Local Land Services North Coast

FACTSHEET

Managing Short Term Ryegrass in the Subtropical Dairy Region

Nathan Jennings
Senior Land Services Officer Agricultural Advice
North Coast Local Land Services Lismore NSW

Bill Fulkerson
Field Officer, Norco Cooperative Ltd, Lismore, NSW

In subtropical NSW, short term ryegrass (*Lolium multiflorum*) is commonly over sown each autumn into a perennial summer grass, such as kikuyu, setaria, paspalum or rhodes grass.

The management of an established annual ryegrass pasture is critical to obtain the benefits of this high quality grass and to ensure a successful transition back to a tropical grass pasture in late spring; this forms the basis of this Factsheet. The establishment of short term ryegrass is covered in the companion Factsheet titled 'Establishing short term Ryegrass in the Subtropical Dairy Region'.

Grazing management

There are a number of grazing management systems used in the dairy industry but the system known as 'leaf stage grazing' is now uniformly adopted by Australian dairy farmers because it considers what is optimal for the plant, in terms of growth and persistence, and also for the grazing animal, in terms of pasture utilisation and feed quality.

Although the name 'leaf stage grazing' refers to the growth stage of the plant (in days post grazing or grazing interval), the duration of grazing (the length of time cows are allowed to graze a given area) and intensity of grazing (the residue remaining after grazing), are also considered and are equally important.

Grazing Interval:

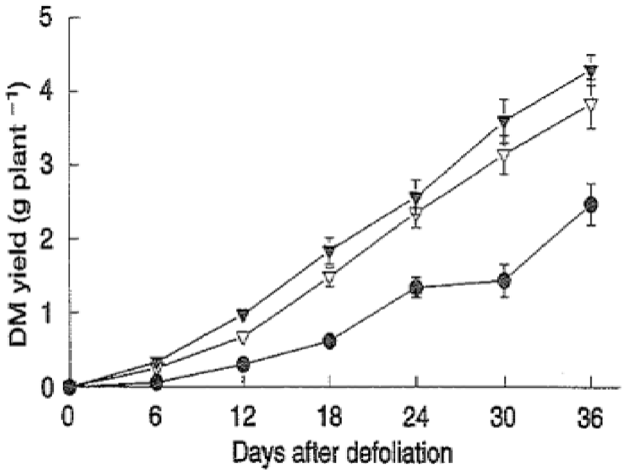
The optimum time to graze ryegrass is the 3 leaf stage

At the 3 leaf stage, the yield of green leaf is maximized because once 3 new leaves per tiller have grown, the oldest leaf will begin to die as the fourth leaf begins to grow and, as a result, the feed quality of the pasture and pasture utilization by stock also declines. Therefore, there is no advantage in grazing beyond 3 leaves and this is considered to be the **maximum grazing interval**.

The **minimum grazing interval** is the 2 leaf stage. This is because until 2 new leaves have grown the plant is still replenishing its Water Soluble Carbohydrate (WSC) reserves which it uses as an energy source for regrowth after grazing when there are no leaves present to photosynthesise energy (sugars). However, after the 2 leaf stage, plant growth and yield rapidly increases so, although grazing then does not reduce regrowth, it does reduce yield.

Figure 1, summarises the results of a glass house study (Fulkerson & Donaghy, 2001) which emphasises the need to maintain a **grazing interval longer than 2 leaves/tiller** (24 days in this case).

Figure 1: The regrowth of ryegrass to 3 leaves (36 days), after previously being cut at the 1 leaf (●), 2 leaf (▽) or 3 leaf (▼) stage of growth. (Fulkerson & Donaghy, 2001).



From Figure 1, it can be seen that regrowth of ryegrass, previously cut at 2 or 3 leaves/tiller, grew at the same rate when allowed to regrow over the next full 3 leaf regrowth cycle. However, the plants cut at 1 leaf/tiller (12 days) only grew at about half the rate even if allowed to grow to 3 leaves /tiller. Also, note the high growth rate over the time when the plants went from the 2 to the 3 leaf stage.

The initial validation research on the leaf stage grazing was undertaken in 2 replicated field studies on a commercial dairy farm at Casino on the north coast of NSW. The results of these studies are shown in the table below which further demonstrates the yield advantage of grazing at the 3 leaf stage.

Table 1: Annual yield (kg DM/ha) of perennial ryegrass defoliated at set intervals of 2 or 4 weeks or 'when ready' (at the 3 leaf stage or when 2500kg DM/ha was *on offer*) in Study 1, (Fulkerson, Slack, Moore & Rolfe 1993) and subsequently in Study 2 (Fulkerson & Bryant 1994) when ryegrass was defoliated at 1 or 3 leaves/tiller.

Defoliation Interval	Annual Yield (kg/ DM/ha)
Study 1 (1993)	
2 weeks	9,260
4 weeks	10,916
'when ready'	12,223
Study 2 (1994)	
1 leaf/tiller	7,894
3 leaves/tiller	9,745

A good way to understand the sequence of events immediately after grazing is to realise that there is a priority for use of energy (WSC or sugars) within the plant at that time as shown in Figure 2 and the priorities are explained in more detail below.

PRIORITY 1: RESPIRATION

The plant needs ongoing energy for respiration and, after grazing, this must come from WSC reserves at the base of the plant as there is no leaf left to produce WSC from photosynthesis. In fact, the death of plants in late spring is often due to insufficient WSC reserves, even for respiration. This insufficiency of WSC in late spring is because the energy requirements for respiration rise dramatically (exponentially) with temperature, and for growth to a lesser extent, and hence WSC cannot accumulate. Therefore, if WSC input from photosynthesis is reduced due to cloud or prolonged wilting when making silage, for example, the plant will respire itself to death. The lack of WSC availability in late spring is also the reason why it is so important to prevent grazing of regrowth shoots by back fencing to keep the grazing duration short (see later under Duration of grazing) at that time of the year.

PRIORITY 2: EXTENDING THE NEW LEAF

The plant relies on WSC reserves in the stubble until it can develop enough leaf to produce new WSC from photosynthesis and this does not happen until ¾ new leaf has regrown, so the second priority must be to grow new leaf.

PRIORITY 3: ROOT GROWTH and WSC REPLENISHMENT

The roots stop growing after grazing. The existing root system can provide adequate nutrients and water for the small re-growing ryegrass plant and that is why Priority 1 and 2 are more urgent. However, after the ¾ leaf stage, the plant's soil nutrient requirements are increasing and in response, the roots begin to grow again as WSC (energy) from photosynthesis, in excess of that required for respiration and growth of the initial leaf, becomes available. At the same time, WSC start to accumulate ready for recovery after the next grazing. It can therefore be appreciated that if the grazing interval is 1 leaf (about 5 days in spring to 12 days in winter), the roots never get a chance to grow and this is reflected in early moisture and nutrient stress in these plants due to shallow rooting. Also, there is no replenishment of WSC and in the field this is reflected in poor regrowth.

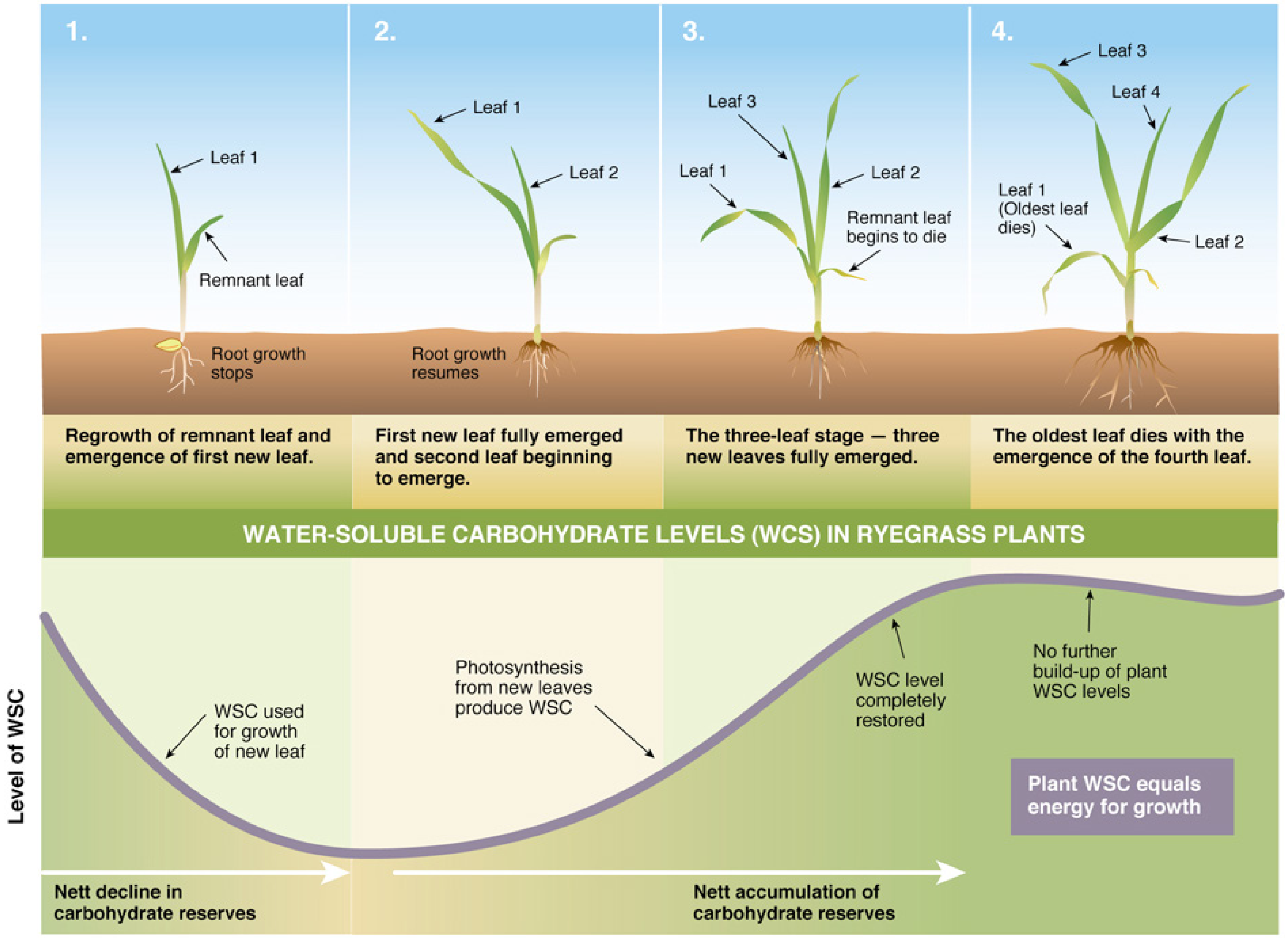
The actual time taken to grow 3 leaves per tiller is primarily determined by temperature (see the equation below).

Grazing interval (days) =
3 (20-(0.55 (max. Temp. (C°) + min. Temp. (C°)/2)

Thus, on the north coast of NSW, the grazing rotation in mid-winter should be:

Grazing interval (days) =
3 (20-(0.55(21.2+9.5)/2)) = 35 days

Figure 2: Regrowth of ryegrass after grazing and the change in WSC levels during regrowth (image source EVERGRAZE)



In practice, a 30 day interval will still be above 2 ½ leaves and would be close to the recommended grazing interval.

As a guide the predicted winter grazing rotation lengths for Casino would be 35 days, for Coffs Harbour 36 days, Taree 37 days and for Beaudesert in Queensland, 32 days.

However, under conditions of severe moisture stress the older leaves die earlier and the rate of appearance of new leaves slows down this decreases the number of leaves exposed to evaporative loss and this is a logical response by the plant to improve plant survival.

Counting leaf number in the paddock

Count 5-6 tillers across a paddock but select those plants between the urine and dung patches as these would have been eaten at the last grazing.

If the remnant leaf is about ½ the length or more of the first full leaf, count it as 1/2, if not ignore it.

Each new leaf grows about 25% longer than the previous one, so you can estimate the proportion regrown.

Exceptions to grazing at the 3 leaf stage

In spring the leaves *of* ***Nitrogen-fertilised ryegrass*** pastures are broader and the pasture will start to lodge (the leaves block the sunlight) at 2 to 2 ½ leaves/tiller, therefore pastures should be grazed then. Grazing at 2- 2 ½ leaves per tiller, when pasture on offer exceeds 2500 kg DM/ha, will reduce the growth potential but utilization will be maintained. However, grazing earlier than 2 leaves per tiller will set back re-growth.

If ryegrass is ***infested with rust***, it needs to be grazed at very short intervals (1-1 ½ leaves). Reducing the grazing interval reduces the length of time the canopy is closed and as a result humidity is kept low. Although this will significantly reduce regrowth, it is better than having a rusty pasture which stops growing and is unpalatable to stock.

In a dry early spring (***August/ September)***, stay on a long winter grazing interval which may mean grazing beyond the 3 leaf stage. This will reduce the amount of time the ground is exposed to evaporation after grazing and allow better growth.

Duration of Grazing

Although it is sometimes difficult to achieve in practice, the grazing duration (time cows spend on a given area of pasture) should not be greater than 2 days except in mid-winter when it could be extended to 3 days. Observe cattle behaviour, if they are grazing the regrowth shoots, the duration is too long. This is important because the new leaf grows primarily from the WSC reserves built up prior to grazing and if this is removed by back grazing there is no more reserves and regrowth is severely reduced. Use a back fence where ever possible to prevent back grazing.

Grazing Intensity

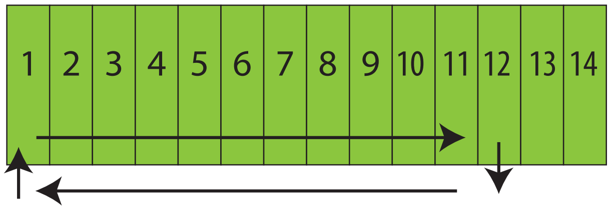
The optimal grazing intensity for milking cows, in terms of pasture utilization and cow intake, is when they graze down to a stubble height of about 5cm, equivalent to about 1200kg DM/ha on the north coast of NSW. Most of the WSC reserves are in the lower stem up to 5cm above ground level, so grazing harder than this will reduce regrowth and grazing lighter will reduce utilization, and although regrowth will be a bit higher, it does not compensate for the reduced utilization of grass. The exception is in late spring when the residue should be raised to 8-10cm if plants become moisture-stressed and are undergoing stem development.

When ryegrass is growing rapidly in spring there are two main objectives:

- Retain ryegrass quality and optimise utilization by stock for as long as possible, and
- Ensure that the commencement of summer grass growth is not inhibited by shading from ryegrass.

Both these objectives can be achieved by speeding up the grazing interval (12-18 days, unless there is moisture stress or rust infestation is high, as mentioned previously). Excess ryegrass can be conserved as silage to reduce grazing interval, - the diagram below demonstrates this.

Assume each paddock represents 1 day's grazing, the herd is on a 14 day rotation in spring, the cows finish paddock 12 and they start to leave a higher residue than is desirable. Rather than go to paddock 13, they now go back to paddock 1, leaving paddocks 13 and 14 to be conserved as silage. If at the next grazing round the post grazing residue is still too high, more paddocks are dropped out. This method will lead to conservation of the ***true surplus*** *to requirements.*



Grazing management in the transition between ryegrass and summer grass

If summer grass 'wants to grow' in late spring and if it is shaded by ryegrass for longer than about 6 days (as a consequence of a grazing interval greater than a 14 days), it not only inhibits growth of the summer grass at that time but can really reduce subsequent growth up to the end of January and in some cases will kill the summer grass. These problems are evident in a wet spring when ryegrass cannot be grazed or cut for silage for prolonged periods. It means that the latest that ryegrass silage can be made (requiring and extended lock up period) is mid September on the far north coast and probably end of September on the lower north coast.

Fertiliser management

Nitrogen (N)

Nitrogen is the major driver of pasture growth, if the other macro nutrients (Phosphorus, Potassium or Sulphur) in the soil are adequate.

Nitrogen for ryegrass growth will almost always need to be applied as fertilizer or manure.

Nitrogen- based fertilisers are applied as soon after grazing as possible. The application rate should be 46kg/ha N/month (100kg Urea/month), or 23kg/ha N (50kg Urea/ha) after every grazing if the grazing interval is, say, 14 days.

Another way to determine N application rate, once the ryegrass is established, is to actually relate it to grazing interval. The recommendation provided by Dr Martin Stein, based on results of the Greener Pastures project in WA, is to apply **1 ½ kg N (or 3.3kg Urea)/ha/day)** multiplied by days since last grazing. For example, in spring on a 14 day grazing interval, apply 46 kg Urea/ha (3.3kg Urea*14 days) after each grazing. Although applying 100kg/ha every second grazing when grazing intervals are short, will reduce the cost of application, it will reduce the response significantly compared to applying at every grazing.

Acidification of soil

Table 3 compares the soil acidifying effect of Urea to some other Nitrogen-based fertilizers, in terms of the amount of lime needed to neutralize the effects.

It can be seen that the acidifying effect of Urea is quite small and for a typical annual application of about 400 kg Urea/ha, a yearly application of 330kg lime/ha, or in practice, 2t Lime/ha every 5 years, will neutralize the acidification effect.

Table 2: Kilograms of lime required to neutralize the acidification effects of 1 kg of Nitrogen *(source Ledgard et al. 1994).*

Fertiliser	Amount of lime (kg) per kg of Nitrogen
Gran am	5.4
DAP	3.6
Urea	1.8
Calcium Ammonium Nitrate	1.4

Volatilisation losses from Urea

Extensive research by Dr Richard Eckhard, DPI Victoria, has found that the average loss of N from Urea through volatilisation is small. Key points from Richard's work and local experience are:

The losses of N through volatilisation after applying Urea are in the first 48 hours, so if there is rain (>5mm) or irrigation straight after application, there should be no losses

The average loss in winter was found to be about 4% and in summer 14%, under typical on farm conditions where you wait for rain or an average delay in watering after application of Urea.

Under hot and windy conditions in summer, after grazing and without rain or irrigation, the losses can be as high as 20%. The major loss is through the wind and this is one reason why some farmers apply Urea 1-2 days before grazing – then results in the wind near ground level being near zero. However, studies undertaken in NSW (Griffiths N, *pers. comm.*) found no benefit of applying Urea before grazing, in terms of response to Urea application and the benefit probably depends on the circumstances. There is insufficient Urea to harm the cows grazing the pasture.

Surprisingly, the loss of N can rise to 25% if Urea is applied after good rain which saturates the soil and then it comes in hot and windy which is often the case, with loss as N_2 and the green house gas, N_2O .

The loss is also very high (25%) if Urea and lime are applied at the same time. Therefore, apply lime at least 10 days after Urea. Similarly, do not mix and apply lime and poultry manure together as the loss of the N component in the manure can be high.

There is virtually no volatilisation of N from DAP or Gran am.

It takes 4-5 days for the applied N to reach the root zone after application of water.

Expected pasture growth response to Nitrogen fertilisers

Table 3 below shows the expected pasture yield response to Urea and the cost of producing the extra pasture after taking into account the cost of Urea, the lime needed to neutralize the acidifying effects and the loss of N through volatilisation.

Table 3: The pasture yield response to, and cost of Urea application

	Winter	Spring/ Autumn	Summer
Kg DM/kg N	10	25	30
Cents/kg DM	12.0	5.0	4.0
Cents/kg DM + volatilisation	13.0	5.5	4.2
Cents/kg DM +Lime and volatilisation	13.3	5.7	4.7

With Urea at $540/t and lime at $90/t, and using the higher levels of volatilisation (8% in winter and 14% in summer), the cost of the extra feed in winter is $133/t DM and in summer it is $47t DM, both very cost effective compared to alternate feed sources.

Nitrate Poisoning

Interestingly, in short rotation ryegrass, the nitrates peak about 12 days after application. The problem of excess N (nitrates) in ryegrass increases substantially if more than 46kg N/ha (approximately 100kg Urea) is applied in one application.

Very high Nitrate pastures can be tolerated by cows if they are adapted to them. In this regard, a problem can occur if dry cows on poor rough pasture calve and begin to milk on very high Nitrate ryegrass pastures. A small amount of ryegrass each day, for a week before calving, will adapt the cows by accustoming the rumen microbes to the new grass feed in general.

Ryegrass quality at different growth stages

Retaining Quality and Utilisation of Ryegrass

Quality in ryegrass falls as stem and seed head development proceeds and the timing of this depends on ryegrass variety (short versus long season) and day length.

- In the vegetative tiller, the growing point is near ground level and so it is virtually impossible to kill the plant by heavy grazing. However, the energy (WSC) for the plant to re-grow after grazing is mainly in the tiller base so overgrazing (below 5cm) will reduce regrowth substantially.
- In the tiller undergoing stem elongation, the growing point is at the uppermost node on the stem and herbage below this node has lower quality.
- When the tiller sets seed, the WSC is converted to starch and is concentrated in the seed head; as a consequence the vegetative part of the tiller declines in digestibility. If the stem is grazed or cut below the uppermost node (this is called topping-see below), this tiller will die and the remaining WSC can then be used to initiate a new vegetative tiller at the base of the plant, thus providing new green leaf of high feed quality again.

Topping ryegrass pasture

Topping is slashing or mowing a ryegrass pasture to below the growing point so that new vegetative tillers can be initiated. Milking cows are seldom willing to graze below the growing point once stem elongation commences and that's why topping after grazing is essential in late spring to initiate new leaf.

Cutting ryegrass for silage

If making ryegrass silage, delaying cutting to the early stages of seed set in late September, can result in low quality feed with Metabolisable Energy levels down to around 8MJ/kg DM and protein as low as 14%. This decline in quality, with onset of seeding, is far worse on the north coast than in temperate areas, probably due to higher temperatures earlier in the season which tends to increase lignin content.

Table 4: Typical Metabolisable Energy and Crude Protein values at various stages of ryegrass maturation

Tiller maturity	Metabolisable energy (MJ/kg DM)	Crude Protein (%)
All Leaf	11.5	24
Stem node below 5cm	11.5	20
Flag leaf, stem nodes above 5cm	11	18
Seed head developing	10.5	17
Seed head emergence	9.5	16
Seed head filling	8.5	14

Note: 'Node' refers to uppermost node on the stem which is the growing point and can be identified as a bump on the stem.

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