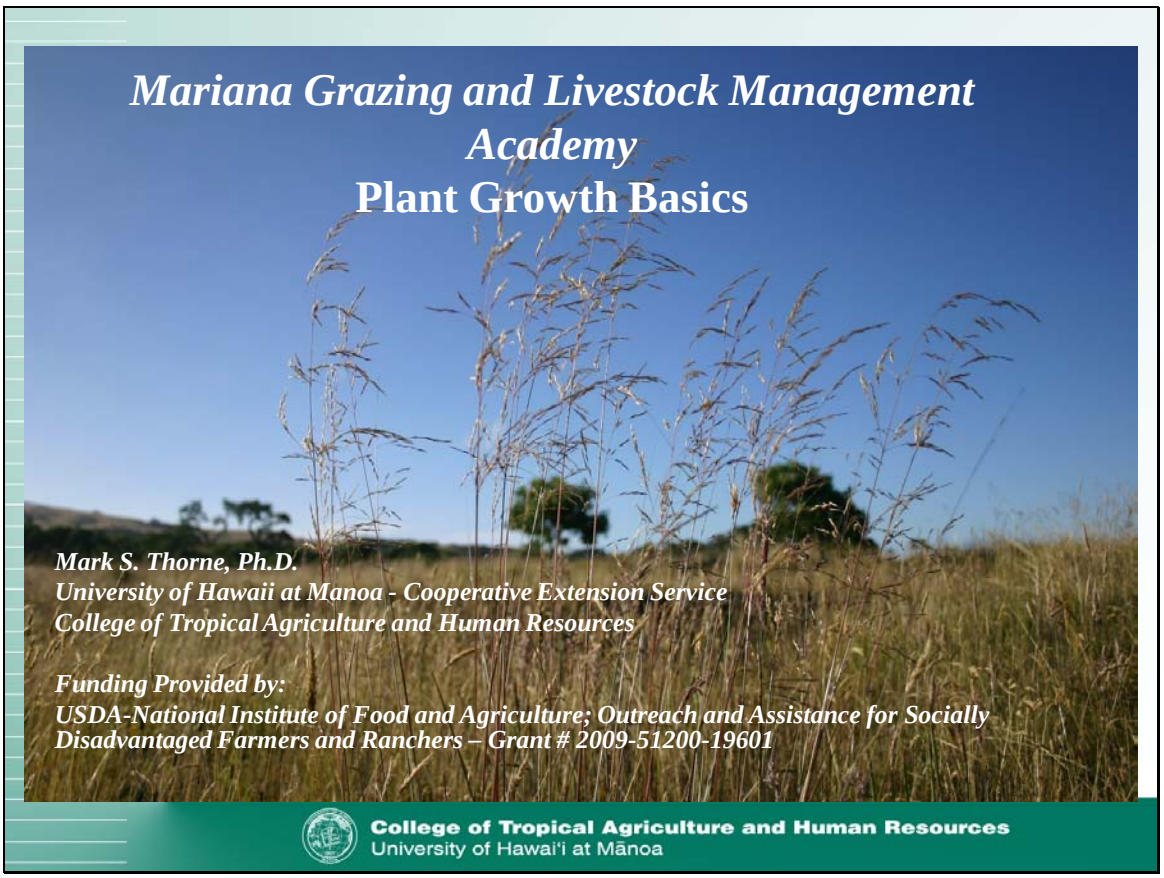

Outline:

- Introduction - Types of Range Plants
- Range and Pasture Grasses
  - A) Importance of grasses
  - B) Grass structures
  - C) Function of grass structural components

III. Primary Production –

IV. Grass Growth

V. Phases of Grass Development – Implications for Grazing Management
  - A) Vegetative Phase
  - B) Transition Phase
  - C) Reproductive Phase

VI. The effect of Grazing on Grass Development
  - A) Response of root carbohydrate levels
  - B) Grazing height and plant response
  - C) Root responses to grazing
  - D) Grazing Period vs. Rest Period

VII. Forbs

VII. Shrubs

Range and Pasture Plants:

Three types of plants that are typically utilized by grazing animals:

- Grasses and grass-likes
- Forbs
- Shrubs

Each functions differently

- Ecologically
- Nutritionally
- Physiologically

Grazing management decisions will be influenced by and affect the composition and distribution of these three plant types in the range or pasture system.

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Range and Pasture Plants:
Grasses and grass-likes
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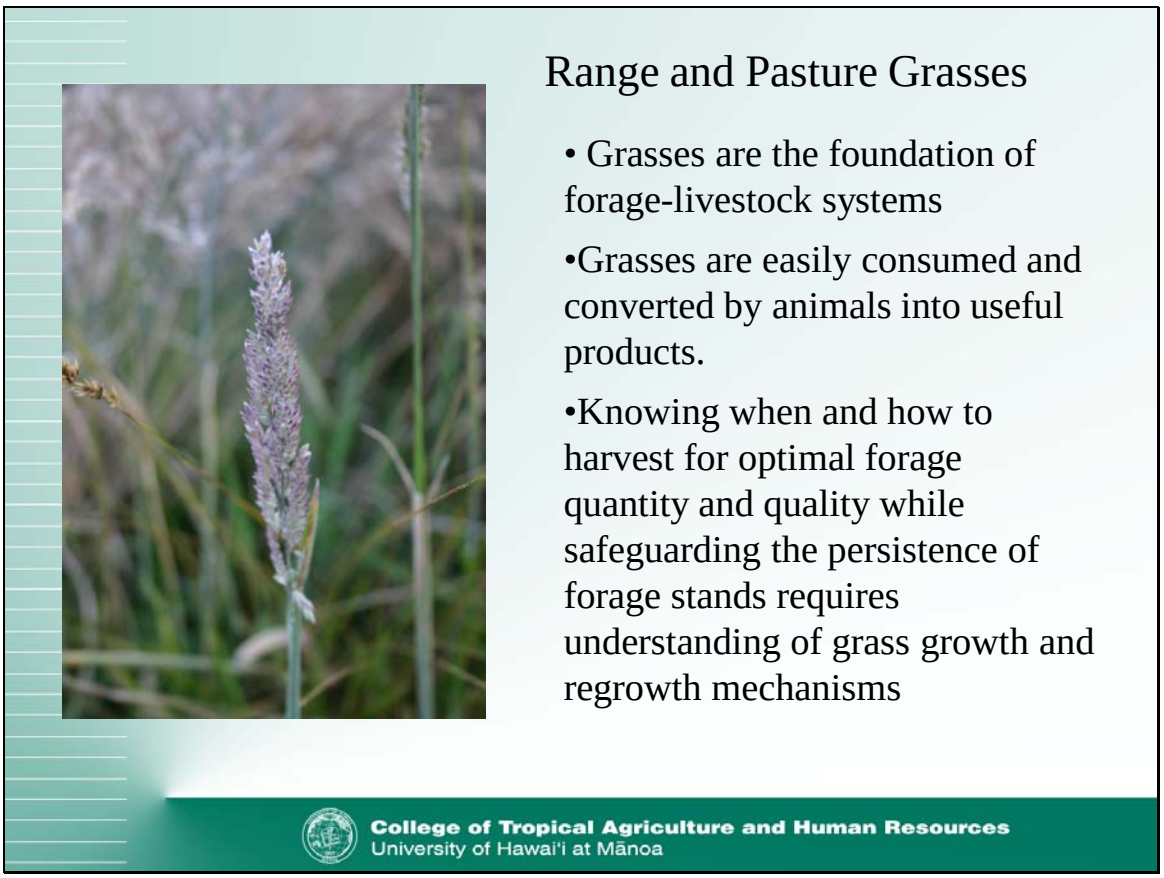
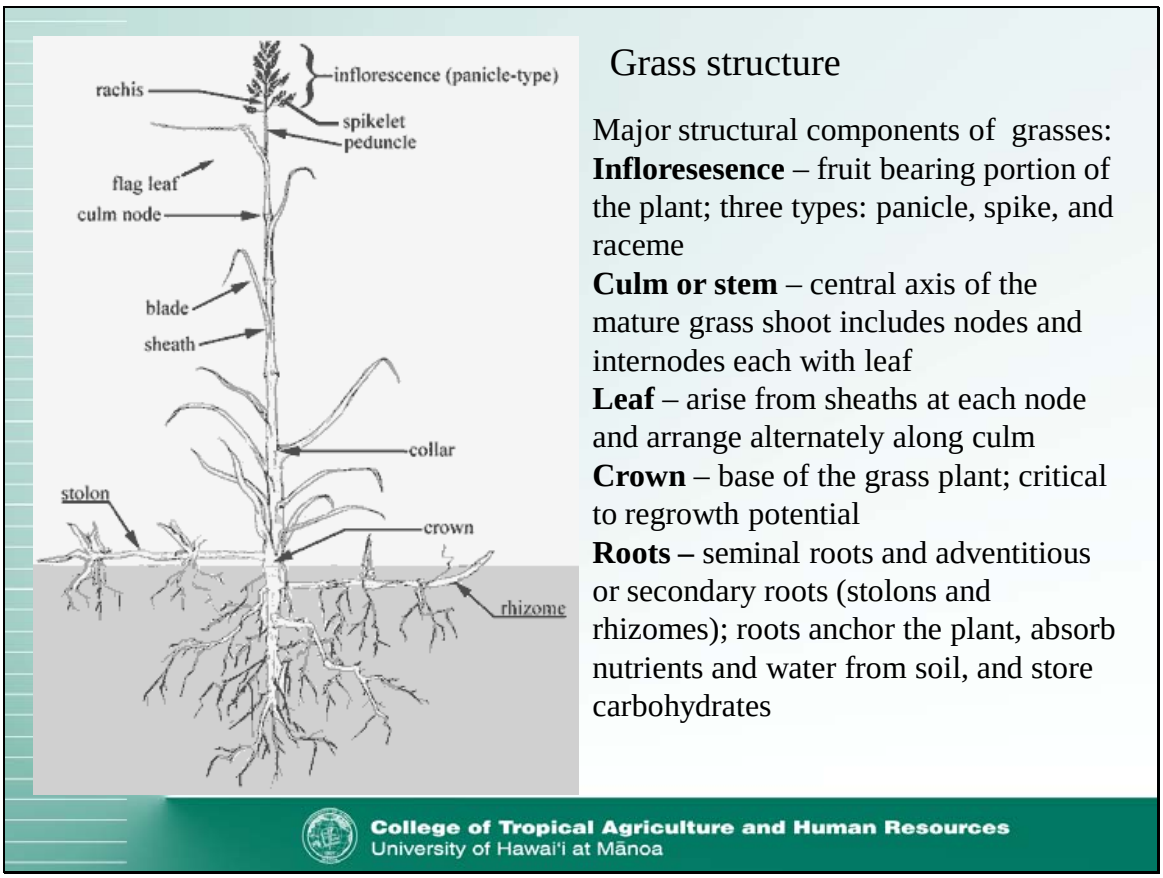
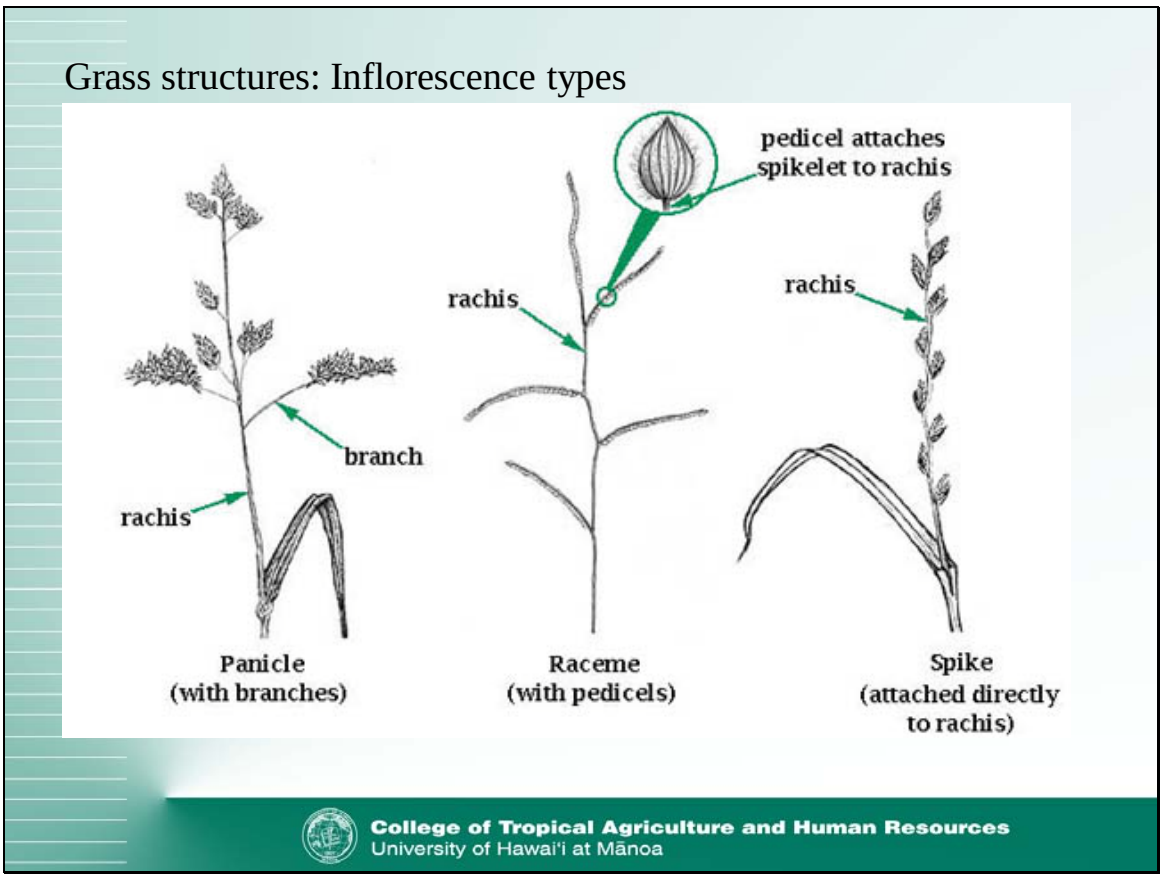


Range and Pasture Grasses

Grasses from the foundation of forage-livestock systems around the world because they can be consumed and converted by animals into useful products. Consumption assumes the grass is harvested directly through grazing, or by machine for greenchop, or hay. Knowing when and how to harvest for optimal forage quantity and quality while safeguarding the persistence of forage stands requires understanding of grass growth and regrowth mechanisms.



Grass structure
Definitions:
Peduncle – upper most culm segment supporting the seed head
Flag leaf – uppermost leaf of the culm, enclosing the seed head during the boot stage
Culm node – solid region on the culm which gives rise to a leaf sheath; on some species lower culm nodes may bear adventitious buds capable of producing new tillers
Culm – central axis of the mature grass shoot comprised of nodes and internodes; each bearing a leaf
Leaf blade – part of the leaf above the sheath
Leaf sheath – lower section of a grass enclosing its associated culm internode
Auricles – short, often clasping appendages at the base of the leaf blade
Ligule – variously modified extension of the sheath lying at the base of the blade
Crown – basal zone of the shoot; essential for the perennial growth of the plant as this zone is comprised of merristimatic tissues (basal internodes, rhizomes, stolons, corms).
Stolon – a prostrate or creeping, above-ground stem, rooting at the nodes; a means of vegetative reproduction
Rhizome – a prostrate or creeping below-grond stem, capable of rooting at the nodes and becoming erect at the apex; a means of vegetative reproduction.
Tiller – a daughter plant, a shoot capable of producing a new plant
Meristem – cells capable of growth



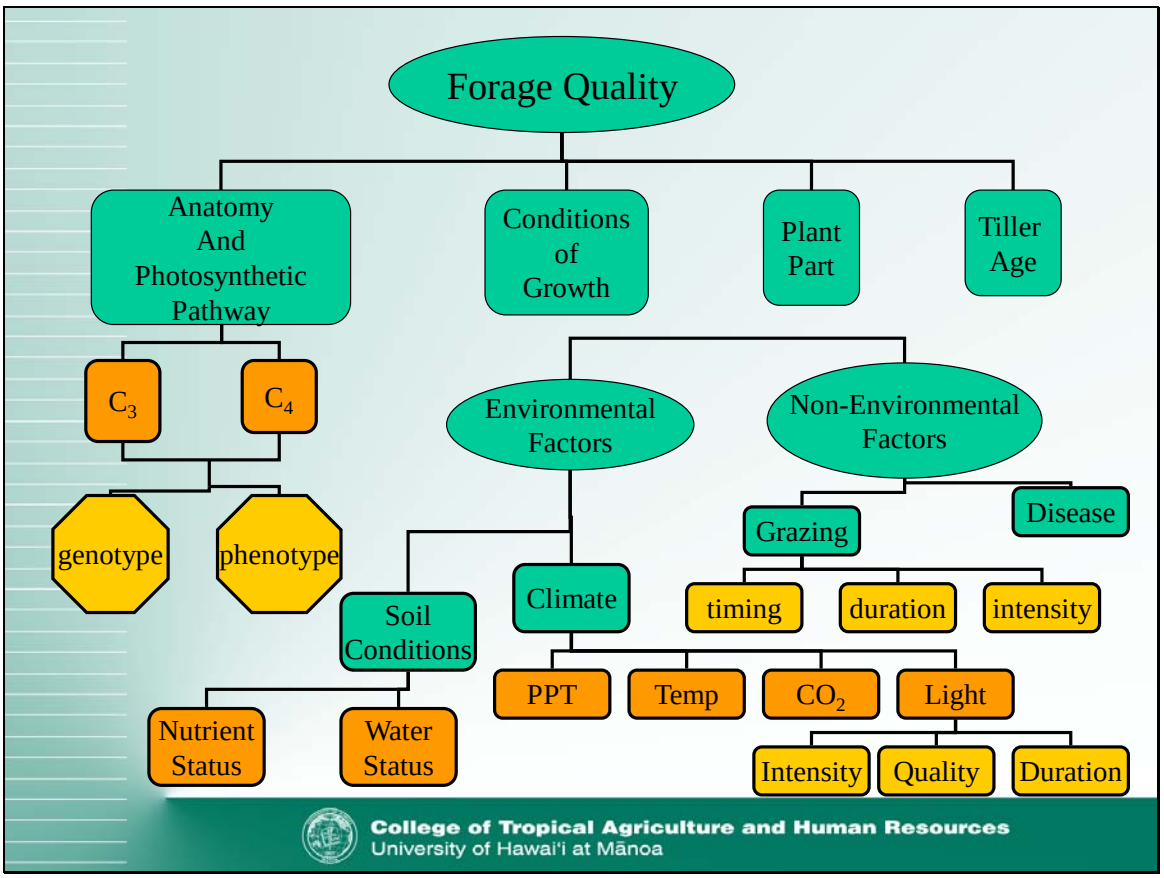
Grass structures: Inflorescence types

Grass inflorescence type is important in the identification of grasses

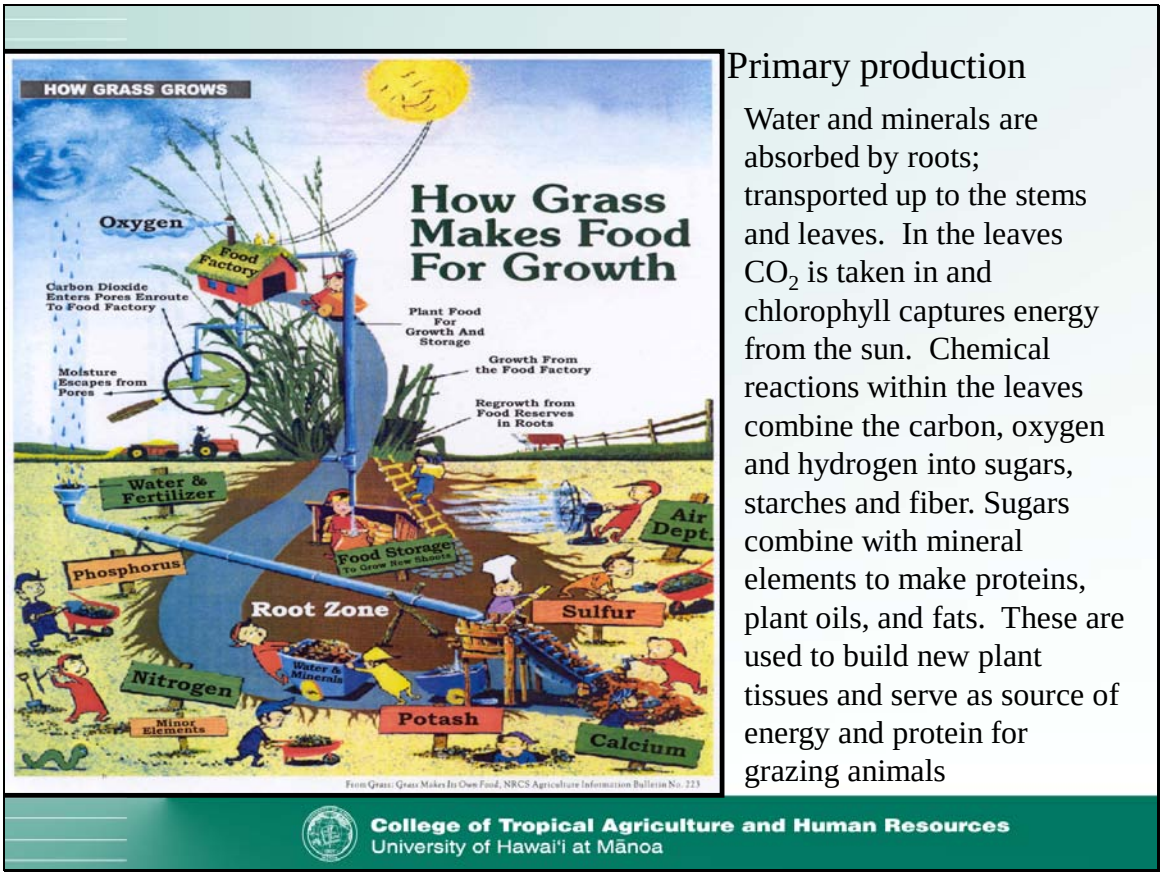
Panicle type grass examples:
Guinea grass, green panic, Wainaku grass, fountain grass, Kikuyu grass

Raceme type grass examples:
Rhodes grass, signal grass, Portarican star grass, Hilo grass

Spike type grass examples
Wheatgrass, Italian rye



Components of Forage Quality



Forage grasses, like most plants, grow and thrive in the following manner: Tiny root hairs come in contact with the surrounding water and minerals, transporting the water and minerals to the main roots, up to the stems and then to the leaves. The leaves take in carbon dioxide from the air through tiny pores. There in the leaves, green chlorophyll captures the power of sunlight. The leaves of the plants are mini solar collectors of the sun's energy. The leaves recombine the carbon with oxygen and hydrogen to make sugars, starches, and fiber. The sugars then combine with the mineral elements from the soil to make proteins, plant oils, and fats. The plant uses these elements to build new tissues to serve as a food source for grazing animals. Plants respire, exchanging oxygen for carbon dioxide, during the night, while cell division and growth occurs during the day.

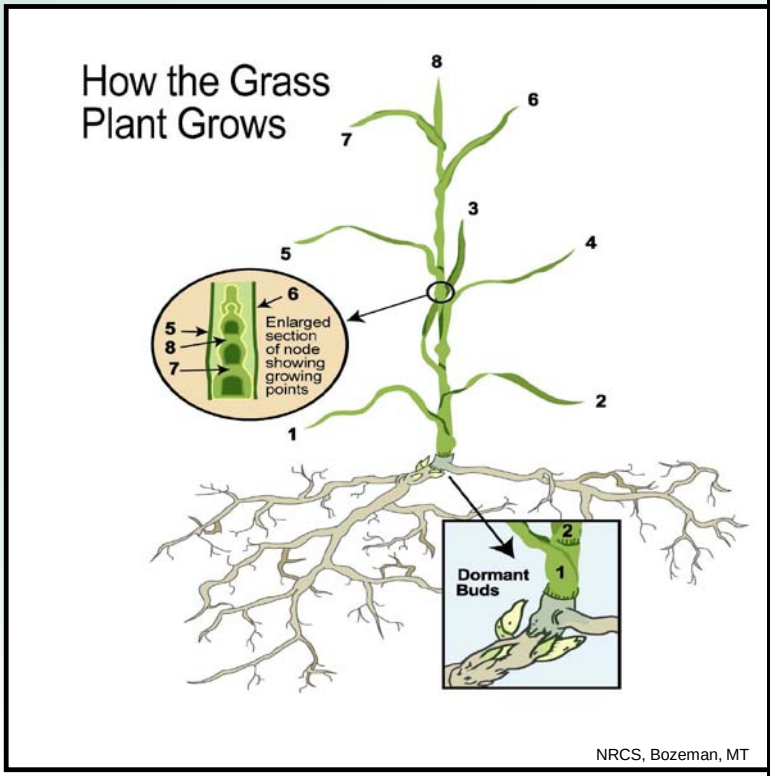
This graphic is adapted from Grass: Grass Makes Its Own Food, NRCS Agriculture Information Bulletin no.223.

Grass Growth

Growing points or meristimatic tissue in grasses is situated at the base of the plant and new leaves are pushed upward from this point.

Grasses are better able to withstand grazing because removal of the top growth rarely removes the growing point

Regular removal of the top growth keeps grass in a vegetative state (higher forage quality)



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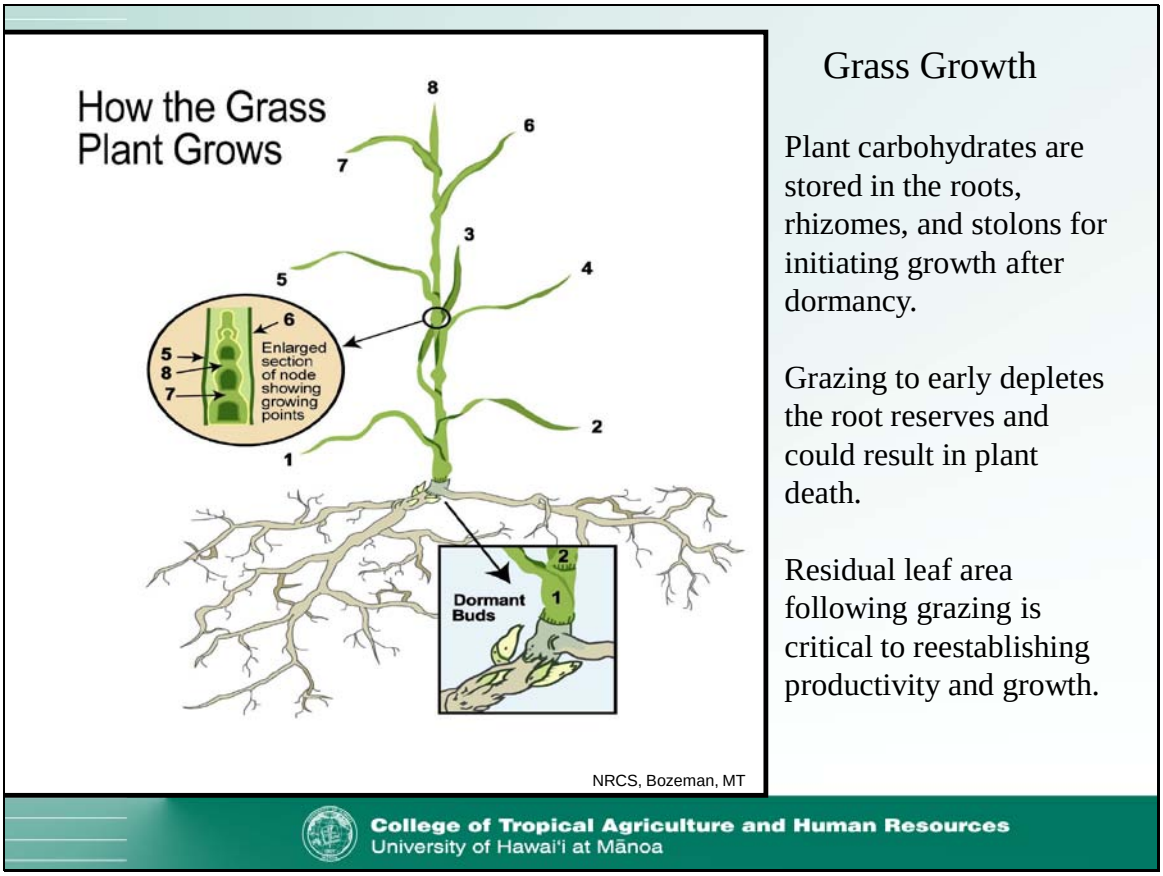
Grasses differ from other flowering plants. All plants have "growing points" where new cells are developed and elongate. The growing points include the tips of the roots as well as the tips of stems and buds on branches of trees and other plants. The growing point of a grass is situated at the **base** of the plant. New leaves are pushed upward from this point. In the spring, new growth of perennial grasses, the nodes are crowded together at the soil surface on a series of unelongated internodes. A leaf arises from each of these joints. As the grass grows, the growing point can be found just above the last completed joint or node of the stem. Grasses are better able to withstand grazing and mowing because removal of the top growth rarely removes the growing point of the plant. In fact, regular removal of the top growth keeps the grass healthy and in the vegetative state. In some grasses, when you pull out the tender shoot that has the seedhead, you are removing the growing point. Recovery time for such grasses grazed at this point can be significantly longer.

This graphic is adapted from Grass: The Stockman's Crop by H. E. Deitz.

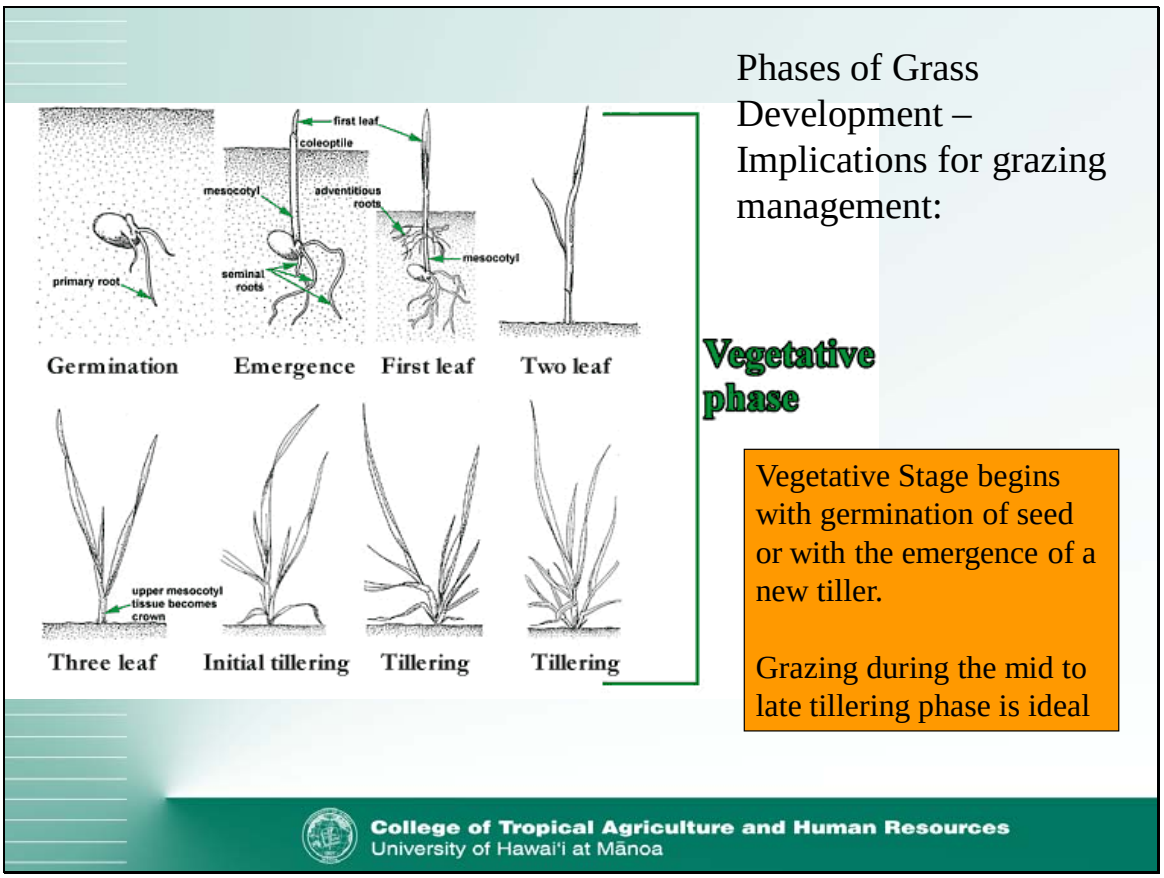


Plants store carbohydrates in their roots, rhizomes, or stolons for initiating growth after dormancy . The food stored in the roots is only used to allow the first few joints to elongate and produce the first couple of leaves. After that, the plant relies on photosynthesis for growth. Regularly removing those first few leaves will weaken the plant root, and eventually it will die.

Carbohydrate reserves play a crucial role in initiating plant growth from the dormant stage. Carbohydrate reserves in the roots do not have much impact on shoot regrowth following grazing. The amount of residual leaf area left for photosynthesis, and/or the availability of active growing points following grazing is more likely to determine the potential rate of leaf regrowth.

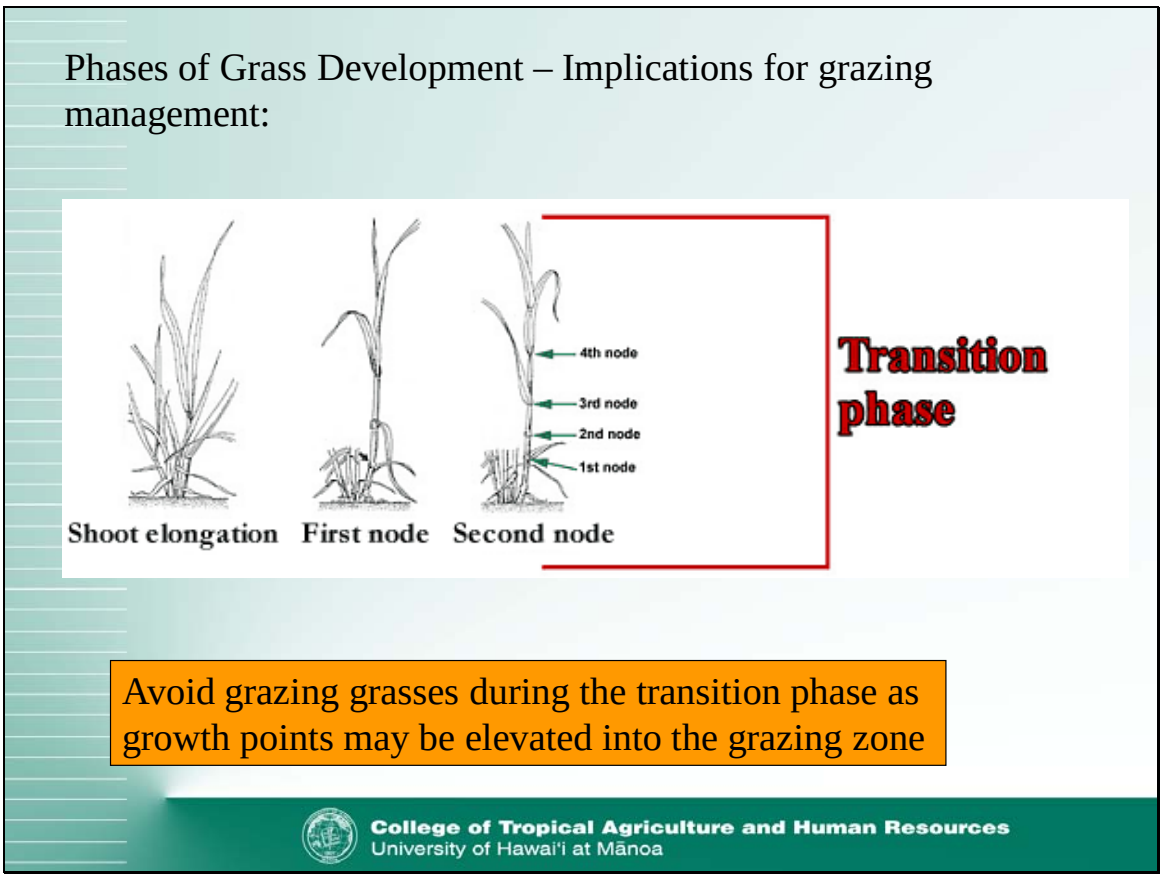
Carbohydrates stored in the grass stubble are also critical for regrowth. Grazing the plants down to the soil removes all reserves for quick regrowth. This is why the amount of grass removed and adequate regrowth and rest periods are so crucial to good pasture management.

This graphic is adapted from Grass: The Stockman's Crop by H. E. Deitz.



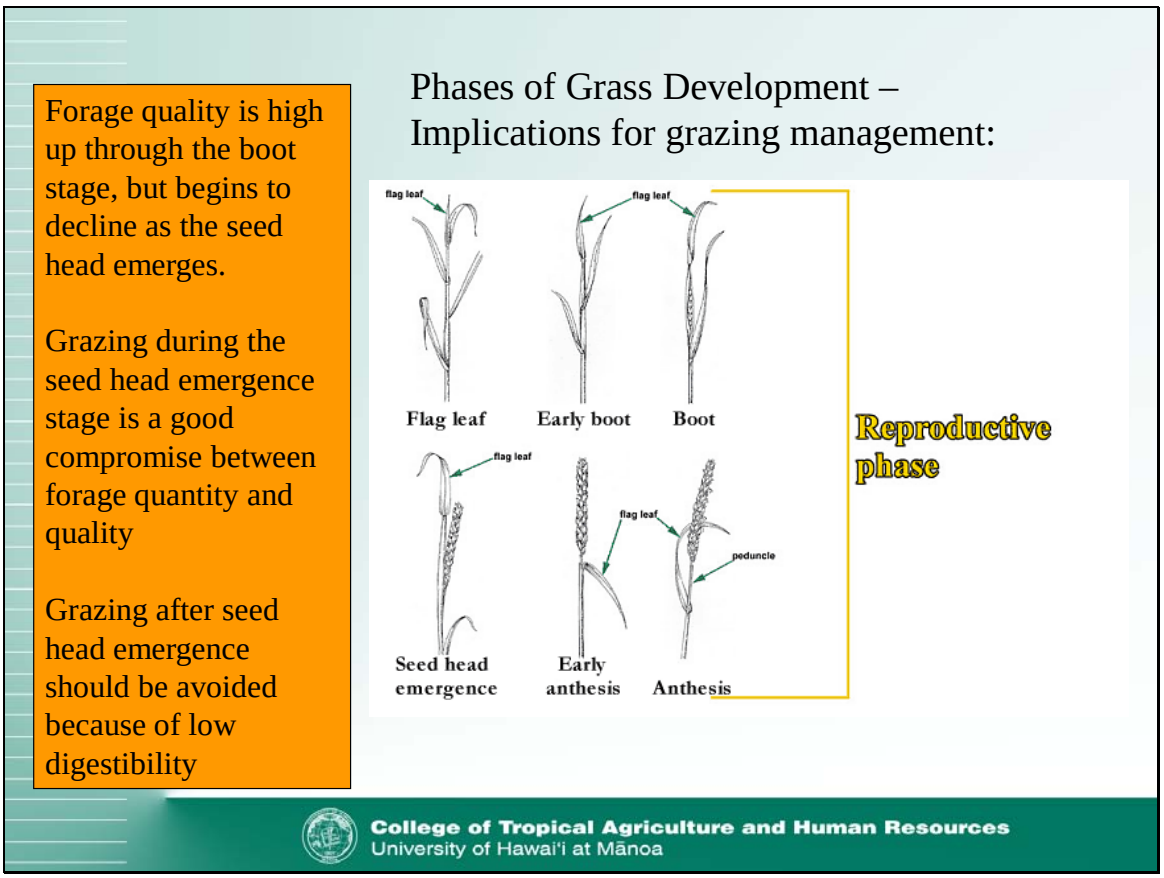
Phases of grass development – Implications for grazing management

Vegetative stage:
The vegetative stage begins from the seed, or with the emergence of a new tiller. Grazing before the tillering phase of newly seeded grasses will cause plant death. Grazing is ideal during the mid- to late tillering phase as it avoids removing critical photosynthetic tissues necessary during early growth and it also avoids grazing the grass during the transition phase when meristimatic tissue may be elevated into the grazing zone.



Phases of grass development – Implications for grazing management

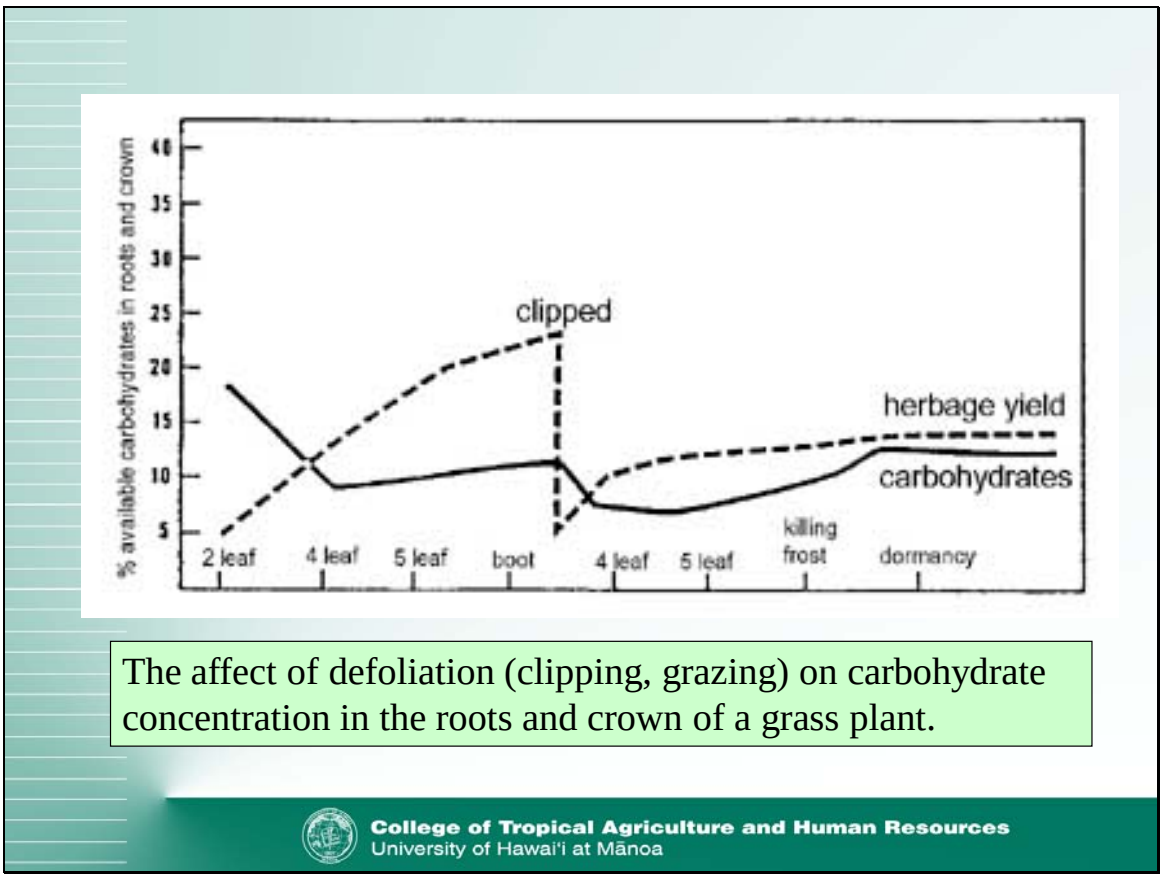
Transition Phase:
During the transition phase, leaf sheaths and culm internodes begin to elongate, raising the meristematic tissue to a grazable height. It is during this phase the grasses are at their most vulnerable and most likely to be slow to recover from heavy grazing.



Phases of grass development – Implications for grazing management

Reproductive Phase:
The reproductive phase begins with the emergence of the flag leaf (uppermost leaf of the culm, enclosing the seed head during the boot stage) which encloses the inflorescence. Development progresses through the boot stage, seed head emergence, to anthesis (release of pollen), and then seed set (not shown).

Forage quality is highest leading up to the boot phase. As the seed head begins to emerge forage quality begins to decline.
Grazing during the boot stage maximizes forage quality though forage quantity will be less than if grazing is delayed.
Grazing during the seed head emergence phase can be a good compromise between forage quantity and forage quality.
Further delays in grazing will often be counter productive because lignin content in the forage increases making it less digestible.

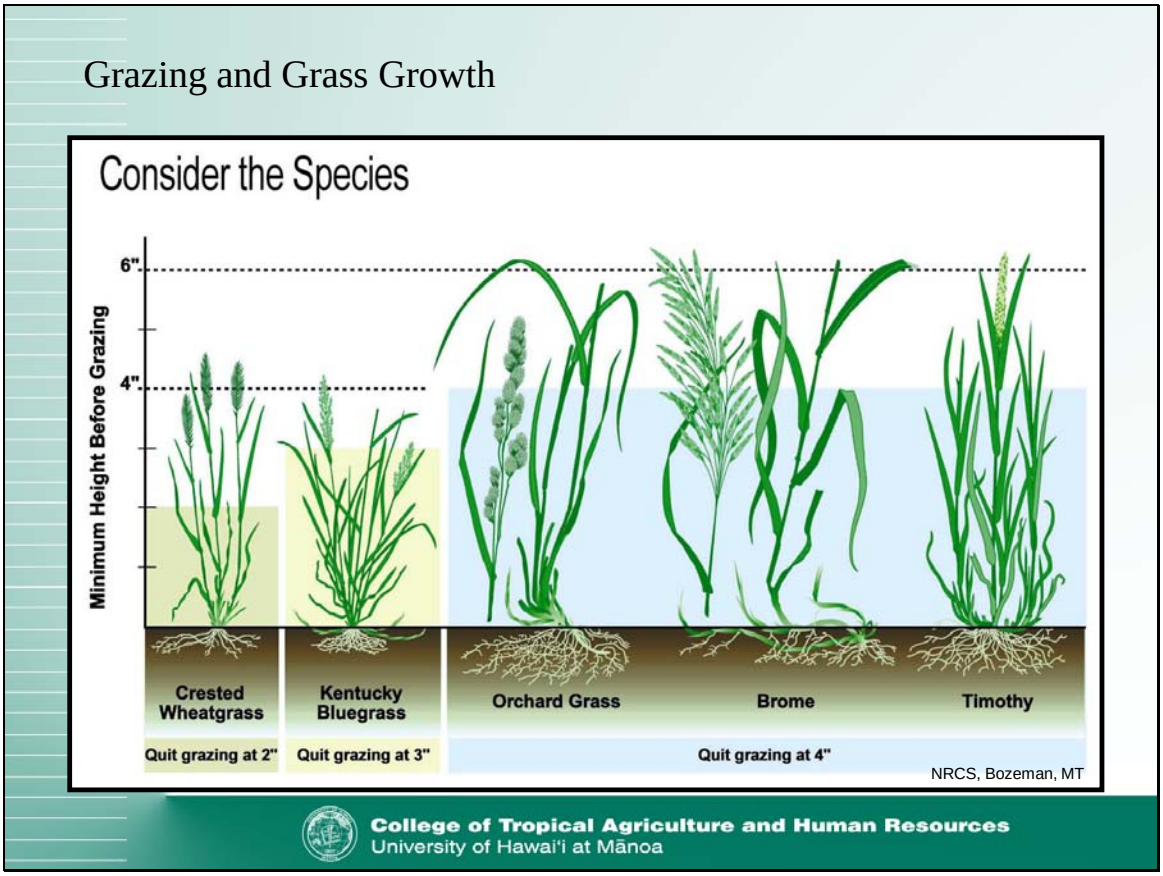


The affect of defoliation (clipping, grazing) on carbohydrate concentration in the roots and crown of a grass plant.

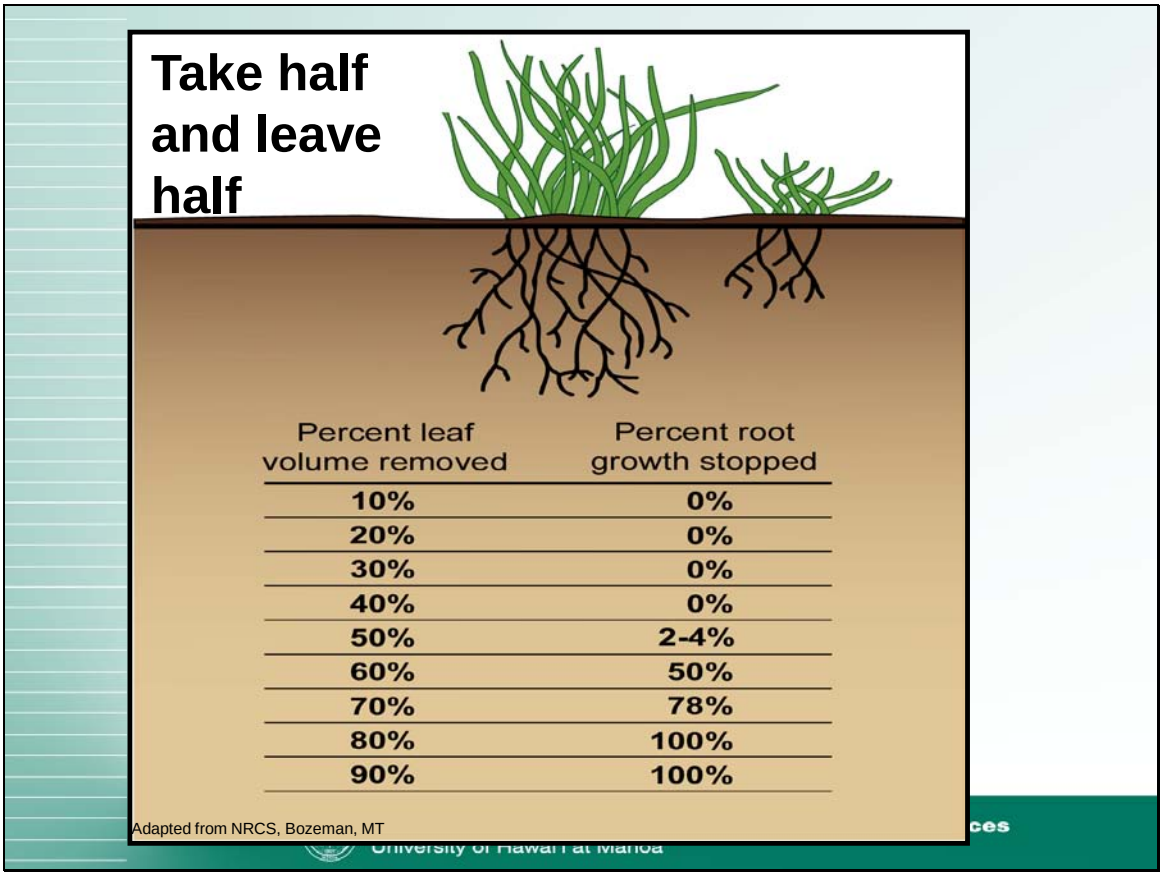
The effect of clipping on carbohydrate concentration in the root and crown of grasses.

Root carbohydrate levels decline during grass development through the 4 leaf stage. At the 4 leaf stage root carbohydrate levels begin to increase indicating that the plant is making more than being used. These stored carbohydrates continue to increase through the boot stage. At that time a clipping event (or grazing event) removes the accumulated aboveground biomass below the 4 leaf level. Root carbohydrates immediately decline as they are utilized for replacing the lost aboveground material. Full recovery of the pre-defoliation levels does not occur until much later (in this case after dormancy).

Repeated defoliation or grazing events before the frost period for this plant would have further depleted root carbohydrate reserves to the point it may have not recovered.



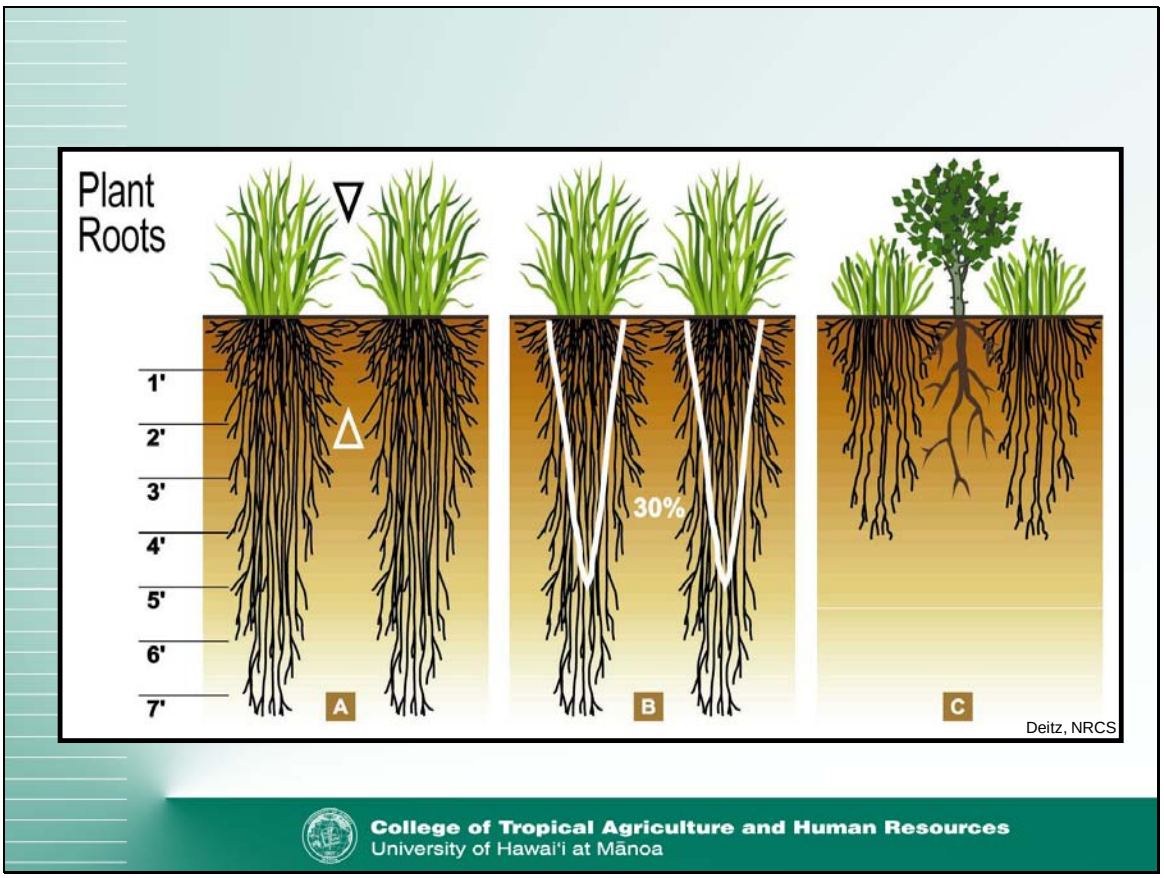
Each species of grass needs to be a certain height before grazing is allowed, and then needs to be rested after a certain amount of the plant has been removed. Select one or two "key species" for monitoring purposes. A key species is the plant on which you base your management decisions (i.e., when to graze and when to rest).
A general rule of thumb is to **"take half and leave half."** This means if your key species is 8 inches tall, grazing should cease when the plant is 4 inches tall. Don't allow half of the plants to be grazed down to the ground while the other half of the plants are left tall!
Animals that are left on a pasture full-time will continually graze the same plants once regrowth occurs. The regrowth of previously grazed grasses tastes the best. Meanwhile, plants that have never been grazed continue to grow and become increasingly unpalatable. Animals need to be encouraged to eat all the forage available in a pasture and then should be removed to allow regrowth to occur. You may need to better match the number of animals to pasture size while limiting the time of access to the pasture and moving your animals to allow regrowth. After the animals have been moved to another pasture to allow for regrowth, mow plants that were not eaten. They will then produce new, more palatable growth.



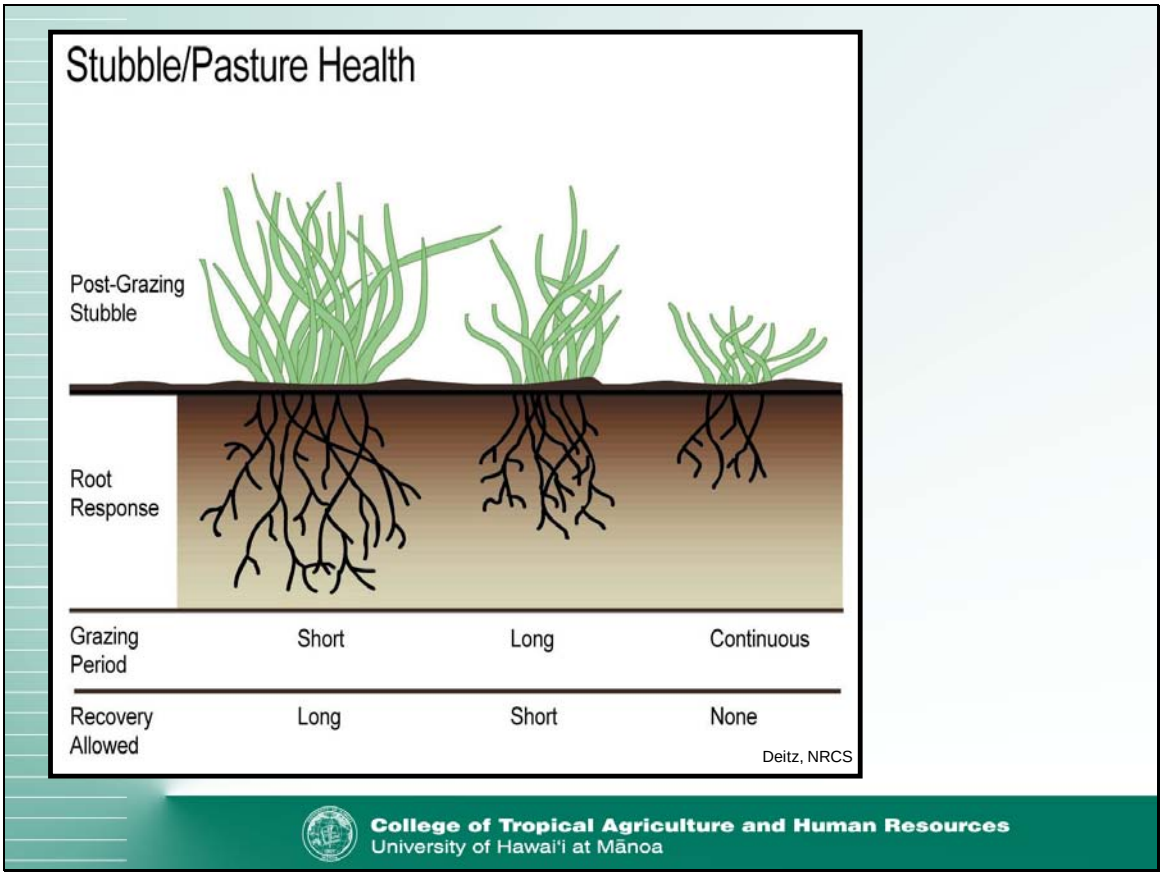
The "take half and leave half" grazing philosophy has a basis in scientific fact. Through study, it has been determined that the effect on roots of the removal of leaf volume through grazing is negligible up to the point where 50 percent of leaf volume has been removed. After this point of "take half, leave half," serious damage to the root system of the plant can occur if as little as 10 percent additional plant leaf volume is removed. This graphic shows that if 50 percent of the leaf volume is removed, only a small amount of root growth is stopped. If 60 percent of the leaf volume is removed, as much as 50 percent of root growth is stopped.

Data taken from Crider, F. J., 1955, Root Growth Stoppage, Technical Bulletin No. 1102, USDA-SCS, Government Printing Office, Washington D.C.

Graphic adapted by A. Miller, Black Dog Graphics, from Grass: The Stockman's Crop by H. E. Deitz.



Each year 30 percent of each grass plant's root system must be replaced. The plant needs to replace this 30 percent loss each year **plus** try to expand the existing root system. Constant removal of vegetative growth from the surface greatly impairs the ability of the plant to replace the root system loss, let alone expand the root system. Continual removal of the vegetation from the forage plants without rest significantly damages the health of the root system, allows weed growth to occur and endangers the pastures ability to be a "sustainable" resource. This process is known as "overgrazing" your forage plants.
Graphic adapted from Grass:The Stockman's Crop by H. E. Deitz.



Remember that plant roots stay strong and healthy when grazing periods are short and rest or recovery periods are long. When grazing periods are long and rest/recovery periods are short, root systems begin to suffer. When grazing periods are continuous and rest/recovery periods are nonexistent, root and plant vigor decreases drastically. This can lead to less forage production over time, increased susceptibility to weed invasion, and possible soil erosion due to open spaces between plants.

Forbs

Include Perennial peanuts, clovers, desmodium, and other legumes. Also includes other flowering plants

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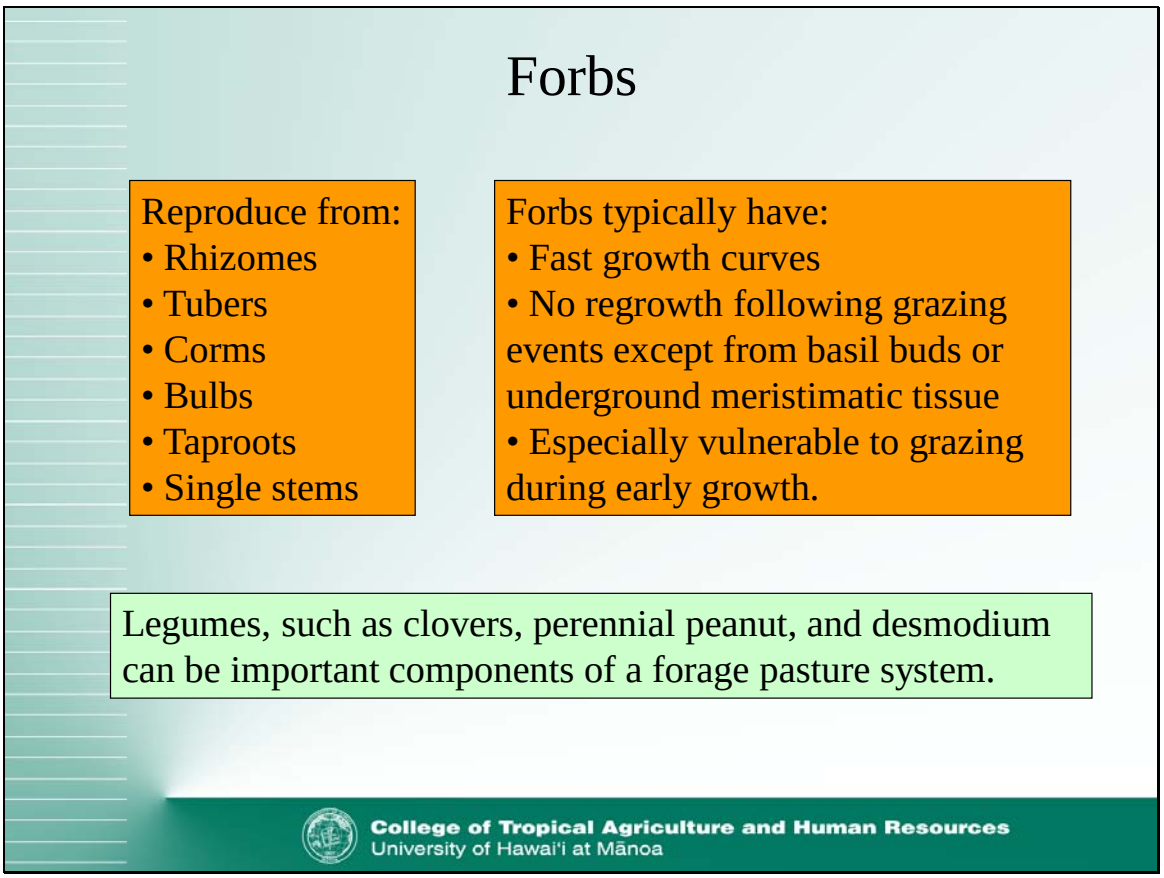

Many forbs, like the legumes clover, perennial peanut, and desmodium are important sources of crude protein in pasture systems.

Shrubs

Shrub growth:
New growth develops from buds at the end of twigs.

Removal of this terminal growth point prompts growth from the next lower bud.

Loss of terminal growth points and leaf material causes a stoppage of root growth as the plant replaces lost material.

Removal of to many leaves and terminal growth points can lead to plant death; especially for young or frequently browsed plants.

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Shrub growth:
New growth develops from terminal buds at the end of twigs. Removal of this terminal growth point prompts growth from the next lower bud. Loss of terminal growth points and leaf material causes a stoppage of root growth as the plant replaces lost material. Removal of to many leaves and terminal growth points can lead to plant death; especially for young or frequently browsed plants.

Summary

There are three types of plants typical of range and pasture systems; grasses, forbs and shrubs.

Each of these functions differently ecologically and physiologically, and nutritionally.

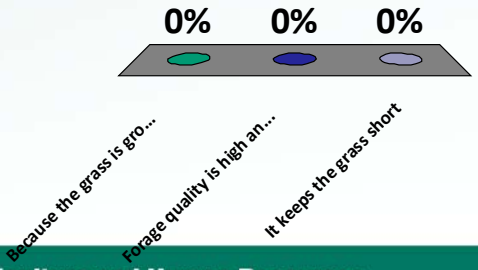
Understanding how plants grow and respond to grazing is important in developing sound grazing management plans.

Grasses comprise the bulk of the diet for grazing animals so it is important to be able to distinguish between different grasses, understand how they grow and respond to grazing, and how to manage them to optimize forage quantity and quality.

Forbs are important components to pasture systems and generally increase the quality of the forage resource.

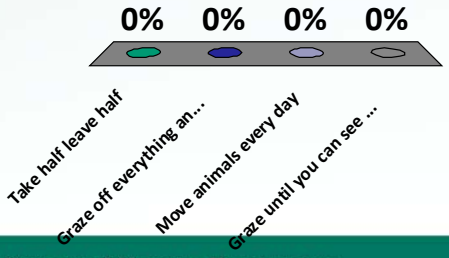
Why is grazing during the mid- to late tillering phase of growth a good management practice?

1. Because the grass is growing fast
2. Forage quality is high and avoids grazing during the transition phase
3. It keeps the grass short



A good rule of thumb for managing grazing level is?

1. Take half leave half
2. Graze off everything and then rest it for a long time
3. Move animals every day
4. Graze until you can see bare ground and then find new pasture



What are the three types of grass inflorescences?

1. Straight, spreading, and finger like
2. Narrow, wide, and in-between
3. Good, Bad, and Ugly
4. Panicle, Spike, and Raceme