7. Grazing theory

Learning outcomes:

This chapter will help you to:

- Set target pre-graze and post-graze points, and shift time, to achieve high pasture production, quality, utilisation and persistence.

The primary aim of pasture management is to increase pasture consumption. This will happen if the pasture management tools (grazing, fertilising, irrigation) achieve:

- **Production** of dry matter at a high rate per hectare per day.
- **Quality** of the feed, or the best balance of feed components (energy, protein, fibre, and minerals) for the cows.
- **Utilisation** of most of that production by the cows, so that not much is wasted.
- **Persistence** of the chosen species, in this case ryegrass, so that resowing is not required too often.

Luckily, all of the above four aims can be achieved together.

Two of the aims, production and persistence:

- Are primarily about the **pasture alone**, and the saying "taking care of your pasture will take care of your cows" is a good one.

However, the **other two aims**, utilisation and quality:

- **Involve the cows** grazing the pasture. So in this chapter we discuss how we might graze a pasture with cows.

7.1 Review of single tiller growth

With ryegrass, **only three green leaves** grow before the oldest dies and decays.

Leaf appearance varies from 6 days to 30 days, depending mostly on temperature, but also on soil moisture. The bottom (oldest) leaf dies after about 18 days in spring, and after 40 to 60 days in winter.

Stored sugars, which accumulate in the tiller base once 2 leaves have regrown, are used to get the first leaf going after grazing and to support new tiller development.

Reproductive tillers will die, shade the base, and reduce quality and are not needed for seed.

Daughters tillers are needed for long-term plant survival and pasture density. They will grow from the base if the base is not shaded and if there is stored sugar to get them started.

Root regrowth is suppressed after grazing and resumes after about 1 leaf has regrown.

Tiller quality (that is, the balance of sugar/ nitrate, minerals, and starch/ fibre) is best at 2 to 3 leaves.

We have discussed how an individual ryegrass tiller grows. Now we will discuss how a whole pasture, that is, a collection of tillers, grows.

7.2 Whole pasture growth

The **quantity of ryegrass pasture** that grows depends on a combination of:

- The **number of tillers** per square metre, that is, **density**.
- The **rate of** leaf **appearance.**
- The **size** of the leaves.

A tiller gets water and nutrient from the soil and carbon dioxide from the air and then uses sunlight energy to combine them into sugars, to grow. So, if there is adequate warmth, water, nutrients and carbon dioxide (all of which is often the case), **pasture will grow the fastest** when it can **capture the most sunlight**:

- To ensure no sunlight hits the ground unused, the **paddock must be covered with about 5 layers** of leaves. Sunlight can pass through about 5 leaf layers before it is all used up and full shade occurs.
- The pasture must be **dense**. The more bigger tillers per square centimetre, up to a point, the more light it captures.
- The pasture must be **high** enough. The higher the pasture gets, up to a point, the more light it captures.

BUT by cramming a lot of tillers together into a high and dense pasture:

- The **tillers compete with each other for light**, water and soil nutrients.
- **Leaves** at the bottom of the pasture sward **die and decay** because some are old (that is, the fourth, fifth, etc., leaf) and because of shading.

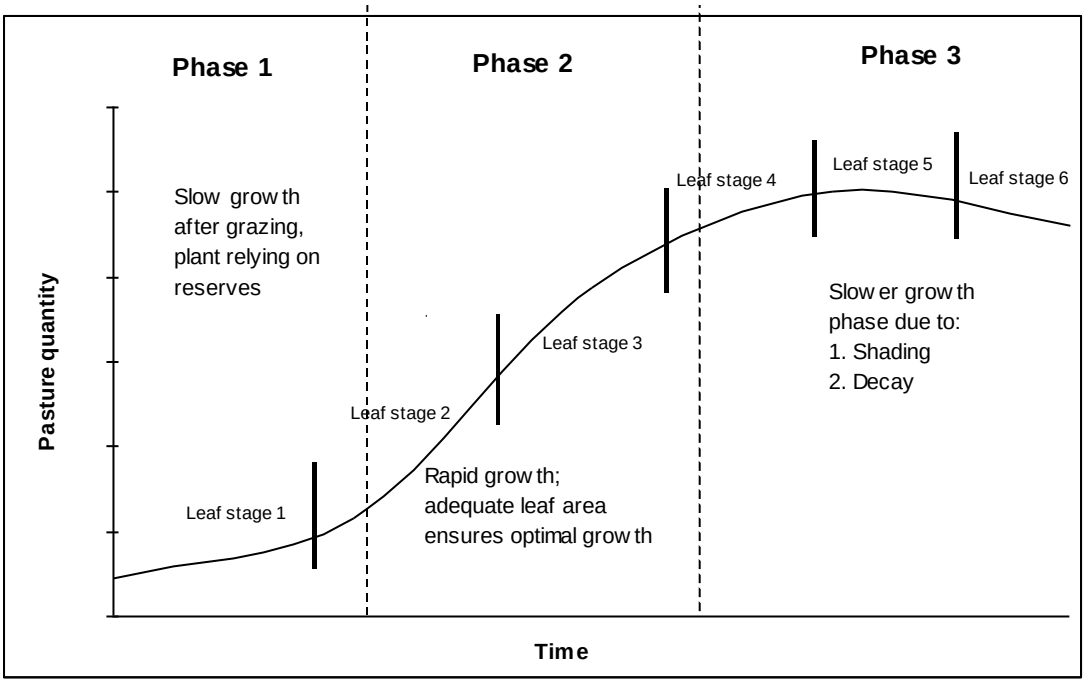
The **ideal pasture height and density** varies with:

- **Pasture species**. For example, perennial ryegrasses grow shorter and denser than short-rotation ryegrasses.
- **Grazing management**. Hard grazing can produce a smaller, slower-growing tiller but with high tiller density. Lax grazing can produce a large, fast-growing tiller, but with lower tiller density.

If a graph is drawn of **pasture quantity after grazing, it follows an S curve (**shown in Figure 7-1):

- The curve is flat, steep, then flat again; and growth rate is the slope of the curve.
- There is:
  - A phase when there is a **slow** increase in quantity, immediately after grazing.
  - Then a phase when there is a **rapid** increase of quantity.
  - Then a phase of **slow** increase in quantity.
- These phases can be seen in pasture as:
  - Changing height.
  - Changing quantity.
  - Changing leaf stages.

Figure 7-1: The growth after grazing S curve, showing the three growth phases



You may come across the phrase, **grazing pressure**. This means the pre-graze point and the post-graze point combined.

With the stages of pasture growth in the back of our mind, the **three important grazing decisions** are:

- The **pre-graze point**, which is the state the pasture is in **just before** it is grazed. It includes concepts such as "readiness for grazing", "paddock spell time", "grazing frequency", "grazing rotation length", "grazing interval", or "grazing round".

- The **post-graze point**, which is the state the pasture is in **just after** it is grazed. It includes concepts such as "how hard to graze", "residue", "residual", "stubble height", "grazing intensity", "grazing severity", or "severity of defoliation".
- **The shift time**, which is how often to shift the cows to a new area. It is also known "grazing duration".

Most dairyfarmers have some target state they would like their pasture to be in before and after grazing. Some use pasture height or kilograms of dry matter, and in the past both methods have been recommended by Target 10, and others. However, the most recent research demonstrates that using these methods is not ideal for pasture production, quality, utilisation or persistence. Thus, Target 10 now recommends that you set your pre-graze point on the basis of leaf regrowth stage, and that you set your post-graze point based on pasture height.

In this manual we recommend:

- A **pre-graze point** of at least 2, preferably 3, leaves, but no more, regrown.
- A **post-graze point** of 4 to 5 cm high, with about one quarter to one third of the area covered with manure- or urine- related clumps no higher than 8 to 10 cm.
- A **shift time** of only 1 day ideally, 3 days maximum.

The remainder of this chapter discusses the theory behind these recommendations, and the pros and cons of the methods that can be used to set your pre-graze point, post-graze point and shift time.

The theory discussion looks at:

- Our desired outcomes of pasture **quantity, quality, utilisation and persistence**.
- How different **pre- and post-graze** points and shift time affect these outcomes.
- The **pasture growth reasons** underlying the effect different pre- and post-graze points and shift time has on these outcomes.

7.3 Setting the pre-graze point for pasture quantity

Our aim is produce high pasture quantity. The leaf stage at which a pasture is grazed determines the short-term and long-term quantities grown.

7.3.1 Pre-graze point at less than 2 leaves regrown

Setting the pre-graze point at less than 2 leaves regrown will **grow less quantity** because:

- The **sugar reserves have not been restored,** so regrowth immediately after grazing will be slower **(leaves will grow smaller)**.
- The most severe form of "grazing less than 2 leaves" is "**backgrazing**" where the cows are allowed to eat the first bits of leaf that regrow in the day or two after grazing. The cows eat off the leaf that has grown from sugar reserves. Subsequent growth is severely limited, and tiller size is reduced.

7.3.2 Pre-graze point at less than 3 leaves regrown

Setting the pre-graze point at less than 3 leaves regrown will **grow less quantity** because:

- Irrespective of the season or any other factor, the third and subsequent leaves grow the fastest (see Figure 7-2), because:
  - As more leaves appear after grazing, the pasture **captures more sunlight**.
  - None of the sugars is now needed to rebuild reserves.

Figure 7-2: An example of growth rates in spring at different leaf stages

Leaf stage	Days after grazing to fully grow leaf	Growth rate (kg DM/ ha/ day)
1st leaf	7 to 9 days	10 to 30 kg
2nd leaf	15 to 20 days	20 to 60 kg
3rd leaf	22 to 28 days	90 to 110 kg

Source: Danny Donaghy.

7.3.3 Pre-graze point at more than 3 leaves regrown

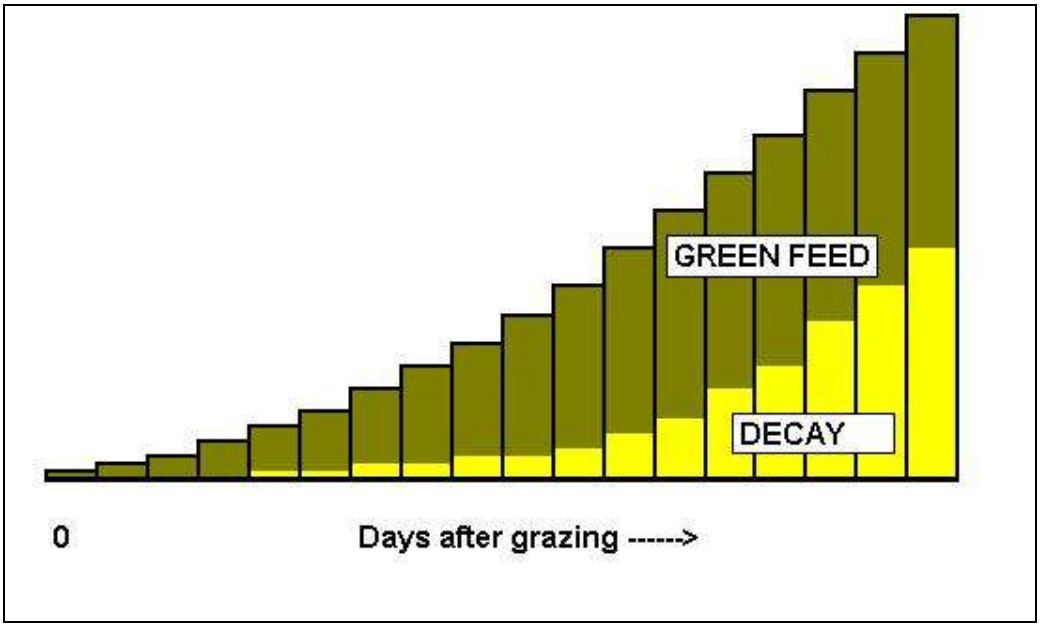
Setting the pre-graze point at more than 3 leaves regrown will **grow less quantity** because:

- **Shading, leaf death and decay** begins:
  - Once the third leaf is fully grown, and the next leaf starts appearing, the **oldest leaf begins to die** and decay.
  - Also, the **lower leaves are getting shaded** by other tillers, so they cannot contribute so much to growth.
  - Because the grasses are able to grow higher than clover, the **clover suffers this shading first**.
  - The pasture may become taller, and it certainly appears to be growing more; but because of leaf death at the base, there is **NO NET GROWTH**. Figure 7-3 eventually shows no increase in green feed.
  - The **decomposing leaf** at the bottom, which could have been used, **is wasted**.
  - The amount of pasture **may actually start to decrease**. The pasture might be gaining dry matter from the new leaves at the

top, but it may be losing more from the oldest decaying leaves at the bottom.

- In spring, longer pasture will contain a lot of **reproductive tillers**, that is, stems and flowers, which have **stopped producing new leaves**.
- After three leaves, regrowth will be less dense, resulting in less quantity:
  - Long pasture causes the sward to thin out as **a few plants dominate** and cause others, particularly young daughter tillers, to die.
  - There is **less new tiller bud development** at the base of the plants that remain, so there are fewer ready for regrowth.
  - The remaining tillers would grow well, but there would not be enough of them.
- There is more chance of **damage by rust fungus** in longer pastures.

Figure 7-3: Net growth of green feed



7.4 Setting the pre-graze point for pasture quality

We want the best quality feed for the cows. The leaf stage at which pasture is grazed affects the quality.

7.4.1 Pre-graze point at less than 2 leaves regrown

Setting the pre-graze point at less than 2 leaves regrown will **reduce quality** because:

- Nitrate is too high and sugar is too low.
- Potassium is too high, and calcium and magnesium are too low.

- Fibre is possibly too low.

7.4.2 Pre-graze point at more than 3 leaves regrown

Setting the pre-graze point at more than 3 leaves regrown will **reduce quality** because:

- The plants are taller and need to be **more fibrous** to stand up, so even the green leaves are less digestible, with lower metabolisable energy.
- Any **decaying leaves** at the base are poor quality.
- Any **reproductive tillers** are poor quality, being too fibrous.
- **Clover**, which can lift feed quality, is being **shaded** out.

7.5 Setting the pre-graze point for pasture utilisation by cows

Keep in mind that high pasture consumption, our main aim, will be achieved by the combination of both:

- High pasture production, which is the total amount grown.
- High utilisation, which is the proportion of the amount grown that is consumed.

We want the cows to utilise a high proportion of the pasture we grow, that is, not waste too much, but, not aim for such high utilisation that it reduces pasture growth or requires per-cow intake to be too low to achieve it. Up to 80% utilisation at any one grazing is the maximum target.

7.5.1 Pre-graze point at less than 2 leaves regrown

Setting the pre-graze point at less than 2 leaves regrown will:

- Generally achieve good utilisation. The fact that nitrate is too high and sugar is too low, may reduce utilisation because the pasture may be less palatable.
- Reduce future growth.

7.5.2 Pre-graze point at more than 3 leaves regrown

Setting the pre-graze point at more than 3 leaves regrown will **reduce utilisation** because:

- The pasture may be so high that the **cows will not graze down** to 5 cm and so waste pasture.
- The higher fibre level will **reduce cow intake**.
- The cows will be reluctant to eat the layer of **decayed leaves** at the bottom.

7.6 Setting the pre-graze point for pasture persistence

We want a pasture thick with ryegrass tillers that remains that way for years. The leaf stage at which a pasture is grazed effects the pasture's persistence.

7.6.1 Pre-graze point at less than 2 leaves regrown

Setting the pre-graze point at less than 2 leaves regrown will **reduce persistence** because:

- The **sugars have not been restored** so:
  - Some **tillers may die**, particularly during stress periods, such as drought, heat, and frost.
  - **Daughter tillers may die** if they have not yet grown big enough to capture sun.
  - These tiller deaths **reduce density** and may allow **weeds** in.
- **Roots will not be growing strongly**. The plant will not cope well, particularly going into summer; and more clumps will be pulled out by the cows, usually in autumn (see Figure 7-4).

Figure 7-4: Ryegrass clumps pulling out of the pasture

7.6.2 Pre-graze point at more than 3 leaves regrown

Setting the pre-graze point at more than 3 leaves regrown will **reduce persistence** because:

- Shading causes some tillers to die and reduces new daughter tiller initiation and development. After grazing, the **lower plant density (or even bare ground)** allows weeds to germinate and establish.

7.7 Setting the post-graze point for pasture quantity

7.7.1 Post-graze point below 4 cm

Setting the post-graze point below 4 cm will **grow less quantity** because:

- The tiller has little or **no green leaf to capture sunlight**.
- The **sugars in the base of the tiller may be removed,** so they are not available to grow the first leaf.
- There will be more **bare ground** that the sunlight falls wastefully on and dries out the soil surface.

7.7.2 Post-graze point above 5 cm

Setting the post-graze point above 5 cm will **grow less quantity** because:

- Although leaving more leaf might cause faster regrowth after that particular grazing, in the **long term, there will be less growth**.
- Less light will reach the base of the tillers, so pasture **density will decrease** because fewer daughter tillers will initiate and grow.
- The **remaining leaves are generally older** and less photosynthetically efficient than younger leaves.
- Longer stubble means **new leaves have to be supported longer** before they appear through the stubble into the sun.
- By the time the new leaves emerge into the sunlight, they have lost some of their ability to photosynthesise.
- If **rust** is present, higher post-grazing residues allow it to build up and spread more rapidly.

7.8 Setting the post-graze point for pasture quality

7.8.1 Post-graze point below 4 cm

Setting the post-graze point below 4 cm **can reduce quality** in the short term but may improve it in the long term:

- A hard grazing may force the cows to eat into poor quality stubble.
- In the long term, if a hard grazing removes the poorer quality stubble, only better quality will be available.

7.8.2 Post-graze point above 5 cm

Post-graze point above 5 cm will **reduce quality** because:

- More **poor quality stubble will develop** at the base.
- Older, poorer quality leaves are not removed.
- Fewer of the poorer quality **reproductive tillers** are removed.
- **Clover**, which can lift feed quality, is **shaded** out.

7.9 Setting the post-graze point for pasture utilisation by cows

7.9.1 Post-graze point below 4 cm

Figure 7-5 shows a post-graze below 4 cm. Setting the post-graze point below 4 cm will:

- Achieve good utilisation.
- Reduce future growth.

Figure 7-5: Hard grazing with strip fences

7.9.2 Post-graze point above 5 cm

Setting the post-graze point above 5 cm will **reduce utilisation** because:

- Any leaf remaining will be dead by the time cows are back in that paddock, so **pasture is wasted**. In fact, leaf death occurs sooner when greater residuals are left after grazing.
- Leaves must grow up from **ground level.** The longer the residue, the further the journey and the greater the waste of leaf that could otherwise have been utilised.
- A **dead stubble layer** will build up that is very **difficult to graze next time**. Each grazing should prepare the pasture for the next grazing, ensuring that it will be quality leaf from top to bottom, so that it will be utilised well, grazing after grazing.

7.10 Setting the post-graze point for pasture persistence

7.10.1 Post-graze point below 4 cm

Setting the post-graze point below 4 cm will **reduce persistence** because:

- The sugars stores may be grazed off, so any developing **tiller may lose its energy source** and die.
- **Root growth** may be **reduced**.
- Soil surface **temperature will increase**. A soil surface temperature greater than 40°C will kill clover and send ryegrass dormant.

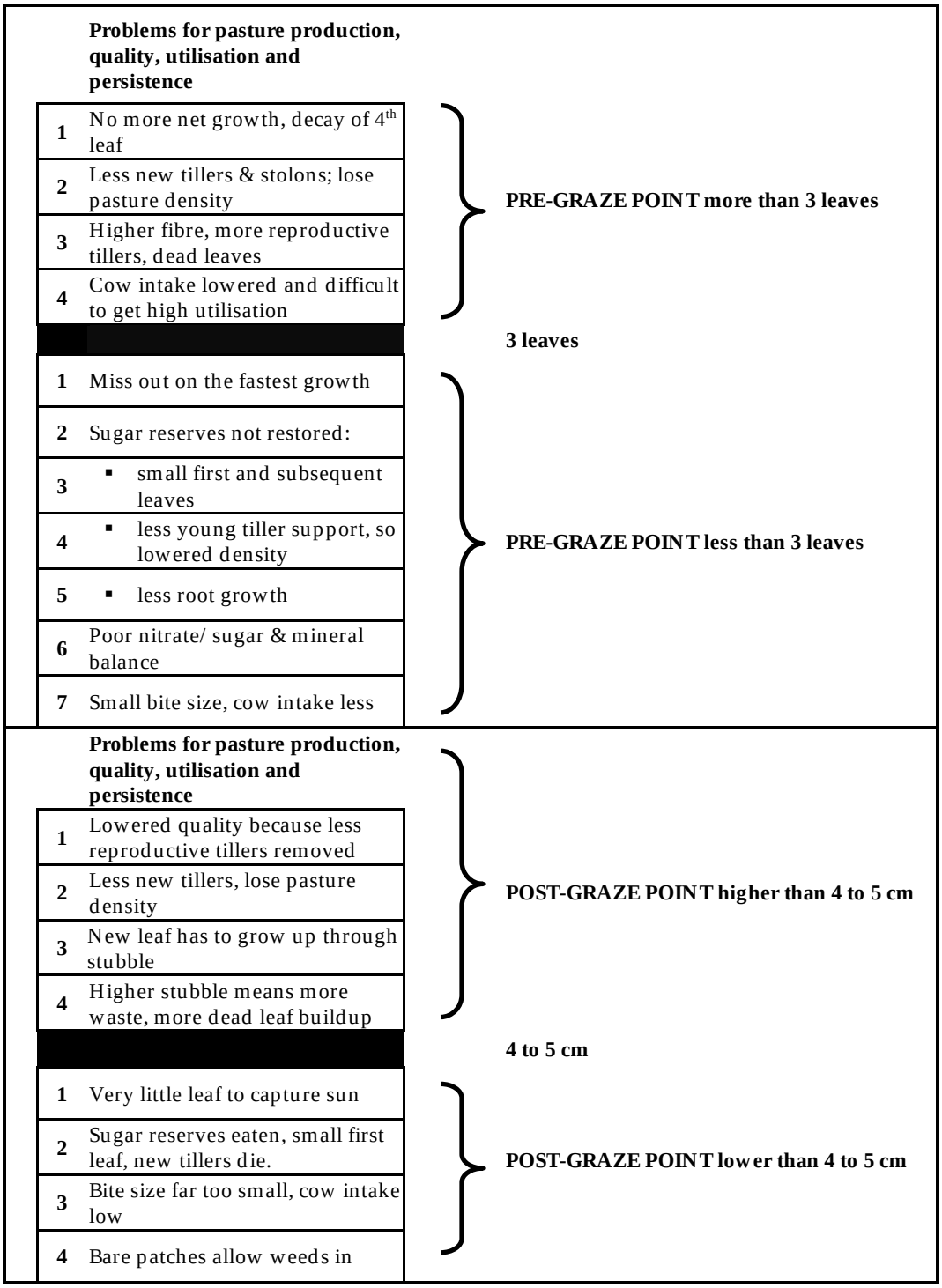
7.10.2 Post-graze point above 5 cm

Setting the post-graze point above 5 cm will **reduce persistence** because:

- A thick **stubble layer** will shade the base and **reduce daughter tiller development**.

Figure 7-6 is a sumary of all the problems that arise when the pre-graze point is set above or below 3 leaves, and when the post-graze point is set above or below 4 to 5 cm.

Figure 7-6: A summary of setting the pre- and post-graze points



7.11 Methods to set the target pre-graze point

There are a number of **methods to set the pre-graze point**. These include:

- **Leaf appearance interval**.
- Pasture **height**.
- Pasture **quantity** or growth rate.
- A standard period of **time**, sometimes based on the number of paddocks.
- **Cow feed requirements**.

7.11.1 Using leaf stage to set the target pre-graze point

Leaf stage is the best method to set the pre-graze point because:

- Regrowth of 2 to 3 leaves per tiller will **best optimise production, utilisation, quality, and persistence** of the pasture.
- It is the **plant's own indicator** of grazing readiness, whereas pasture height or pasture quantity are indicators of how much feed is available for the cows.
- Leaf stage is relatively **easy to identify** compared to pasture quantity or growth rate.

Pasture height or kg of DM/ha is not the best indicator of when to graze, but they are good indicators of how much feed the cows will get.

Generally, using leaf stage means you graze all ryegrass paddocks always in the same order, even though they may differ in height or quantity in each paddock. This is because different:

- Soil **fertility** (particularly nitrogen) will grow different size leaves, and therefore the amount of pasture, but will not change leaf stage or readiness to graze.
- **Different types of ryegrasses** will grow different quantities, but still be at the same leaf stage after the same time since grazing. For example, short-rotation ryegrasses (annual and biennial) are generally larger than perennials at the same leaf stage.

However, you **may** have paddocks that get significantly colder or drier than others; for example, higher areas might be colder, or slopes might be drier. If so, leaf appearance rate may vary in different paddocks, and it might be best not to graze always in the same order.

It is usually best to allow the plant to get to three leaves before grazing again. However, sometimes it is best to graze a little earlier, **right at the two leaf** stage, in the following situations:

- During **spring**, grazing at 2 leaves **removes reproductive tillers** earlier, before they cause a significant drop in pasture quality.
- During **spring**, grazing at 2 leaves **increases the number of daughter tillers**.

- With good soil fertility and moisture, a dense, fast-growing pasture may reach a **high quantity, say 2,500 kg DM per hectare,** at the 2-leaf stage. Looking down, no ground would be visible (canopy closure); parting the canopy would show yellowing at the base, and it may be falling over (lodging). It is then best to graze at 2 leaves, and not wait for 3, to:
  - Ensure the cows eat it down properly. This applies more when the pasture is not high quality, that is, not leafy top to bottom.
  - Avoid all the problems of shading the base already mentioned: leaf death and loss, quality reduction, fewer tillers, density reduction, and clover shading.
- Summer irrigated pastures that contain a lot of **paspalum** need to be grazed earlier to maintain paspalum quality.
- If **rust** fungus has infected more than about one third of the area at an early stage of regrowth, usually from late spring through to early autumn, graze earlier.
- In summer on dry pastures, the high temperature and dry soil cause ryegrass to become semi-dormant. Leaf appearance interval may increase to 20 days or longer. If paspalum and kikuyu are present and still growing, the pasture may benefit from being grazed at the 2-leaf stage, or even earlier, to **prevent these summer grasses from dominating** the pasture. The shorter grazing intervals will do less harm to a dormant ryegrass than letting summer grasses dominate the pasture.

7.11.2 Other methods to set the target pre-graze point

The following are methods, other than leaf stage, to set the grazing rotation:

- A particular **pasture height**, for example 15 cm, is set as the target pre-graze point. However, species, genotype and cultivar differences; soil temperature and moisture; soil fertility; and plant energy levels all have a large effect on plant height and quantity. With good soil fertility and growing conditions, pasture ready to graze (that is, at 3 leaves) is up to 20 cm high; but under poor fertility and growing conditions, the 3-leaf stage might be only 8 cm high.
- Using **pasture quantity or growth rate** to set the pre-graze point ,and consequently the grazing rotation was recommended for many years. Rotational grazing based on quantity creates a “pasture wedge” on the farm, with the narrow end of the wedge (say 1,300 kilograms of dry matter per hectare) in the paddock immediately after grazing, and the wide end of the wedge (say 2,200 kilograms of dry matter per hectare) in the paddock just prior to grazing. The time to grow the 900 kg DM/ hectare difference depends only on the pasture growth rate at the time. For example, in December, the growth rate might be 45 kg DM/ hectare/ day, so 20 days (900/ 45) is the rotation length required. This method has the same problems as pasture height.

- A **standard time** can be used to set the pre-graze point. Pasture is considered ready to graze after so many days. The time may be varied for each season (for example, 10 days in spring, 15 days in summer and 20 day for the rest of the year). This method does not consider the height, quantity or leaf stage of the pasture.
- **Cow requirements** can be used to set the pre-graze point. A paddock is considered ready to graze if the cows need the pasture, and considered not to be ready for grazing if they don't need it. With this method, more area is given if there is less feed per hectare, and vice versa. When the growth rate slows down, the pre-graze point becomes lower, and vice versa. Allocating more area when growth is slower will cause more grazing at less than 3 leaves, with all the problems already outlined. And allocating less area when growth is faster will cause more grazing at more than 3 leaves, with all the problems already outlined.

Using the leaf-stage method to set the pre-graze point will best achieve the objectives of pasture production, quality, utilisation and persistence.

7.12 Methods to set the target post-graze point

There are a number of methods to set the post-graze point:

- Height.
- "Clumpology".
- Quantity.
- Leaf stage.

A **good method** to set the post-graze point **is height** because:

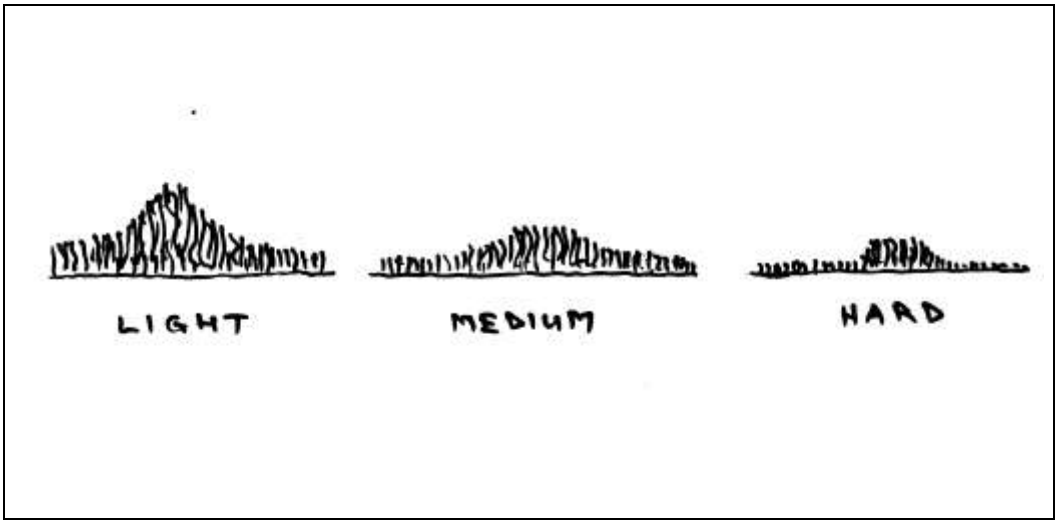
- The state of the actual plant is considered.
- The sugar reserves are in the bottom 4 cm.
- It is best if a new leaf does not have to travel more than about 5 cm inside old sheaths before it reaches the sun.

Clumpology, which is the art of observing how clumps and the areas in between are grazed, is another **useful method** to help set and assess the post-graze point:

- Cows dislike areas of manure or urine and will graze much shorter between these areas, leaving clumps.
- Very rarely is a pasture grazed evenly down to the one height, and some higher clumps always remain.
- A **very light grazing** results in clump tops and sides hardly grazed at all (see Figure 7-7).

- A **medium grazing** results in clumps with some grazed off the top, with the pasture sloping gradually away from the clumps.
- A **hard grazing** results in the clump tops grazed and a sharp shoulder grazed into the edge, leaving them squared shaped.

Figure 7-7: Grazing of clumps



Pasture quantity or leaf stage are NOT good methods to set or assess post-graze point because:

- The quantity of pasture remaining at the ideal post-graze point, of say 5 cm, can vary from 900 kg DM/ hectare in open pasture to 1,800 kg DM/ hectare in dense pasture.
- Zero, half, or 1 leaf remaining could be any height or quantity depending on how much stubble was left from the previous grazing.
- If half a leaf remains, it is the oldest leaf, because the young ones are grazed off the top. This old remaining leaf is already photosynthetically inactive, so it cannot contribute much to regrowth, is about to die, and will be wasted rather than be available at the next grazing.

Setting the **post-graze point is a balancing act** between short-term and long-term considerations:

- In the **short term offering the cows a lot of pasture for that day** allows them to graze lightly and choose plenty of the best pasture. It may also mean using less supplement on that day. However, the result is a high post-graze point.
- In the **long term, offering the cows less pasture for that day** makes them graze harder and utilise more of the pasture. The result is a lower post-graze point, which ensures high growth, quality, utilisation and persistence of the pasture into the future and less use of supplement in the long term.

It is wise to consider "**today's" grazing** as **setting up** the paddock for high growth and high quality for the **next grazing**. Be wary of considering "today's" milk production only and forgetting the "season's" milk production and profitability. If the herd is put in a paddock that was grazed properly at the previous grazing, they will eat it out well, produce well, and continue the process.

The state of the pasture at the post-graze point is a good practical indicator of how much feed (pasture and supplement) is being offered to the cows compared to how much they can eat:

- **Above about 5 cm** (and uneven) indicates **cows are being offered well above appetite** and are starting to waste pasture.
- **Below about 4 cm** indicates **cows are being offered well below appetite**.

The **recommended post-graze** point is:

- **a plant height of 4 to 5 cm, with about one quarter to one third of the area covered with manure- or urine- related clumps no higher than 8 to 10 cm.**

Sometimes, the post-graze point could be set lower than 4 cm, accepting the lower regrowth:

- With dry cows, that may not need as much feed as milkers.
- In winter, when moisture stress on the pasture is unlikely.

Sometimes, the post-graze point could be set higher than 5 cm, risking some waste:

- In summer, when heat and moisture stress on the pasture is more likely.

7.13 Methods to set the target shift time

Shift time is the time cows spend grazing a particular area:

- For example, they may be given a new area and graze it for **3 days**.
- On the other hand, they may shifted to a new area **four times a day**.
- The most common shift time is **half a day**, that is, the cows are given a new area to graze after each milking.
- To get the required shifts, paddocks are often divided with a **temporary electric fence** for each grazing.

The factors that affect the shift time setting are:

- The need to **avoid backgrazing**, that is, avoid eating the regrowth that occurs from stored sugar within 1 day in spring and up to 3 days in winter after grazing. If the shift time is too long, cows will be able to eat this very palatable regrowth, and plant regrowth rate will be set back.

- The need for cows to **get a constant quantity and quality of pasture**, rather than selecting the good feed on the first grazing, trampling some of it, and therefore not getting as much or as good a quality on the next grazing of the same area. More rumen instability and daily milk production fluctuations occur with longer shift times.
- The differing intake of night and day feeds. Usually, about two-thirds of the daily intake is eaten during the day, so **daytime shifts need to be about twice the size of night shifts**. Night paddocks (night shifts) are often undergrazed, and day paddocks overgrazed, because this adjustment is not made.
- The cost of **fencing** or the effort of strip grazing using temporary electric fencing. The shorter the shift time, the smaller the grazing areas, the more fencing or the more strip grazing required.
- The need to avoid **pugging** of the soil during persistent wet weather. Cows concentrated on small areas (long rotations) may cause more damage. However, damage can be minimised by removing the cows after a few hours when most of the available pasture has been eaten. Also, the longer grass achieved by maintaining the long rotation tends to keep the cows' feet from sinking into the wet soil.

Dry cows following milkers, or milkers following calves, is the same as having a shift time that is too long.

7.14 Grazing principles, silage making, and new pastures

An understanding of how plants grow and grazing principles can help to better manage silage making and better manage newly established pastures:

- **Silage making:**
  - To achieve a good quantity of feed to conserve, most pastures are allowed to regrow many more than three leaves.
  - But, to maintain your pasture and to make quality silage, consider locking up paddocks only long enough to achieve no more than four leaves.
- **Autumn sown pastures**:
  - Autumn sown pastures often have very few seed heads in the first spring, as most tillers were formed too late for the cold treatment.
  - They can maintain much better quality in their first year, as opposed to the second year when a large majority of tillers will experience winter cold treatment and go to seed.
- **Newly sown pastures and making silage**:
  - Newly sown pastures often grow very well, particularly in spring, encouraging farmers to conserve some of the extra feed. For the

reasons mentioned about silage making above, this does not help the new pasture to develop density, thus ensuring it will need resowing again soon.

7.15 Summary

To achieve high pasture production, quality, utilisation and persistence:

- The **ideal pre-graze point** allows ryegrass to reach **at least the 2-leaf stage and preferably the 3-leaf stage, but no more**, before grazing.
- The **ideal post-graze point** allows the cows to graze the pasture down to a plant **height between clumps of 4 to 5 cm, with about one quarter to one third of the area covered with manure- or urine-related clumps no higher than 8 to 10 cm**.
- The **ideal shift time**, that is, the time cows graze any one area, is **only 1 day** with a maximum of 3 days.