Perennial ryegrass management
I. Grazing management to maximise growth and nutritive value

Key targets

The 3030 Project identified three basic strategies as the keys to a successful perennial ryegrass grazing management. We call them the 'ABC targets':

A. Graze between the 2nd and 3rd leaf stage.

B. Leave a post-grazing residual of 4–6 cm between pasture clumps [equivalent to 1,500–1,600 kg dry matter (DM) per ha].

C. Maintain a constant cover of green leaf area all year.

These guidelines are not an attempt to present a 'silver bullet' for perennial ryegrass pasture management. They are not meant to be exclusive; using other guidelines based on similar principles can also achieve success in maximising the growth of high quality pastures and minimising waste.

To successfully apply the management practices (see the 'Practical application of grazing principles' Information Sheet) that arise from these ABC targets, you need to understand the principles behind each of them. This Information Sheet focuses on these principles (the 'whys') and how they work on southern Australian dairy farms.

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A. Graze between the 2nd and 3rd leaf stage

Perennial ryegrass tillers normally maintain three live leaves. After being grazed (and the three leaves removed), the 1st emerging leaf is produced using the soluble carbohydrates (sugars) stored in the base of the plant. When the 2nd leaf emerges, the plant will start restoring some of the sugar reserves that have been used. However, it is not until the 3rd leaf has almost fully emerged that the sugar reserves in the plant will be fully restored (see Figure 1). After that, as the 4th leaf emerges (the youngest), the oldest leaf (the one that emerged first) begins to die.

Grazing before the 2nd leaf has emerged will penalise regrowth rates and threaten plant survival. Grazing after the 3rd leaf has fully emerged will waste pasture and reduce the overall nutritive value of the herbage consumed. In practice, cattle will reject a higher proportion of this lower nutritive value pasture, lowering utilisation. The drop in nutritive value after the 3rd leaf stage occurs faster in the warm seasons (spring-summer) than in winter.

The timing of grazing also affects root growth. Immediately after a ryegrass tiller is grazed, the growth of the root stops. This happens because the ryegrass plant needs to prioritise the use of sugar reserves for the growth of new leaf tissue. Once the 1st leaf emerges, the root growth will recommence. This is why pastures that are grazed too frequently will have less root biomass (see Figure 2). These plants will be more easily pulled by cattle and are more vulnerable to hot and dry conditions. They are also susceptible to attack by root-damaging pests such as red headed cockchafers.

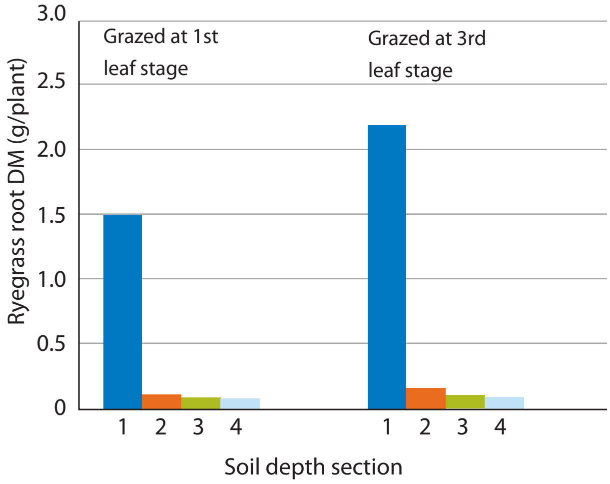


Figure 2. Root mass of perennial ryegrass plants in 50 mm sections of soil depth (1=0–50 mm; 2=50–100 mm; 3=100–150 mm; 4=150–200 mm) when grazed at 1st or 3rd leaf stages (adapted from Donaghy, 1998).

Grazing at the right leaf stage can have a positive effect on tiller density. This effect is related to the plant's ability to grow 'daughter' tillers. These are small tillers originating from the base of a larger 'parent' tiller. They are normally initiated in autumn and spring and will only be generated in summer if sufficient irrigation is provided. They survive for about 12 months.

The 'daughter' tillers will only be independent of the 'parent' tiller once their 3rd leaf has emerged. Until then, the 'daughter' tillers depend on the sugar reserves of the 'parent' tiller. Grazing at the 3rd leaf stage will allow the 'daughter' tillers to become independent, which will have a positive effect on the overall pasture density (more tillers/m^2).

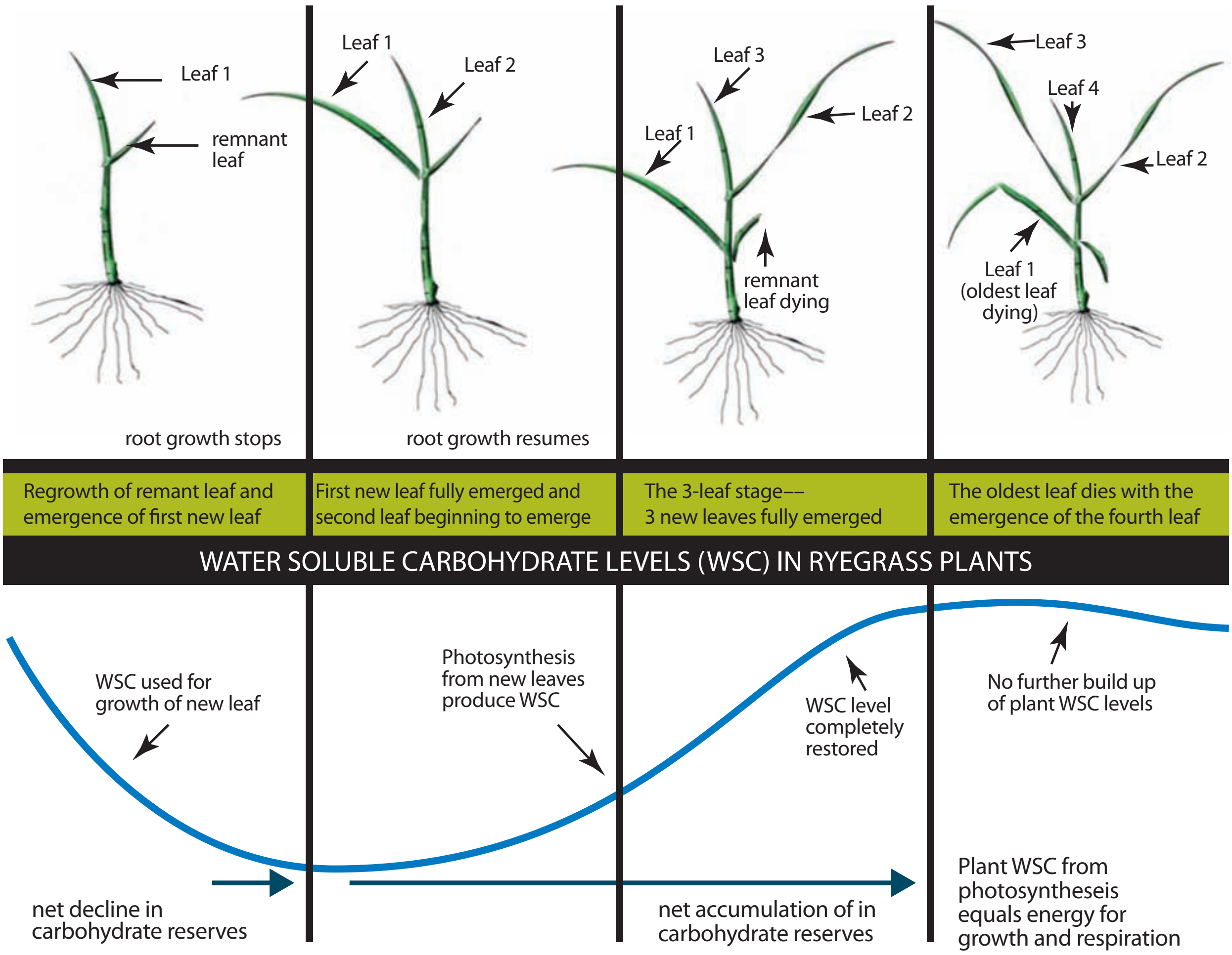


Figure 1. Leaf regrowth and water soluble carbohydrate levels of a ryegrass tiller following defoliation (adapted from Donaghy, 1998).

The general target is to graze within the 2nd and 3rd leaf stage. There are benefits from grazing closer to the 2nd or 3rd leaf stage, depending on the time of the year. Moving within this range can balance quantity and quality of consumed pasture. In general, grazing closer to the 3rd leaf stage maximises growth, but risks a lower nutritive value.

Late autumn and winter

In late autumn and winter, it is normally beneficial to graze closer to the 3rd leaf stage. At this time of year the 3rd leaf is 40% heavier than the 2nd leaf (see Figure 3) and more growth can be captured by waiting until the 3rd leaf is fully emerged. These differences in leaf weight were measured at the 3030 Project farmlet studies at Terang in western Victoria where pastures were managed to consistently achieve a post-grazing residual of 1,500 kg DM/ha.

Another reason for grazing at the 3rd leaf stage in autumn–winter is that the decline in nutritive value if grazing slips past the 3rd leaf stage is smaller than at other times of the year.

Spring

In spring, particularly under high nitrogen fertility, it is beneficial to graze closer to the 2nd leaf stage. There are three reasons for this:

1. As the plants reproductive stage is initiated in spring, stem elongation and appearance of the seed heads will normally cause a sharp decline in the nutritive value of the whole sward if grazing is delayed.
2. The difference in size between 2nd and 3rd leaf disappears in spring (after September, see Figure 3), as found by a detailed monitoring at the 3030 Project farmlets at Terang. At this time of year, there is no additional net growth to be captured by waiting until the 3rd leaf stage, provided that the post-grazing residual of 1,500 kg DM/ha is consistently achieved.
3. Because leaves are larger in spring, canopy closure is reached at an earlier leaf stage than in autumn-winter. Once this occurs, stem elongation is promoted and the shading of the lower leaves delays the production of sugars by photosynthesis. There are no benefits in accumulating sugar reserves by delaying grazing until the 3rd leaf stage.

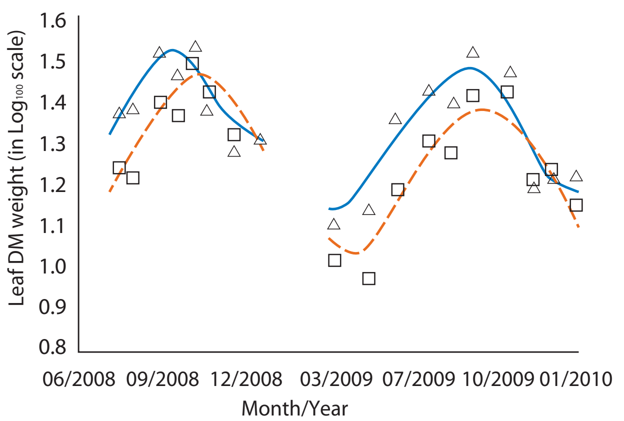


Figure 3. Weight of perennial ryegrass tillers' 2nd (▭) and 3rd (Δ) leaves before grazing (expressed as Log100, which represents increases in exponential units, e.g. 100; 10,000; 1,000,000). From Chapman et al. (2011).

An example of grazing at different leaf stages throughout the year is provided by the results of the 3030 Project farmlet studies from 2006 to 2008. As shown in Figure 4, both farmlets were grazed close to the 3rd leaf stage in the winter period, and between 2 and 2.5 leaves for the rest of the year.

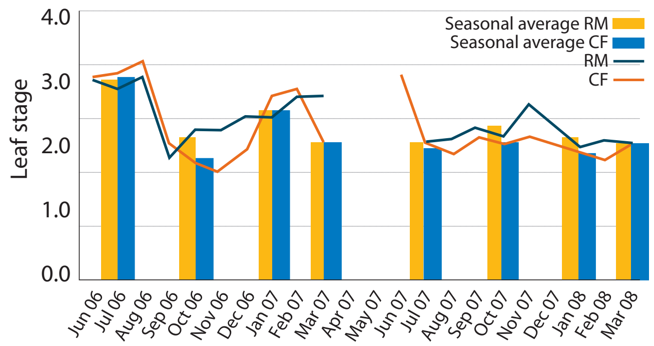


Figure 4. Leaf stage at grazing in the RyegrassMax (RM) and Complementary Forages (CF) farmlets at Terang in 2006/07 and 2007/08.

B. Leave a post-grazing residual of 4–6 cm

At the 3030 Project farmlet studies and on partner farms, the 4–6 cm (1,500–1,600 kg DM/ha) range was adopted as the target post-grazing residual to optimise pasture productivity, nutritive value and persistency while not compromising the intake of milking cows.

A practical way to measure this height is by the '2nd knuckle test' when touching the ground with the fingertips (see Figure 5). The 4–6 cm height refers to the height of ryegrass plants between pasture clumps. These clumps are normally the result of cow's rejection where manure was deposited during the last grazing.

Figure 5. Ryegrass post-grazing residual height (2nd knuckle height or 5cm).

To understand why 4–6 cm is the target post-grazing residual the consequences of leaving higher or lower residuals need to be examined.

Consequences of continually leaving higher residuals (> 6 cm):

1. Waste of feed: When residuals are higher than 6 cm it is likely that a substantial proportion of the new growth was not removed. Based on the same principle described for the 2nd to 3rd leaf grazing target, if one of those three leaves was not removed, it will be dead by the next grazing (when another three leaves should have been produced).

   A faster regrowth can sometimes been seen from a high residual (>6 cm). This is because the ungrazed leaves can photosynthesise (use the sunlight to create growth) to support regrowth faster than when relying on mobilisation of sugar reserves. However, this effect is often transient and can result in a higher level of wastage.

2. Poor utilisation in the next grazing: The dead material present during the next grazing (particularly in pasture clumps) will be rejected or avoided. This effect is cumulative and, if nothing is done, it will lead to a more severe loss of grazed pasture and nutritive value in the following grazings.

   During spring, this loss of nutritive value will be compounded by the development of reproductive stems. Cows will normally graze these stems when they have just emerged, but reject them once they have fully elongated as they contain a high proportion of lignin (indigestible fibre).

3. Reduced tillering: The generation of new tillers occurs at the base of the ryegrass plant and is induced by sunlight reaching that area. When dead material is accumulated (when high post-grazing residuals are left recurrently), the shading of the base of the plant limits the production of new tillers (see Figure 6). This will affect the overall density of the pasture sward (a 'more open pasture') and decrease productivity.

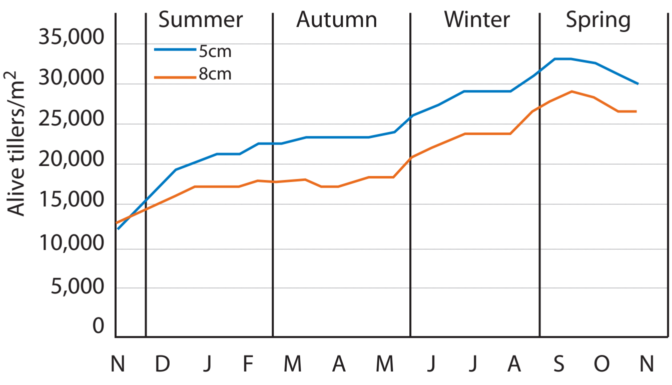


Figure 6. Tiller density of perennial ryegrass as affected by grazing residuals of 5 or 8 cm height in Valdivia, Chile (39°45"S). From Lopez et al. (2010).

4. Aerial tillering: 'Lax' grazing induces the production of 'aerial tillers' (tillers originated from nodes of elongated stems that are not attached to the base of the plant, Figure 7). These tillers should not be promoted. They can only develop roots and attach to the ground if there is abundant moisture at the ground level. In practice, they are sensitive to water stress and exposed to trampling because the roots are not initiated at ground level.

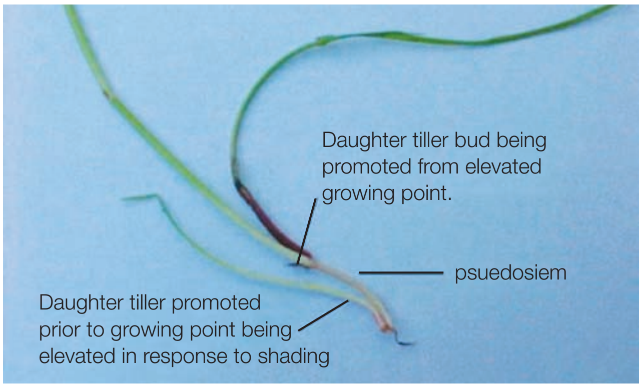


Figure 7. Aerial tillering in perennial ryegrass.

Consequences of continually leaving lower residuals (< 4cm):

1. Weaker regrowth: As explained above, after grazing, the growth of the 1st leaf comes from sugar reserves but the growth from the 2nd leaf onwards relies on photosynthesis from sunlight. Normally, 70% of perennial ryegrass sugar reserves are stored in the first 5 cm from the base of the tiller. If that portion of the plant is removed by grazing, there will be fewer reserves available for the initial regrowth.
2. Putting persistency at risk: The continual depletion of sugar reserves will lead to fewer and smaller tillers and less root growth. This will make the plant more exposed to any stress (e.g. drought, cockchafers).

In addition, continuous intensive grazing (<4 cm) reduces the area of ground covered by pasture. With lower ground cover, the soil temperature during summer will increase, sometimes exceeding 40°C, and induce dormancy in perennial ryegrass. These extreme temperatures could also kill any white clover plants that were present.

C. Maintain a cover of green leaf area

This principle could be re-stated as "nothing grows grass like green grass". Although perennial ryegrass plants can mobilise carbohydrate reserves to sustain the initial regrowth after grazing, the process is slower than generating growth from photosynthesis in the green leaf. The higher the proportion of the farm area under pasture that maintains a green leaf cover, the higher the potential for pasture growth.

Although it is impossible to eliminate dead material, it is important to minimise its proportion within the pasture. The dead material (either leaf or stem) can intercept the sunlight but not use it for photosynthesis. It takes up space that actively growing leaves could be using, which reduces the total pasture growth potential.

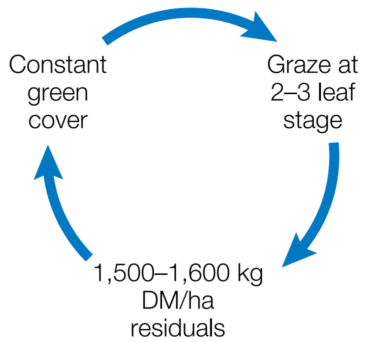
Achieving a constant cover of green leaf requires adequate plant and tiller density, and minimal bare ground. This is often overlooked as the focus of the ryegrass monitoring for grazing management tends to be on each single plant or tiller.

When enough soil moisture is available and high growth rates are promoted (typically in spring), it is relatively easy to reach a closed cover of green grass. However, the challenge is to maintain this closed pasture cover during winter and summer (especially during hot and dry years).

The key to reaching acceptable levels of pasture cover during winter is pasture cover management in autumn (see the 'Grazing management specific practices' Information Sheet). In brief, this management strategy aims at starting the autumn grazing rotation when pre-grazing covers have reached a certain target. Autumn- or split-calving herds that tend to start grazing too early in autumn due to the lack of available feed face poor pasture cover during the subsequent winter. A low pasture cover during winter normally results in low pasture growth rates and could limit pasture intake.

A+B+C = productivity

Although the principles behind the ABC targets have been explained separately, they are closely interconnected in practice. Achieving each of these targets will have a positive effect on the others, as illustrated in the diagram below:



Maintaining the rotation length to graze between the 2nd to 3rd leaf stage means that cows will be grazing pasture with adequate nutritive value. This will ensure the post-grazing residuals are achieved. There will be a lower proportion of dead tissue, which will help maintain a constant green cover.

The performance of one of the 3030 farmlets during the first year of trial (2005/06) is a good example of the interconnection between the ABC targets. The grazing management during that year was not adjusted to graze before the 3rd leaf stage. Because of this, pre-grazings pasture masses increased dramatically (up to 4,500 kg DM/ha) and post-grazing residuals increased accordingly, reaching up to 2,500 kg DM/ha (see Figure 8). The high post-grazing residuals meant that a higher proportion of the cover was dead material and not green leaf, undermining the overall growth rates across the farm.

In the second and third year, by grazing between the 2nd and 3rd leaf stage and closely monitoring pasture cover, it was possible to achieve residuals of around 1,500 kg DM/ha and maintain a high proportion of green leaf across the farm.

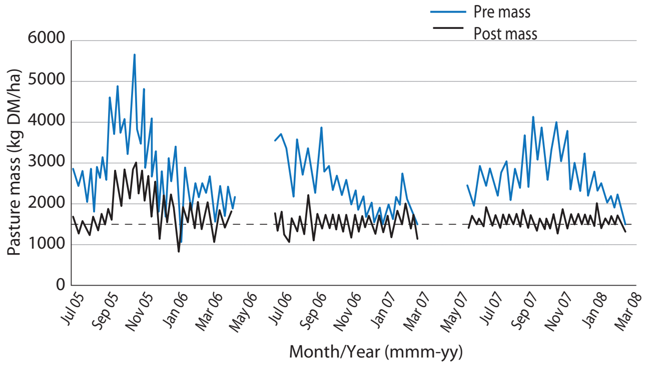


Figure 8. Pre-grazing cover (blue) and post-grazing residual (black) measured at the RyegrassMax farmlet in 2005/06, 2006/07 and 2007/08 at the 3030 Project farmlets at Terang.

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Lopez et al. (2010) Lolium perenne L. tiller growth dynamics as affected by different intensities of pasture utilisation by grazing dairy. In 'An overview of research on pastoral-based systems in the southern part of South America. International workshop' (Ed. C. F. Machado), pp. 43–55.

See also

3030 Project Milestone 8: Final Report (2008) [Relevant section: pages 96–102].

3030 Project Field Day Report (2008) Gems from Project 3030. [Relevant section: pages 16–30].

3030 Project TCC document (2010) Management Factor: Grazing management for perennial ryegrass (including silage conservation), pages 1–7.

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About 3030

PROJECT 3030 aims to help farmers achieve a 30% improvement in farm profit by consuming 30% more home-grown forage (pasture plus crop). It is aimed at dryland farmers in southern Australia who have mastered the challenge of growing and using ryegrass pasture for dairy-cow feeding.

For further information

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