Higher ME values correspond to better quality feed.

The amount of energy in a kilogram of feed can make a big difference to the real cost. For example, two supplements both cost 20 cents/kg DM, but one contains 7 MJ ME and the other 12 MJ ME. The first costs 2.85 (20 ÷ 7) cents/MJ ME and the second costs 1.66 (20 ÷12) cents/MJ ME. In energy terms the first feed is 70% more expensive. A list of commonly used supplements and their relative cost is shown in Table 9.2. This table shows a large range in relative feed costs. It is very easy to enter into a high cost system unless all feeds are evaluated on their merits.

It is also worth noting that there is an extremely wide range of ME values within each of these feeds. It is therefore worth the cost of feed testing prior to purchasing large quantities of supplementary feeds.

Table 9.2 Relative costs of various feeds.

Feed	MJ ME/kg DM	Cost (¢/kg DM)	¢/MJ ME
Dryland pasture (ryegrass/clover)	10 – 12	4 - 6	0.3 - 0.6
Irrigated pasture (ryegrass/clover) (assuming 4 000 kg DM extra)	11 – 12	8 – 20	0.7 - 1.8
Nitrogen fertilised pasture (10:1 response)	11 – 12	11	0.9 - 1.0
Maize silage	10	16 - 20	1.6 - 2.0
Round bale silage bought (250 kg DM/bale @ $50/bale)	6 – 11	20	1.8 - 3
Pit Silage (own)	6 – 11	8 – 14	0.7 - 2.3
Hay bought (300 kg DM/bale @ $50/bale)	7	17	2.4
Barley @ $180 - $260/tonne	12	20 - 29	1.7 - 2.4
Pellets @ $250 - $330/tonne	12	28 - 37	2.3 - 3.1
Brassicas 8 tonne/ha @ $1000/ha including re-sowing and lost pasture	12	12.5	1

Profitable feeding of dairy cows

High production per hectare can only be achieved if there is a high level of DM produced per hectare and if this production is utilised efficiently. The range of pasture utilisation achieved at ERDS annually has been around 20,000 kg DM/ha on best paddocks to 6,000 kg DM/ha on the worst paddocks.

With such a range in annual pasture production it is obvious why the question of supplementing or completely replacing pasture with fast growing fodder crops arises at times. The reasoning is that fodder crops will greatly increase the annual DM production. In theory, upwards of 15,000-20,000 kg DM/ha can be achieved using maize and Tama combinations. However, practical experience has demonstrated that yields such as these are impossible to achieve consistently. All forage cropping systems, by their very nature, have periods when DM production is zero, such as when the land is being prepared, sown, crops are germinating, and being harvested.

When the costs of establishment, harvesting and feeding of forage crops are accounted for, any extra DM production from the crop would need to be considerably higher than pasture to cover these extra costs involved. The profitability of forage crops depends on the yield obtained. For example, with turnips a yield of about 8 tonnes/ha must be obtained just to break-even. However, forage crops can be useful in some areas, (eg. peaty swamps) as a crop between re-sowing of a new pasture in order to break down matted soil and organic matter.

Table 9.2 reinforces the cost-effectiveness of ryegrass/clover pastures as a source of DM when compared to other feed sources, including fodder crops. The most profitable DM production is likely to come from a predominant ryegrass/white clover pasture and management should aim to maximise production from this feed source.

SUMMARY

The basic points in pasture management are:

Growing large quantities of grass

- Make sure the plants' basic requirements for growth are met
- Graze the pasture when the ryegrass is near the 3-leaf stage
- Graze to 4-6 cm

Maintain pasture quality

- Graze near the 3-leaf stage
- Control pests
- Use other pasture management tools as appropriate

Utilise pasture grown

- Match feed supply with demand as best as possible by choosing:
  - the correct stocking rate
  - calving date and spread
  - drying-off date

Efficient conversion of pasture to milk

- Ensure that the nutritional requirements of the stock are being met
- Avoid large changes in liveweight and condition score

The best way to put all these together is to develop a feed plan and feed budget for your farm. This increases the amount of control you have and allows you to plan ahead. While using a feed budget may seem laborious and time-consuming initially, the more it is used, the easier it will get. As well as this, your ability to make decisions based on the plan will improve. Instead of reacting to situations as they arise, you will be able to plan for them in advance.

While developing your grazing management skills, it is useful to work with other people who have good pasture management ability. This may be with other farmers, consultants, advisers or as part of a discussion group.

Good pasture management is a technical skill that can be learnt. This manual has outlined the basic principles and demonstrated how to put these into practice by developing a feed plan. Being able to grow and efficiently utilise pasture is one of the keys to improving farm profitability. The knowledge and skills learnt must now be applied to your farm.

Appendix A

Effective Milking Area: ____________ ha

Cow No's (to calve): ___________ Rising 1 year olds (R1): __________

Stocking Rate (SR): Cow No. ________ + 0.5 R1 _________ ÷ Area __________ = Cows/ha

End of budget period (break-even date, or start of calving): _______________

Pasture growth needed to meet herd requirements:

SR ___________ × 15 kg DM/cow = _____________ kg DM/ha/day

FEED INPUTS

1. Assess Farm's Average Pasture Cover ______________ kg DM/ha _________
2. Supplements
   a) Hay
      i) small square bales: No._____ × 15kg/bale ÷ area = kg DM/ha ________
      ii) large square bales: No. _____ × 400kg/bale ÷ area = kg DM/ha ________
      iii) large round bales: No. _____ × 250kg/bale ÷ area = kg DM/ha ________
      TOTAL _________
   b) Silage
      i) large round bales: No. _____ × 250kg/bale ÷ area = kg DM/ha ________
      ii) pit silage (wet): No. tonnes _____ × 300kg ÷ area = kg DM/ha ________
      TOTAL _________
   c) Nitrogen: ______ kg N × 10 kg DM/kg N ÷ area _____ = kg DM/ha _________
   d) Grain/Conc.: _________ kg ÷ area ________ = kg DM/ha _________
3. Grazing off : No. of cows off __________ × No. of days _________ × 6kg/cow/day
   ÷ area _________ = kg DM/ha _________
4. Growth (today to end of budget period): Date ___/___/____
   M1 __________kg DM/ha/day × No. Days ___________ = __________
   M2 __________kg DM/ha/day × No. Days ___________ = __________
   M3 __________kg DM/ha/day × No. Days ___________ = __________
   M4 __________kg DM/ha/day × No. Days ___________ = __________
   M5 __________kg DM/ha/day × No. Days ___________ = __________
   M6 __________kg DM/ha/day × No. Days ___________ = __________
   M7 __________kg DM/ha/day × No. Days ___________ = __________
   TOTAL _________

1 + 2 + 3 + 4 = Total Feed Supply _________

FEED REQUIREMENTS

1. Dry cow requirements (today to middle of calving period)

   No. days: ____________ × 6 kg DM/cow × SR = _________

2. Milker requirements (middle of calving to end of budget period)

   No. days _________ × 12 kg DM/cow × SR ____________ = _________

3. Extra condition

   __________ extra score needed × 150 kg × SR = _________

4. Inductions

   No. cows induced _______ × average no. days brought forward ______

   × 6kg DM above maintenance ÷ area __________ = kg DM/ha _________

5. Required Average Pasture Cover at end of budget period _________

1 + 2 + 3 + 4 + 5 = Total Requirements _________

TOTAL FEED INPUTS LESS TOTAL REQUIREMENTS _________

SURPLUS/DEFICIT PER HECTARE _________

Divide surplus by SR _________ and then divide by

6 if doing 0.6 kg MF/cow
5 if doing 0.5 kg MF/cow
4 if doing 0.4 kg MF/cow
3 if doing 0.3 kg MF/cow

The result is the extra days you can continue milking until drying off _________
