Macedon Ranges Shire Council

Information Sheet 2

Maintaining Grazing Ecosystems

Summary

The plant's stored energy is used to help regrowth after grazing and is stored in different places depending on growth form.

The root growth of a plant changes after grazing, releasing carbon into the soil.

Leaf emergence is determined by temperature and moisture.

Pasture plants use leaf to grow more leaves.

The tillering process is critical for dense perennial grasses.

Growing a healthy productive pasture

Grassland plants have adapted to being grazed. Understanding grassland plants' growth traits will help inform the managers (farmers) of these grazing ecosystems how to maintain and promote the plant species they require in the pasture. With an understanding of how a plant grows, regrows, maintains and reproduces, managers can better manage their grazing ecosystems in an otherwise uncontrolled and very complex environment. This knowledge will mean recognising how the plant can build resilience to pests and disease, and stresses (moisture and temperature).

Energy storage

Each pasture plant stores energy required for growth, regrowth and for overnight when not photosynthesising. A mature plant that is growing in ideal conditions will have more energy stored than one in less favourable conditions or a younger plant, for example. As a healthy plant is grazed, the energy stores are used to:

- quickly grow a leaf so the plant can continue photosynthesis
- release sugar (carbon) into the soil so that soil biota are activated to assist in the new leaf growth.

The following diagram shows where different grassland plants store energy. The tufted species of plants store their energy in the first 4 centimetres above the soil. The stoloniferous plant store their energy along the soil surface within the 'runners' (or stolons) and below the surface in the rhizome. The taproot plant stores energy in the bulb or taproot. Naturally, a plant's regrowth will be greater if grazing does not remove the energy stores from the plant. Energy stores can be dramatically impacted by grazing (see Information Sheet 3).

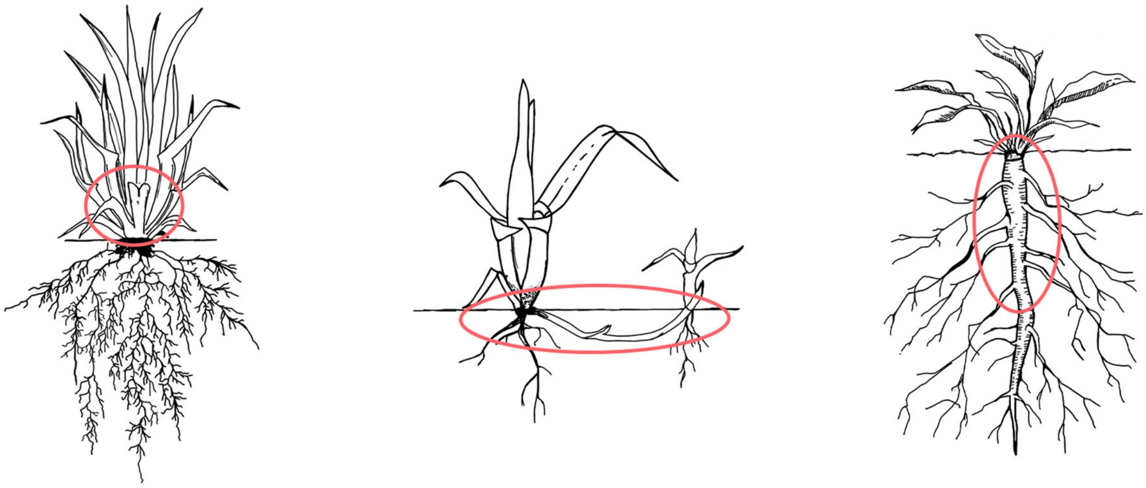
ABN 42 686 389 537

PO Box 151 Kyneton Victoria 3444

T 03 5422 0333 F 03 5422 3623 E mrsc@mrsc.vic.gov.au

www.mrsc.vic.gov.au

Location of energy reserves



Grass growth

The ryegrass plant is one of the most understood grazing plants and will be the foundation plant used to explain growth.

“All pasture plants grow in a similar way to ryegrass; they will:

- grow a certain number of leaves, then the older leaves die
- store sugar (energy) so that they can regrow after grazing, when there is very little leaf to capture sun
- need light to the base of the plant to produce daughter tillers, stolons or runners.”

Source: *Grazing Dairy Pastures*

The following diagram is an *Evergraze* production from research conducted by Danny Donaghy. This research shows ryegrass plant growth in four stages.

In **Stage 1**, it shows how, after grazing, the ryegrass plant loses water soluble carbohydrate (WSC – energy/carbon) as the plant releases energy from the roots. The remnant leaf refers to the leaf that was partially grazed by the animal. The remnant leaf has a blunt tip when compared to a non-grazed leaf which has a pointed tip. As the first leaf grows, root growth stops (at best) but more often degenerates. (This is a critical part of replacing carbon into the soil, and in building topsoil.)

In **Stage 2**, after the initial growth from energy stored, the plant begins to photosynthesise when conditions are favourable to grow leaf one and leaf two. During this time, energy that has been produced by photosynthesis is being used by the plant to grow leaf or respire (overnight) and released into the soil for the symbiotic relationship with soil biota. A little energy is being used to grow roots.

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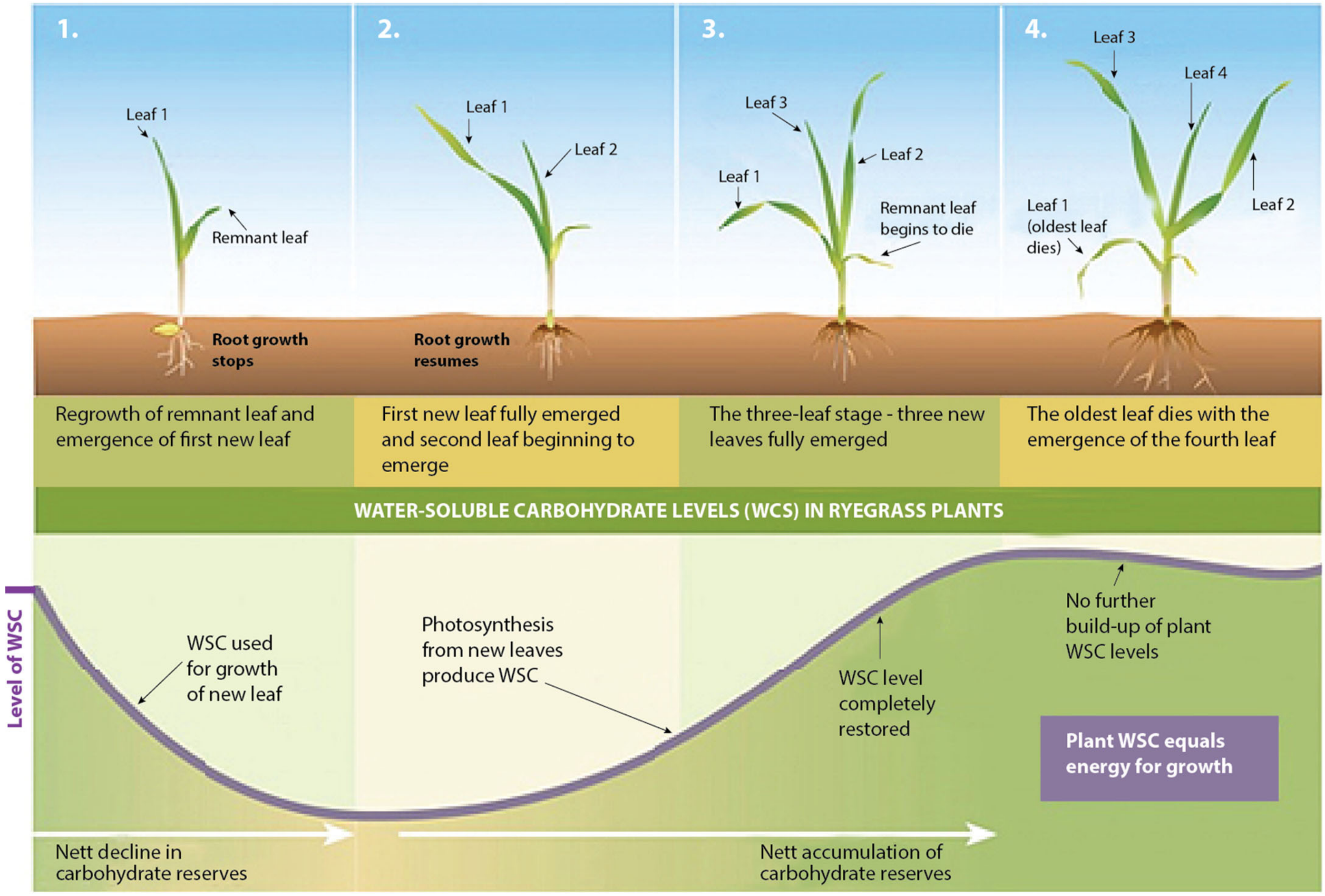

In **Stage 3**, the ryegrass plant is starting to grow its third leaf. During this time, the plant restores its energy reserves (in the bottom 4cm), and actively grows roots. It also will put energy into tiller growth (multiplication of plants).

In **Stage 4**, the third leaf is fully grown, the first leaf is dying as the fourth leaf emerges. The plant's percentage of WSC reaches an equilibrium as photosynthesis equals growth, respiration and decay. Importantly, during this stage in favourable conditions, the plant is growing more biomass above (leaf) and below the ground (root).

Important: The ryegrass plant during vegetative phase only has three leaves. Other grass plants will have more, four to six 'green' leaves (see table in Information sheet 4).

The take-home message is that as a pasture plant is grazed root biomass is lost and it uses energy stores to power the start of regrowth. The energy stores and the roots of the pasture plant are not restored until the plant has reached maturity, the plant has now fully recovered. Once the pasture plant reaches its maximum number of 'live' leaves, an equilibrium in energy levels is reached. Grazing pastures at the correct maturity can increase the amount of carbon compounds the grazed plant releases into the soil. (The area around the roots is called the rhizosphere.).

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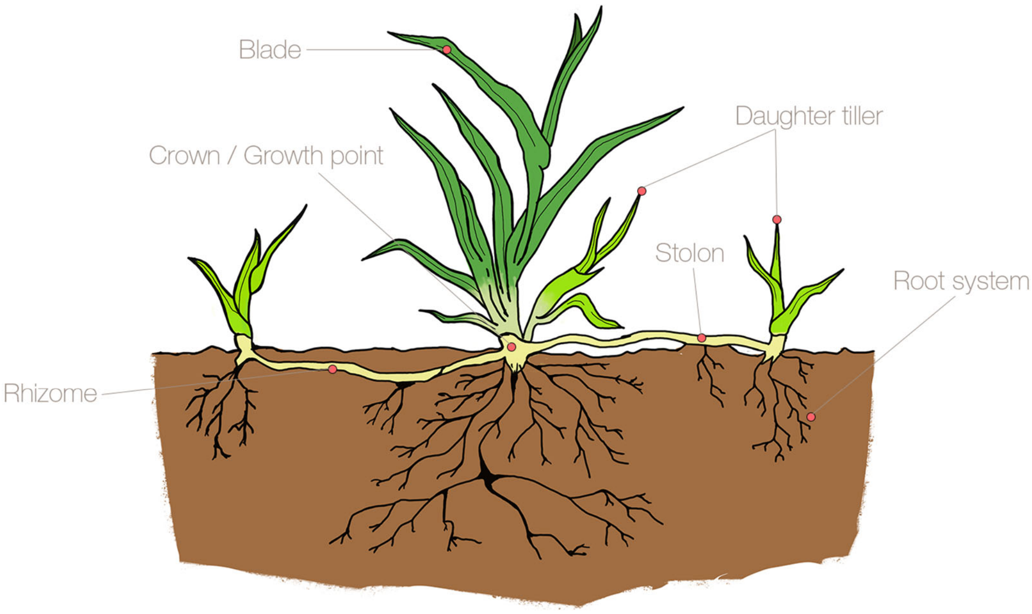
Leaf emergence

The growth of grasses is through the growth of leaves. After grazing, in favourable conditions, it will take only a matter of hours to see leaf growth continue and emerge. One leaf grows at a time, and only when this leaf has completed growth will a new leaf start growing from the growth point, up through the middle of the stem. The growth point for bunch grasses is hopefully at the base of the plant, (soil junction). So, no matter the energy stored or the size of the plant within a pasture, the **leaf emergence rate (LER)** or leaf stage will be the same as shown in the photograph (thanks to *Grazing Dairy Pastures*). **The LER is determined by moisture and temperature only**. For temperate grass species, this means that in a favourable spring, leaf emergence is quicker: hence recovery times are shorter compared to winter.

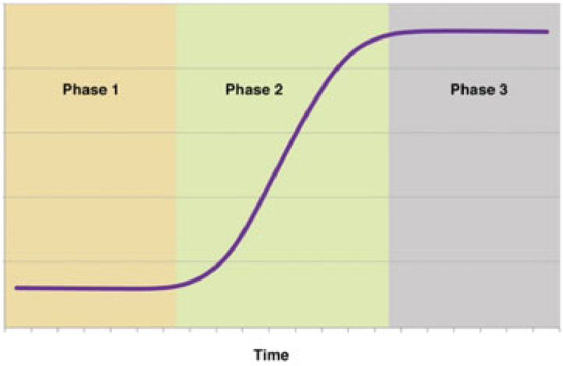
Structure of a grass plant



Growth curve

The adage 'leaf grows more leaf' is very true with grassland plants. As the plant grows, it has more leaf area to photosynthesise. As the first leaf grows it has relied on stored energy at the beginning, then as the next leaf emerges, it has the first leaf helping it to grow and when leaf three grows it has two leaves to support growth. This is demonstrated with the 'S' curve image below (adapted from *Evergraze*). The plant's growth and height of the 'S' curve is greater in favourable growing conditions (i.e. spring for temperate species), and is flatter during less favourable conditions (winter).

To extend this understanding, a recently grazed plant in winter will be growing at the **same leaf emergence rate** as a plant grazed seven weeks earlier. But the recently grazed plant will be growing significantly less leaf area as it is growing its first leaf, whereas the plant grazed seven weeks ago may be growing its third leaf and growing more leaf area, hence growing more biomass.



As mentioned, the size of the plant has no effect on the speed of LER. However, the size of leaf grown – the length, width and thickness of the leaf – is determined by the energy stored (the size of plant prior to grazing) in the stem. It is important that the energy in the stem has not been grazed (i.e. in bunch-type plants not below 4cm). A larger plant not only has larger energy stores, it also has a larger root system. This combination means that early in regrowth the plant is able to grow a larger first leaf to capture more light and has access to more nutrients required for growth.

Understanding the leaf emergence of your grasses is a powerful tool in understanding the level of maturity your grasses have reached after the previous grazing. (See Information Sheet 3 for further information.)

Capturing light

Maintaining and restoring energy reserves is critical to the plant's longer-term survival and ability to flourish. These energy reserves can only be built by capturing solar energy and converting it via photosynthesis to sugar-based energy. This process is central to life on Earth. As Charles Massy states in *Call of the Reed Warbler* in describing a healthy landscape function: *"This means as much year-round green leaf mass – including grasslands – as possible. This can only be achieved by three methods: (1) increased duration of plant growth; (2) increased density of plants; and (3) increased total leaf area. That is, lots of green leaves for as long as possible."*

40% cover

70% cover

90% cover

An effective grazing regime is about maximising light hitting the vegetative (green) leaf surface rather than bare ground. That green growth efficiently converting that sunlight to sugars (carbon) which can then travel further along life's pathway. The maintenance of ground cover is a critical step. There are a few methods for assessing ground cover. One is to have quadrant (as above), or to stand with legs 1m apart, to assess a 1m x 1m area. Or take a stroll across an area and every 10 steps record what is at your toe (plant or plant litter = 1, soil = 0). Take 20 records and multiply the number by 5 to get a percentage of ground cover.

The aim is to have a ground cover greater than 90 per cent and a strong preference for this ground cover to be deep-rooted perennial plants. A good grazing regime will improve ground cover over time as plants fill space from seed and tillering. In some cases, intervention through seeding a diverse range of perennial plants may accelerate this process when ground cover is lower than 70 per cent.

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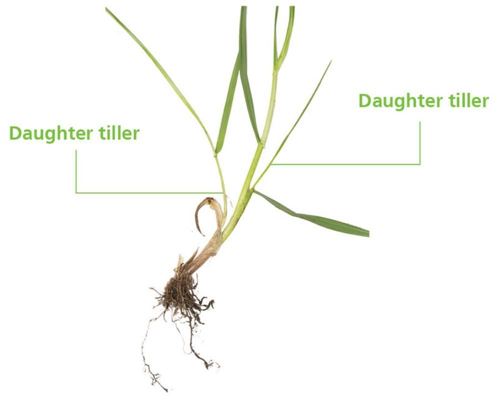
Tillering

Tillering is how tufted and stoloniferous plants reproduce through self-cloning, to spread in the grazing ecosystem. Annual pasture species invest little into tillering and their lifecycle revolves around seed production, producing a vast number of seeds, so when conditions are favourable again, the annual seeds germinate and continue the lifecycle. Perennial grass species usually invest energy into strategies such as tillering and deeper roots and therefore primarily spread via tillering rather than seed. The perennial plants strategy of surviving through the hard climatic times is rewarded by its ability to grow quickly when conditions return to being favourable, rather than using that time to germinate from a seed.

When the grass tiller (annual or perennial) moves from a vegetative to reproductive, it produces a seed head (flower). This process results in the growing point of the tiller becoming the seed head. This tiller of grass has now finished its life cycle.

The perpetual nature of perennial grass plants is due to the plants continually producing and being replaced by daughter tillers (right) and not by individual plant surviving forever. The established plant (the parent tiller) will only produce daughter tillers when it has recovered its own sugar reserves and growing roots. The greater the number of vegetative green leaves and tillers the healthier the landscape function.



The daughter tiller will begin growth at the growing point (at the base of the parent plant) or via stolon or rhizome, as shown in the Structure of a Grass Plant diagram (above).The daughter tiller relies on the parent plant until it has grown enough leaves to store its own sugars and establish its own root (more than two leaves).

Daughter tillers usually develop when the growing conditions are optimum for that grass species. Critically, the growing point of the plant needs light and if it does not have enough light at the base (soil interface) it will move up the stem. With tufted species, this means any daughter tillers produced will result in aerial tillering. Aerial tillering means the daughter tiller will not be in contact with the soil and not form its own roots. For a grass plant where this growing point has moved from the soil interface and then transfers to its reproductive stage and a seed head produced, the parent plant will die and hence the aerial tiller will also die. The ability for sunlight to reach the soil surface to maintain the growing point at the soil interface, hence creating a viable daughter tiller with its own roots are critical to the perennial growth.

With tufted grasses the tillering spread is slower than with stoloniferous species. By understanding the tillering nature of the species of plants in your grassland ecosystem, can guide your choices around establishing the maximum year-round ground cover. The ongoing density of perennial grasses is primarily determined by the plant's ongoing ability to tiller and spread by this method.

For more information, email **environment@mrsc.vic.gov.au** or call 5422 0333.

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